Proposal for a Doctoral Program in Electrical Engineering

Presented by:

The Department of Electrical and Computer Engineering

University of Puerto Rico
Mayagüez Campus

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1 Introduction

1.1 Program Title and Degree

The proposed program title is Doctoral Program in Electrical Engineering and the degree to be conferred will be Doctor of Philosophy in Electrical Engineering.

1.2 Program Description

NCES CIP Code: 14.1001 Electrical, Electronics and Communications Engineering

The proposed program will provide the most advanced education in electrical engineering in Puerto Rico. Graduates of this program will utilize their knowledge and training to think critically and creatively to significantly contribute to the social and economic development of Puerto Rico and its hemisphere in the areas of research, development, and education. The proposed program emerges from the natural evolution of research and graduate studies at the Master level in the Department of Electrical and Computer Engineering, and addresses the need for advanced studies and research in electrical engineering.

The program will neither include specialty nor concentration areas. Instead, it will utilize internal areas of emphasis in order to guide students in their curriculum and research. This is done in order to maintain a flexible structure which will allow the program to adapt itself to the rapid technological changes in electrical engineering and related areas while permitting the development of non-traditional interdisciplinary research areas that do not fit into the traditional electrical engineering mold. The doctoral program will have an initial emphasis towards the areas of energy systems, applied electromagnetic, signal and systems, and electronics. However, the program structure has enough flexibility to accommodate new efforts in bioengineering and microelectromechanical systems being developed at UPRM. Descriptions of the areas of emphasis are included in Appendix A.

The proposed academic program will consist of a minimum of forty-nine credits, from which a minimum of twenty-four will be taken in one of the areas of emphasis. Of the forty-nine required credits, a minimum of six credits will be taken in advanced graduate or undergraduate level courses to satisfy a mathematical sciences requirement, of which at least three credits will be at the 6000 or higher level. The objective behind this requirement is to strengthen essential analytical skills required for state of the art research in electrical engineering. A list of sample courses to satisfy the mathematical sciences requirement is included in the appendix. In addition, six credits in electives outside the area of emphasis will be required. Each doctoral candidate will be required to participate in the doctoral seminar each semester for which he will receive one credit at the conclusion of his/her dissertation. Besides, students will be required to pass a qualifying exam and a comprehensive exam as part of the process of evaluating their ability to engage in doctoral level research. Finally, students will be required to approve 12 dissertation credits.

The dissertation will measure the scope of acquired knowledge and it will evidence the student's degree of creativity. It will require an original contribution to the existing scientific and/or technological body of knowledge in the field of electrical engineering or related areas.

1.3 Non-conventional modalities

Not contemplated.

1.4 Beginning Date

The program will begin as soon as it is approved by the competent authorities. It is tentatively set to begin during the first semester of the 2013-2014 academic year.

1.5 Program Duration

According to the academic requirements described in this proposal, the doctoral program will have a normal duration of <u>four to five years</u> for students who begin with a bachelor's degree and two to four years for students starting with a master's degree.

The maximum time limit allotted for a student to complete the degree will be the same as that specified in the existing UPRM Graduate School Norms which at the time of writing this proposal (Certification 09-09) are:

- Ten years, if the student begins with a Bachelor's degree when starting the program, even if the student has transferred from another graduate program or has temporarily postponed studies.
- Eight years, if the student begins with a Master's degree at the initiation of the program, even if the student has transferred from another graduate program or has temporarily postponed studies.

2 Accreditation and Program Licensing

2.1 Professional Accreditation

The proposed program does not require professional accreditation.

2.2 Accreditation by Council of Higher Education

Once approved by the corresponding bodies of the University of Puerto Rico, the proposed program will require approval by the Council of Higher Education (Consejo de Educación Superior).

3 Justification

3.1 Academic reasons for establishing the program

The traditional notion of electrical engineering tells us that it is mainly concerned with information processing systems and electrical energy processing systems. The former utilizes electrical means in order to transmit, store, and process information; while the latter transmits energy from one place to another or converts energy from one form to another. In the twenty-first century, the scope of electrical engineering will extend far beyond traditional areas. This may be confirmed by studying the publications of the Institute of Electrical and Electronic Engineers (IEEE), the largest professional society in the world with over 320,000 members in more than forty countries. IEEE publications are classified in the following categories:

- Devices
- Circuits

- Electronics
- Computers
- Systems
- Power
- Interdisciplinary Areas

Interdisciplinary areas include among others:

- Bioengineering
- Biotechnology
- Manufacturing
- Aerospace
- Nanotechnology
- Mechatronics
- Reliability
- Robotics
- Material Sciences

The Department of Electrical and Computer Engineering has offered graduate programs for over forty years. During this time, programs have been in constant evolution. Since its inception, in 1967, with fewer than 10 students and approximately 20 professors, the electrical engineering Master's degree program emphasized the traditional areas of Power, Electronics and Controls. Throughout the years, the department has grown including the creation of a master's degree program in computer engineering. At present, the department consists of more than a hundred graduate students, over fifty professors and includes multiple areas of specialization. The degree of maturity, relevance, and magnitude of Department involvement in research projects has reached levels where the depth of exploration, dedication to scientific endeavors and formulated expectations cannot be sustained by the existing graduate master's degree program.

The proposed doctoral program will develop engineering professionals at the doctoral level through preparation and formation in the signals and systems, electronics, applied electromagnetics, and energy systems tracks while providing the means for developing existing graduate and research endeavors in electrical engineering and related areas. Furthermore, it will become a key instrument in strengthening interdisciplinary research projects.

As reported by the Research and Development Center, the Department of Electrical and Computer Engineering averages above four million dollars a year, for the past ten years, in external research funding. This department has a highly competitive faculty with which to establish a PhD degree. The department has five NSF CAREER awardees, one Presidential Early Career Awardee (PECASE) under President Clinton in 1997, and one NASA Faculty Award for Research (NASA FAR). This is particularly noteworthy given that this campus has received only seven Careers awards, two PECASE, and two NASA FAR awards. The department includes two institutes, and 17 laboratories with the equipment and facilities to support the proposed program. In addition, the department has been successful in establishing national recognition through participation in the Center for Power Electronics Systems (CPES), the Center for Subsurface Sensing and Imaging Systems (CenSSIS) and the Center for Collaborative Adaptive Sensing of the Atmosphere (CASA, http://stb.ece.uprm.edu/), established in collaboration with universities in the United States. These joint ventures have enabled collaborative research activities beyond our local environment and increased our academic offerings by taking advantage of distance education and exchange programs. In addition, these collaborations provide our relatively young faculty with guidance and mentoring opportunities in their development as researchers.

This analysis concludes that the Doctoral Program in Electrical Engineering represents, from the academic perspective, a natural evolution of the master's degree program in Electrical and Computer Engineering at UPRM and an enabling step to leap the capabilities of the ECE Faculty to become involved in translational research that can contribute to the economical development of Puerto Rico. Academic and research experience, faculty competencies, the developed infrastructure, and the country's needs have established the basis for establishing a Doctoral Program in Electrical Engineering at the University of Puerto Rico at Mayagüez.

3.2 Public policy reasons for establishing the program

Since 1983, Puerto Rico has envisioned transforming the economy of the country from one based primarily on manufacture and services to one based on research and development of new products, and more recently, one based on the creation and handling of knowledge in the areas of science and technology. The first efforts in this direction were during the years 1985-1987, when the highest official in the Puerto Rico Industrial Development Company (PRIDCO), Antonio Colorado, developed the following initiatives:

- Establish the Economic Development Bank to provide funds to high risk, high potential companies.
- Passing laws providing tax exemption for commercial enterprises in research and development.
- Creating venture capital funds for startup companies.
- Passing the venture capital law designed to bring this type of company to the island by means of tax credits.

Throughout the years, the different administrations have emphasized the importance of bringing a paradigm shift in the Island's economy from one depending mostly on manufacturing to one that is also based on technological and knowledge-based innovation.

One initiative implemented to foster this paradigm shift was the creation of the Puerto Rico Technoeconomic Corridor. This technology corridor was based on technology parks elsewhere, such as the North Carolina Research Triangle Park, Silicon Valley and the Singapore Science Park. Created in 2000, the Puerto Rico Technoeconomic Corridor (PRTEC) is a conglomerate of public and private entities with the purpose of developing a collaborating environment between private companies, government entities and academia. PRTEC runs various initiatives to promote the creation of high-tech startups and research centers, such as incubators and high technology companies dedicated to developing and commercializing new ideas and advances in the above mentioned areas.

The technology corridor was established in the west, from Aguadilla to Lajas, due to the fact that many successful research parks were linked to universities. As such it was decided that the best place would be close to the University of Puerto Rico at Mayagüez, who in its tradition of excellence and dedication to the development of Puerto Rico, had the desired characteristics to become the academic axis of the corridor.

To meet the new challenges for the economic and social development of Puerto Rico, evidenced by the initiatives described above, will require a critical mass of scientists and engineers with the capacity to be leaders in the different areas of science and technology. To produce this critical mass in researchers to permit the evolution of the island from manufacture to research and development, it is essential to have advanced technological degrees and research at the University of Puerto Rico at Mayaguez.

The proposed Doctoral program in Electrical Engineering will be instrumental in developing the knowledge-based economy, as doctoral programs provide the scientific and technological discoveries on which most high-tech startup companies are based, and also provide the professionals needed to support the research and development endeavors of both start-ups and well-established companies.

4 Program's Relation with the Institutional Mission and Planning

4.1 Relation with the UPR and UPRM Mission and Development Plan

Relation with UPR Mission and Development Plan

The proposed program addresses directly four strategic objectives of the Ten for the Decade Strategic Agenda of the University of Puerto Rico

Objective 2: Academic culture of actualization, experimentation and renovation

A PhD program is an important element in having the academic infrastructure needed for research, for being more competitive to obtain external funds, and for impacting our society.

Objective 3: Competitive research

The PhD program will provide the needed student body with the technical and the academic preparation needed to improve our capability of pursuing competitive research. Although the ECE Department has been quite successful in obtaining external funds its capability to sustain this funding level and to compete in mainstream research programs is limited since Master degree students cannot perform research of the required quality and depth.

PhD Students facilitate the process of translational research that is needed to bring results from research to applications. This improves our capability to develop partnerships with industry and government that will impact our society. One of the proposed initiatives to expand funding and develop closer industrial partnerships is the expansion of the ECE Industrial Affiliates Program to support graduate-level research.

The PhD program is designed to provide students a rich academic environment. Its flexibility, allows students to explore traditional and emerging areas of electrical engineering as well as interdisciplinary work. Graduate student participation and mentoring is a key component of research efforts at the UPRM ECE Department.

The UPRM ECE Department has been very successful in participating in multi-university research center such as NSF Engineering Research Centers and DHS Centers of Excellence. Having a PhD program will enable a more effective participation of UPRM faculty in center research programs. The creation of this doctoral program is an institutional commitment made in CPES, CenSSIS, and CASA NSF ERCs in which our department participates.

A PhD program will facilitate the development of research that produce results publishable in peer reviewed journals and conferences. The proposed PhD faculty has been quite successful in their publication record. However, it takes the effort of many Master degree students to produce a single journal paper. This is something that will benefit faculty but furthermore, students who pursue the PhD program will have the opportunity to develop their research to a level that it can be published in peer reviewed journals giving them a very valuable experience something that few of our MS students can have now.

Objective 7: Calling for a Global World

As part of the proposed program, a strong recruitment plan to attract students from Puerto Rico, USA, and international will be developed. Student body diversity provides a richer academic environment. Our current graduate programs in ECE have nearly 50% international students enrollment. We expect this trend will continue in the PhD program.

Increased research productivity will result in increased number of publications and presentations in national and international forums that will increase the visibility of UPR. The faculty participating in the program has shown a commitment (see CVs and Appendix D) to participate in national and international forums to present their work.

Relation with the UPRM Mission and Development Plan

The proposed program supports UPRM Vision and Mission. First it contributes to the Vision by strengthening the position of UPRM as a leading institution of higher learning in Electrical Engineering in Puerto Rico and throughout the entire American hemisphere. The program supports UPRM Mission by

- Forming educated, cultivated citizens capable of critical thinking and professionally prepared in the field of electrical engineering capable of contributing to the educational, cultural, social, technological and economic development of Puerto Rico and of the international community within a democratic and collaborative framework.
- Supporting research and creative endeavors to meet the needs of our local and international society while preserving, transmitting, and advancing knowledge.

Within the strategic plan, the program supports the following "Critical Areas and Strategic Orientations" (CASO).

CASO 4: Investigation, creative activities and graduate studies

- Increase the number of excellent academic and professional graduate offerings.
- Improving institutional conditions and climate necessary for the increase of research and creative activity in Electrical Engineering
- Stimulating the application of acquired knowledge, generated by research and creative activity, to Puerto Rico's development through the creation of an industrial affiliates program supporting graduate-level research.
- Continue developing, through proactive activity and practical experiences, creative professional engineers, who are innovative and skilled in the application of research for solving problems in Puerto Rican society.
- Strengthen inter and intra collegiate collaborative efforts, as well as industrial, commercial and governmental collaborative efforts in Puerto Rico and abroad. The creation of this doctoral program is an institutional commitment made in intercollegiate research center in which our department participates.
- Strengthen the institutional infrastructure to continue promoting the search for additional sources of external funding for research by allowing our researchers to become involved in advanced research endeavors.

4.2 Relation to the Academic Offer in Other Programs

4.2.1 Within the Mayagüez Campus

The proposed doctoral program is directly related to the existing master's degree program in Electrical Engineering. Most of the courses presently offered in this program form part of the courses that will be offered in the doctoral program. Qualified graduates of the master's degree program may be admitted into the doctoral program and may transfer all earned credits (except those obtained for thesis or project work) toward the doctoral program. The proposed program will increase demand of existing graduate courses in electrical engineering.

The proposed program is related to the Master's Degree Program in Computer Engineering (with options in computing systems, embedded systems, and signal processing) and the Ph.D. program in Computational Science and Engineering (Computer Science and Engineering option). Some of the courses in these programs are part of the courses included in the Signal and Systems, and Electronic Areas of the proposed program. Qualified students or graduates from these programs may be admitted to the new program with or without deficiencies.

The proposed program is related to the baccalaureate degree programs in Electrical Engineering and Computer Engineering at UPRM. Some advanced undergraduate courses from these programs are included in the proposed program. Any qualified student who has graduated from either program may be admitted directly into the doctoral program. The proposed program will increase demand of existing advanced undergraduate level courses in electrical engineering.

No other program in UPRM is directly related to the new program. Nevertheless, graduates from other qualified engineering, science, and mathematics programs might be considered for admission into the electrical engineering Ph.D. program. Depending on the applicant's academic background, deficiency courses may be assigned and admission granted, or a master's degree in electrical or computer engineering may be recommended prior to consideration for admission into the doctoral program.

4.2.2 In Other UPR Campuses

The proposed program will be the only doctoral program of its type offered within the UPR System and has no direct relation to any other graduate or undergraduate program in the University of Puerto Rico system. Nevertheless, graduates from other qualified science, and mathematics programs through the UPR System might be considered for admission into the electrical engineering Ph.D. program. Depending on the applicant's academic background, deficiency courses may be assigned and admission granted, or a master's degree in electrical or computer engineering may be recommended prior to consideration for admission into the doctoral program.

4.2.3 In Other Institutions of Higher Learning in Puerto Rico

The proposed program will be the only doctoral program of its kind offered in Puerto Rico. Nevertheless, there are master and bachelor degree programs in electrical and computer engineering at other institutions of higher learning which are related to this one. The new program provides qualified graduates of those programs with the opportunity to pursue a doctoral degree in electrical engineering.

The proposed program is related to the Master's Degree program in Electrical Engineering offered at Universidad Politécnica de Puerto Rico. Graduate students from this program may seek admission into the Doctoral program and may transfer some course credits, provided these credits meet UPRM residency criteria and approval of the Departmental Graduate Committee.

The proposed program is related to the baccalaureate programs in Electrical Engineering at Universidad Poltécnica, Universidad Interamericana at Bayamón, and Universidad del Turabo in Caguas. The new program offers students the opportunity to continue graduate studies and obtain a doctoral degree in Electrical Engineering. Additionally, members of those faculties who do not possess a doctoral degree will have the opportunity to complete doctoral studies in Puerto Rico.

5 Conceptual Framework

5.1 Mission and Vision

The mission and vision of the doctoral program are:

- **Mission:** Be a program of excellence in training of doctoral students in Electrical Engineering.

- **Vision**: Establish a doctoral program in Electrical Engineering which contributes significantly to the technological, scientific and economic development of Puerto Rico and the hemisphere.

5.2 Program Goals

The doctoral program's goals are as follows:

a) Prepare the professional engineers at the highest level capable of contributing to the social and economic development of Puerto Rico and its hemisphere in government, industry, and academia.
b) Provide the highest level of Electrical Engineering education in Puerto Rico.
c) Develop close ties with industry and government in order to support graduate education and research relevant to the economic development of Puerto Rico and facilitate technology transfer.

5.3 Program Objectives

The specific objectives of the doctoral program are:

a) Award a minimum of 15 PhD's during the first ten years of the program.
b) Establish a student recruitment program to attract students primarily from Puerto Rico, United States, and Latin America.
c) Establish mechanisms for the continual improvement of administrative support, laboratory infrastructure, equipment, library, and collaborations supporting the doctoral program.
d) Establish assessment mechanisms for evaluation of program performance.
e) Establish a system for the distribution of publications and technical reports providing public access to research work performed by the students and faculty.

5.4 Educational Philosophy

The Ph.D. program is an individualized-learning research-oriented program and as such we decided to have a general structure without specific options or areas of specialization that leaves enough freedom to develop study programs that meet student interests and research opportunities. This is the format currently used in the existing Masters program in Electrical Engineering and has proven to be quite successful in meeting academic and research interests of students and faculty. Several areas of emphasis (not specializations or options) are proposed to provide guidance to the students in traditional areas of electrical engineering with the technical course depth required for a doctoral level program. However, the open structure also gives the opportunity to develop individual programs of study that will meet multidisciplinary research opportunities not satisfied by the areas of emphasis.

The faculty advisor and the student's graduate committee are viewed as mentors in the process of developing a professional who can perform advanced research work in electrical engineering and be a contributor to society. The student, in coordination with his/her graduate advisor and graduate committee will propose a study program that will meet the core requirements of a particular area and structure the technical, mathematical and free electives to meet the student interest and the needs of the proposed research project. The student in coordination with his/her graduate advisor and graduate committee will work on defining a research project that will constitute an original contribution to the state of the art in electrical engineering and related areas. The proposed open structure will allow the program to have the capability to adapt and address more efficiently the fast changing technological societal needs in Puerto Rico and the world.

5.5 Graduate Profile

Among the general skills of the professional profile for the graduates of the Doctoral Program in Electrical Engineering the following are the most outstanding:

1. Profound knowledge in the area of expertise. Knowledgeable of state of the art language, topics, and research problems in this area.
2. Capable of active participation in scientific research and application to their area of expertise.
3. Ample knowledge in electrical engineering, which allow for significant contributions to the academic milieu in institutions of higher learning.
4. Ability to creatively apply and integrate this knowledge to the development of scientific research, and engineering solutions.
5. Ability for oral and written communication in both Spanish and English.
6. Ability to clearly formulate short term, medium-range and long term objectives and to communicate ideas and results adequately with colleagues.
7. Ability to communicate effectively the essential aspects of a problem and its solution to the general public.
8. Ability to develop research proposals for public and private funding agencies.
9. Ability to present results in written form in technical papers and orally in technical presentations in the field.
10. Ability to lifelong learning, due to the changing nature of the discipline.
11. Awareness of an individual's professional impact on society's quality of life including a clear understanding and respect for the legal, ethical, social and cultural issues pertinent to the profession.
12. Appreciation of the relationship between theory and practice. The Ph.D. graduate should appreciate both the value of good design as well as the theoretical framework on which it is based. That is, she/he should understand the value of the relation between theory, experiment and results while being able to utilize this understanding effectively in his professional practice.

6 Curriculum Design

6.1 Curriculum Scheme and Balance

The proposed academic program will consist of a total of at least forty-nine credits. It is required that students approve a minimum of 49 credits distributed in the following manner:

- 24 credits in graduate or advanced undergraduate level courses within a particular area of emphasis
- 6 credits in mathematics at the graduate level (at least one course at 6000 level or above)
- 6 credits in elective courses outside the selected track
- 1 credit doctoral seminar
- 12 credits in doctoral dissertation

No more than nine credits in advanced undergraduate courses (5000 level) may be used to complete the PhD course requirements. At least 6 credits in advanced level courses (8000 or higher) must be completed in the selected area of emphasis. Additionally, the student must take a qualifying and a comprehensive exam, and must present and defend a dissertation which shows an original work in their area of emphasis.

6.2 Course Descriptions

The following courses will comprise the academic offerings of the Doctoral Program in Electrical Engineering.

6.2.1 Existing Courses

INEL 5046 PATTERN RECOGNITION. Three credit hours. Three hours of lecture per week. Prerequisite: (INEL 4095 or INEL 4301) and (ININ 4010 or ININ 4011). This course is an introduction to the basic concepts, topics and methods in Pattern Recognition. The first part of the course is a review of the basic concepts and skills in probability and linear algebra. The second part of the course is related with classification algorithms, its application and methods for easier implementations. It includes sections on Statistical Decision Theory, Non-Parametric Methods and Neural Networks. The third part of this course will introduce the student to application such as image analysis, and computer vision. The emphasis of this course will be in theory and application as well.

INEL 5205 INSTRUMENTATION. Three credit hours. Three hours of lecture per week.
Prerequisite: INEL 4206 and INEL 4202. Signals from transducers; signal conditioning, data conversion and transmission; effects of noise. Data storage and display; use of microprocessors in instrumentation.

INEL 5206 DIGITAL SYSTEMS DESIGN. Three credit hours. Three hours of lecture per week. Prerequisite: INEL 4207. Design methods in combinational and sequential systems. Use of programmable logic devices in digital systems design. Analysis and design of system controllers.

INEL 5207 ANALOG SYSTEMS DESIGN. Three credit hours. Three hours of lecture per week. Prerequisite: INEL4201 and INEL4205. This course covers the design of applications using analog integrated circuits. A discussion on the characteristics of operational amplifiers is followed with a detailed overview of applications.

INEL 5209 INTRODUCTION TO SOLID STATE ELECTRONICS. Three credit hours. Three hours of lecture per week. Prerequisites: INEL 4201. Energy levels in atoms. Crystal properties, energy bands and charge carriers, semiconductors, transport properties of bulk materials. *P-n* junction diodes, bipolar transistors, field effect transistors.

INEL 5265 ANALOG INTEGRATED CIRCUITS DESIGN. Three credit hours. Three hours of lecture per week. Prerequisite: INEL 4205 and INEL 4201. Design and analysis of analog and mixed-signal (digital-analog) circuits using advanced analytical design techniques and advanced computer aided design tools. Discussion of topics about physical design and development of functional testing of analog integrated circuits.

INEL 5307 OPTICAL COMMUNICATIONS. Three credit hours. Three hours of lecture per week. Prerequisites: INEL 4301 and INEL 4152. Optical communication principles; transmitter and receiver design; fiber optic channels.

INEL 5309 DIGITAL SIGNAL PROCESSING. Three credit hours. Three hours of lecture per week. Prerequisite: INEL 4301. Signal classification; Z-transform and discrete Fourier transform; matrix representation of digital filters and digital systems; digital filter design; discrete Fourier transform algorithms.

INEL 5315 THEORY OF COMMUNICATIONS II. Three credit hours. Three hours of lecture per week. Prerequisite: (INEL 4011 or ININ 4010) and INEL 4301. Information theory; coding theory; signal design; noise and probability of error.

INEL 5327 IMAGE PROCESSING. Three credit hours. Three hours of lecture per week. Prerequisite: INEL 5309. Mathematical representation of 2-D digital signals. 2-D filter design. Image coding standards. Image filtering, enhancement and compression.

INEL 5406 DESIGN OF TRANSMISSION AND DISTRIBUTION SYSTEMS. Three credit hours. Three hours of lecture per week. Prerequisite: INEL 4415. Design of electric power distribution systems with emphasis on distribution transformer connections and energy tariffs. Transmission line design with emphasis on conductor selection, and mechanical considerations. Review of transmission line parameters.

INEL 5407 COMPUTER AIDED POWER SYSTEM DESIGN. Three credit hours. Three hours of lecture per week. Design of power systems using digital computers; load flow, economic load dispatch, symmetrical and unsymmetrical faults. Selection of breakers.

INEL 5408 ELECTRICAL MOTORS CONTROL. Three credit hours. Three hours of lecture per week. Prerequisites: INEL 4405, INEL 4416 and INEL 4505. Characteristics and selection criteria of alternating current (A.C.) and direct current (D.C.) motors; design and control of solid state drive systems; braking methods; heating and duty cycle calculations. Performance calculations and design of closed loop controllers.

INEL 5415 ELECTRICAL SYSTEMS PROTECTION DESIGN. Three credit hours. Three hours of lecture per week. Prerequisites: INEL 4415. Design and selection protective devices used in electric energy generation, transmission and distribution systems: relays, fuses, breakers, reclosers, arresters among others. Selection of system components such as sectionalizers and throwovers. Insulation coordination.

INEL 5505 LINEAR SYSTEM ANALYSIS. Three credit hours. Three hours of lecture per week. Prerequisite: INEL 4505. Linear spaces and matrices; state variables representations for linear continuous and discrete systems; the Z-transform and its application; controllability and observability; state estimators; stability.

INEL 5506 PROCESS INSTRUMENTATION AND CONTROL ENGINEERING. Three credit hours. Three hours of lecture per week. Prerequisite: INEL 4206 and INEL 4505. Design of process instrumentation and control systems, based on analog and digital instruments and mini or microcomputers. Standards and practical considerations emphasized.

INEL 5508 DIGITAL CONTROL SYSTEMS. Three credit hours. Three hours of lecture per week. Prerequisite: INEL 4505. Analysis and design of digital control systems; stability, controllability and observability of discrete systems. Practical considerations when implementing a digital control system.

INEL 5516 AUTOMATION AND ROBOTICS. Three credit hours. Three hours of lecture per week. Prerequisites: INEL 4206 or ININ 4057. Analysis and design of automated pneumatic systems using programmable controllers. Programming of industrial robots.

INEL 5605 ANTENNA THEORY AND DESIGN. Three credit hours. Three hours of lecture per week. Prerequisite: INEL 4152 and INEL 4301. Radiation mechanism. Types of antennas; impedance; radiation patterns; arrays. Antenna measurements.

INEL 5606 MICROWAVE ENGINEERING. Three credit hours. Three hours of lecture per week. Prerequisite: INEL 4152. Rectangular and circular wave guides; passive components; tubes, and solid-state devices used in microwave systems.

INEL 5616 WIRELESS COMMUNICATIONS. Three credit hours. Three hours of lecture per week. Introduction to the study of cellular and wireless personal communications. The communications channel is characterized by describing large-scale path loss and small-scale fading and multipath interference properties. Development of Modulation and Diversity Methods to Facilitate Signal Transmission and to Improve Quality of Reception, Respectively. Study of Multiple Access Techniques for The Efficient use of The Radio Spectrum. Introduction to Wide Area Wireless Communication Systems. Description of Some Wireless Systems and Standards.

INEL 5629 TELECOMMUNICATION ELECTRONICS. Three credit hours. Three hours of lecture per week. Prerequisite: INEL 4301, INEL 4201 and INEL 4152. Study of the operation theory of radio frequency and microwave devices and components and foundations of the design techniques for RF systems with the purpose of understanding the operation of the different components of a telecommunication system.

INEL 6000 INTRODUCTION TO NONLINEAR CONTROL SYSTEMS. Three credit hours. Three hours of lecture per week. Analysis and synthesis of nonlinear control systems; phase plane and describing function techniques; Lyapunov's second method and its application in the design and stability determination of nonlinear systems.

INEL 6001 FEEDBACK CONTROL SYSTEMS I. Three credit hours. Three hours of lecture per week. The Z-transform and its application to sampled-data control systems; analysis of automatic control systems, using state variable concepts; stability criteria; introduction to parameter optimization techniques.

INEL 6007 INTRODUCTION TO REMOTE SENSING. Three credit hours. Three hours of lecture per week. History, principles, and applications of remote sensing. Electromagnetic radiation; aerial photography; image interpretation; land observation satellite systems; image resolution; preprocessing and classification of images; geographic information systems.

INEL 6009 COMPUTER SYSTEM ARCHITECTURE. Three credit hours. Three hours of lecture per week. Fundamentals of the architecture and organization of computers. Concepts of high-level languages. Architectural support to the compilation process and to operating systems.

INEL 6025 ADVANCED ENERGY CONVERSION. Three credit hours. Three hours of lecture per week. Theory and design of processes for direct energy conversion. Thermoelectric, thermionic, and photovoltaic conversion. Fuel cells. Introduction to irreversible thermodynamics and its application to describe operations. MHD equations and generators. Conversion efficiency and electrical losses.

INEL 6026 COMPUTATIONAL METHODS FOR POWER SYSTEMS ANALYSIS II. Three credit hours. Three lectures per week. Prerequisite: INEL 5027. Application of numerical techniques and computer methods to the solution of a variety of problems related to the planning, design and operation of large interconnected electric power systems.

INEL 6027 DYNAMICS AND CONTROL OF INTEGRATED POWER SYSTEMS. Three credit hours. Three hours of lecture per week. Discussion of a variety of transient and control problems associated with interconnected power systems, and techniques for their analysis and solution. Methods for dynamic analysis of large systems are stressed.

INEL 6028 OPTIMIZATION AND ECONOMIC OPERATION OF INTEGRATED POWER SYSTEMS. Three credit hours. Three hours of lecture per week. Theory of optimization under equality and inequality constraints; computational methods and application to generation scheduling in integrated power systems.

INEL 6047 ADVANCED CONTROL SYSTEM THEORY. Three credit hours. Three hours of lecture per week. Advanced Problems In Linear and Nonlinear Control Systems. The use of Linear Algebra for The Analysis and Design of Linear Systems Is Emphasized. The implementation of linear systems via analog and digital simulation diagrams is also studied.

INEL 6048 ADVANCED MICROPROCESSOR INTERFACING. Three credit hours. Three hours of lecture per week. Architecture of 8, 16, and 32 bits microprocessors; bus, input/output and memory interfacing; parallel processing architecture; configuration and interfacing of multiprocessors; applications of the multiprocessor system.

INEL 6049 MULTIDIMENSIONAL DIGITAL SIGNAL PROCESSING. Three credit hours. Three hours of lecture per week. Representation of multidimensional signals and systems; Fourier analysis of multidimensional signals; design and implementation of two-dimensional digital filters; applications of digital filtering techniques to beam forming and image analysis.

INEL 6050 ADVANCED DIGITAL SIGNAL PROCESSING ALGORITHMS. Three credit hours. Three hours of lecture per week. Prerequisite: INEL 5309. Theoretical foundations, fast algorithms for the Discrete Fourier Transform. Fast convolution algorithms, multidimensional techniques, fast filtering computations, architecture of filters and transforms, fast algorithms in VLSI. Application studies in transmission error controlling codes, sonar, radar, speech, image processing, and other engineering areas. Study of software implementations on vector and parallel architectures. Algorithms and symbolic computation.

INEL 6055 SOLID STATE ELECTRONICS. Three credit hours. Three hours of lecture per week. Introduction to the study of the properties and functionality of solid state devices. Structure of crystal and metal solids. Electronic emission semiconductors, dielectrics and magnetic devices.

INEL 6058 HIGH FREQUENCY POWER CONVERTERS. Three credit hours. Three hours of lecture per week. Analysis, simulation, design and control of high frequency power converters. Pulse width modulated and resonant converter topologies. Applications such as power direct current sources, uninterruptible power sources, and superconducting electromagnetic energy storage.

INEL 6059 INTELLIGENT SYSTEMS AND CONTROLS. Three credit hours. Three hours of lecture per week. Engineered intelligent systems and their application to complex decision, modeling, and control processes.

INEL 6066 CONTROL OF ELECTRIC DRIVE SYSTEMS. Three credit hours. Three hours of lecture per week. Theory and operation of phase and chopper controlled direct current (d.c.) drives, closed loop d.c. drives and their analysis, phase locked loop d.c. drives; design of controllers for optimal performance. Speed control and control schemes for induction and synchronous motors; inverters and cycloconverters; closed loop alternating current (a.c.) drives; stability and performance analysis.

INEL 6075 INTEGRATED CIRCUITS FABRICATION. Three credit hours. Three hours of lecture per week. Basic principles underlying the fabrication of circuits with emphasis in very large scale integrated systems (VLSI). Properties of materials like silicon and gallium arsenide; phase diagrams; solid solubility; crystal growth; doping; evaporation; sputtering epitaxy; diffusion; ion implantation; oxidation; lithographic process; device and circuit fabrication. Thin and thick film circuits, assembly, packaging processing, yield and reliability.

INEL 6076 ADAPTIVE AND OPTIMAL SIGNAL PROCESSING. Three credit hours. Three hours of lecture per week Signal and system modeling, spectrum estimation, linear optimum filtering, linear and nonlinear adaptive filtering.

INEL 6077**.** SURGE PHENOMENA IN POWER SYSTEMS. Three credit hours. Three hours of lecture per week. Transient surge phenomena in electric power systems: generation, propagation, analysis, modeling, and protection.

INEL 6078. ESTIMATION, DETECTION AND STOCHASTIC PROCESSES. Three credit hours. Three hours of lecture per week. Fundamentals of detection, estimation, and random process theory for signal processing, communications, and control. Random processes and sequences. Linear systems driven by random processes. Bayesian and nonrandom parameter estimation. Signal detection and estimation from waveform observations Wiener and Kalman filtering.

INEL 6079 INTEGRATED CIRCUIT ADVANCED DESIGN TECNIQUES. Three credit-hours. Three conference contact hours per week. Prerequisites INEL 4202 or INEL 5265. The course studies novel design techniques geared to the design of Low-Power Low-Voltage Analog and Digital Integrated Circuit Design. This course also focuses on optimization of speed and signal to noise ratio of integrated circuits.

INEL 6080 VLSI SYSTEM DESIGN. Three credit-hours. Three conference contact hours per week. Design, Implementation and fabrication of very high level integrated systems (VLSI). System analysis and design using MOSFETS (Metal Oxide Semiconductor Field Effect Transistors). The course focuses on synchronization and physical implementation of various computational systems.

INEL 6085 ANALYSIS AND DESIGN OF POWER SEMICONDUCTOR CIRCUITS. Three credit hours. Three hours of lecture per week. Analysis and design of single phase and three phase controlled rectifiers, dual converters, A.C. voltage controllers, PWM converters, for power supplies, four quadrant choppers, voltage and current source inverters with modulation techniques, A.C. to A.C. converters.

INEL 6088 COMPUTER VISION. Three credit hours. Three hours of lecture per week. Introduction to computer vision. Computer vision systems. Biological vision system and biological signal processing; early image processing; boundary detection; region growing; texture and shape analysis.

INEL 6096 ELECTRIC POWER QUALITY. Three credit hours. Three hours of lecture per week. Prerequisites: INEL 4103 o equivalent e INEL 4201 o equivalent. Analysis, modeling and mitigation of the difficulties related to the distortion of voltages and currents in power systems. Special emphasis on harmonics and sources of power quality problems. Voltage sags and swells, impulses and other transient events.

INEL 6601 ADVANCED ELECTROMAGNETICS. Three credit hours. Three hours of lecture per week. Advanced study of Maxwell equations, electric properties of the matter, wave propagation, polarization, reflection, and transmission and the techniques and theory for the analysis of electromagnetic systems, use of Green functions.

INEL 6605 ACTIVE REMOTE SENSING TECHNIQUES. Three credit hours. Three hours of lecture per week. This course presents the theory behind radar and ladar techniques. Topics discussed include wave propagation and polarization, transversal section of objects, coupled filters, ambiguity function, radar coded signals, processing and interpretation of radar and ladar echo signals. Typical applications discussed include weather radar, synthetic aperture radar, and lidar.

INEL 6606 INTRODUCTION TO RADAR SYSTEMS. Three credit hours. The course aims to develop the basic theory underlying the radar system, focusing in the hardware. The students will learn basic radar concepts including the radar equation for different applications; different types of radars such as Fm, Fm-cw, Pulse, etc., are discussed; strengths and weaknesses are addressed, as well as applications for different types of radars. Calibration and detection of signals in noise techniques are also discussed. Typical radar transmitters and receivers are studied.

INEL 6615 MICROWAVE ACTIVE CIRCUITS. Three credit hours. Three hours of lecture per week. This course studies the theory and analysis of the design of microwave transistor amplifiers and oscillators. Parameters such as noise, bandwidth, gain and power are considered for the design of the amplifiers. Different transistor amplifiers such as broadband, low noise and power amplifiers are discussed. The course also covers the design of microwave oscillators using dielectric resonators.

INEL 6668 MICROWAVE ANTENNA ENGINEERING. Three credit hours. Three hours of lecture per week. Analysis and design of microwave and millimeter wave antennas.

INEL 6669 MICROWAVE REMOTE SENSING. Three credit hours. Three conference hours per week. The interaction of electromagnetic waves with natural (i.e. clouds, rain, snow) and artificial targets. It provides with an introduction to radiometry (Planck's Law) and to operation principles of active (radars) and passive (radiometers) instrumentation used in remote sensing, with emphasis on passive systems.

INEL 6995 SPECIAL TOPICS IN ELECTRICAL ENGINEERING. Three credit hours. Three hours of lecture per week. Study of selected topics in Electrical Engineering.

6.2.2 Courses that can be used to meet the Mathematics Requirement

A list of potential courses that can be used to meet the mathematics requirement in the EE Ph.D. program is included in Appendix G. This list will be revised by the ECE Graduate Committee yearly and updated according to course offers in mathematical sciences and related fields.

6.2.3 New Courses

The course creation forms are presented in Appendix B.

INEL 8295 ADVANCED TOPICS IN ELECTRONICS. Three credits. Three contact hours per week. Study of selected topics in electronics or related fields.

INEL 8395 ADVANCED TOPICS IN SIGNAL PROCESSING Three credits. Three contact hours per week. Study of selected topics in signal processing or related fields.

INEL 8397 ADVANCED TOPICS IN COMMUNICATIONS SYSTEMS. Three credits. Three contact hours per week. Study of selected topics in communication systems or related fields.

INEL 8495 ADVANCED TOPICS IN ELECTRIC POWER ENGINEERING. Three credits. Three contact hours per week. Study of selected topics in electric power engineering or related fields.

INEL 8496 ADVANCED TOPICS IN POWER ELECTRONICS. Three credits. Three contact hours per week. Study of selected topics in power electronics or related fields.

INEL 8595 ADVANCED TOPICS IN CONTROL SYSTEMS. Three credits. Three contact hours per week. Study of selected topics in control systems or related fields.

INEL 8695 ADVANCED TOPICS IN APPLIED ELECTROMAGNETICS Three credits. Three contact hours per week. Study of selected topics in applied electromagnetics or related fields.

INEL 8995 ADVANCED TOPICS. Three credits. Three contact hours per week. Study of selected topics in electrical engineering or related fields.

INEL 8997 INDEPENDENT STUDY. Three credits. Independent student research in electrical engineering and related fields.

INEL 8998 DOCTORAL SEMINAR. Zero to One credit. Oral presentation on a research topic in electrical engineering.

INEL 8999 DOCTORAL DISSERTATION. Zero to twelve credits.
Development, preparation, and defense of a dissertation based on an original research project in electrical engineering that represents a significant contribution in the area of specialization.

6.3 Proposed Program Course Sequences

The curriculum will be administered by the ECE Graduate Committee in Coordination with the area coordinators and the ECE Associate Chair for Graduate Studies and Research. The Ph.D. program is a research oriented program and as such we decided to have a general structure that leaves enough freedom to develop study programs that meet student interest and research opportunities. Students will have an advisor who will, in conjunction with the student graduate committee, decide which of area of emphasis to select and which courses to take to meet student interest and research project needs. Information about the areas of emphasis is given in Appendix A. Examples of programs of study for each area of emphasis are given in Appendix E. The open structure also gives the opportunity to develop individual programs of study that will meet multi-disciplinary research opportunities not satisfied by a single area of emphasis such programs will need the approval of the ECE Departmental Graduate Committee.

6.3.1 Course sequence for a student admitted with a BS in Electrical Engineering.

Course	*First Semester*		*Credits*
INEL Axxx	Course in Electrical Engineering		3
INEL Axxx	Course in Electrical Engineering		3
INEL Axxx	Course in Electrical Engineering		3
INEL 8998	Doctoral Seminar		0
		Total	9

Course	*Second Semester*		*Credits*
INEL Axxx	Course in Electrical Engineering		3
INEL Axxx	Course in Electrical Engineering		3
MATE Axxx	Graduate or Adv. Undergraduate Mathematics Course		3
INEL 8998	Doctoral Seminar		0
		Total	9

Course	*Third Semester*		*Credits*
INEL Axxx	Course in Electrical Engineering		3
INEL Axxx	Course in Electrical Engineering		3
MATE Axxx	Graduate or Adv. Undergraduate Mathematics Course		3
INEL 8998	Doctoral Seminar		0
		Total	9

Course	*Fourth Semester*		*Credits*
INEL Axxx	Course in Electrical Engineering		3
---------------	Elective Course		3
---------------	Elective Course		3
INEL 8998	Doctoral Seminar		0
		Total	9

Qualifying Exam

Course	*Fifth Semester*		*Credits*
INEL 8999	Doctoral Dissertation		3
INEL 8998	Doctoral Seminar		0
		Total	3

Course	*Sixth Semester*		*Credits*
INEL 8999	Doctoral Dissertation		3
INEL 8998	Doctoral Seminar		0
		Total	3

Comprehensive Exam

Course	*Seventh Semester*		*Credits*
INEL 8999	Doctoral Dissertation		3
INEL 8998	Doctoral Seminar		0
		Total	3

Course	*Eighth Semester*		*Credits*
INEL 8999	Doctoral Dissertation		3
INEL 8998	Doctoral Seminar		1
		Total	4

6.3.2 Course sequence for a student admitted with an MS in Electrical Engineering (Assumes 18 credits accredited from previous graduate work)

Course	*First Semester*		*Credits*
INEL Axxx	Course in Electrical Engineering		3
INEL Axxx	Course in Electrical Engineering		3
MATE Axxx	Graduate or Adv. Undergraduate Mathematics Course		3
INEL 8998	Doctoral Seminar		0
		Total	9

Course	*Second Semester*		*Credits*
INEL Axxx	Course in Electrical Engineering		3
INEL Axxx	Course in Electrical Engineering		3
MATE Axxx	Graduate or Adv. Undergraduate Mathematics Course		3
INEL 8998	Doctoral Seminar		0
		Total	9

Qualifying Exam

Course	*Third Semester*		*Credits*
INEL 8999	Doctoral Dissertation		3
INEL 8998	Doctoral Seminar		0
		Total	3

Course	*Fourth Semester*		*Credits*
INEL 8999	Doctoral Dissertation		3
INEL 8998	Doctoral Seminar		0
		Total	3

Comprehensive Exam

Course	*Fifth Semester*		*Credits*
INEL 8999	Doctoral Dissertation		3
INEL 8998	Doctoral Seminar		0
		Total	3

Course	*Sixth Semester*	*Credits*
INEL 8999	Doctoral Dissertation	3
INEL 8998	Doctoral Seminar	1
	Total	4

Table: 6.1: Summary of Credit Distribution for a student admitted with a Bachelor degree.

Semester	Credits			
	Courses	Seminar	Thesis	Total
1	9	0	-	9
2	9	0	-	9
3	9	0	-	9
4	9	0	-	9
5	-	0	3	3
6	-	0	3	3
7	-	0	3	3
8	-	1	3	4
Total	36	1	12	49

Table 6.2: Summary of Credit Distribution for a student admitted with a Master degree

Semester	Credits			
	Courses	Seminar	Thesis	Total
1	9	0	-	9
2	9	0	-	9
3	-	0	3	3
4	-	0	3	3
5	-	0	3	3
6	-	1	3	4
Total	18	1	12	31

6.4 Curriculum Coherence and Sufficiency

The curriculum is the instrument to implement the process to meet the program educational objectives and achieve the desired student profile. The mapping between curriculum components (courses, seminar, and dissertation) and profile skills is summarized in Table 6.3. Skills 1, 3, 4 and 12 in the student profile will be addressed by means of course work. Skills 5,6,7,8,9,10 and 11 of the student profile will be gained through the doctoral seminar. Skills 2,4,5,6,8,10 and 12 in the student profile will be gained through the preparation of the thesis proposal and dissertation. The mathematical requirements have been included to help our students develop the analytical skills and the capability for abstract thinking needed to pursue doctoral level research work and study the advanced technical literature.

6.5 Educational Method

The educational methods to be employed in the proposed academic program will seek to develop and strengthen the skills described in the student profile.

Skills 1, 3, 4 and 12 in the student profile will be addressed by means of course work. The educational strategies employed will consist of independent work, cooperative learning, team work, and research experiences. Independent work skills will be developed through course assignments and the preparation of technical reports in some courses. The ability for teamwork and cooperative learning will be promoted and evaluated by means of projects that will require complex designs and effective collaboration among students in the process of finding a common solution.

Skills 5,6,7,8,9,10 and 11 of the student profile will be gained through the doctoral seminar. Through seminars, students will be trained for independent work and research, to prepare research proposals and write technical articles, and to prepare effective technical presentations. Additionally, the seminars will serve to guide students as to the different career paths for Ph.D. graduates in academia, government, and private industry, as well as the creation of research and development oriented businesses.

Skills 2,4,5,6,8,10 and 12 in the student profile will be gained through the preparation of the thesis proposal and dissertation. Through the preparation of a doctoral dissertation and the publication of articles in conferences and refereed professional journals, students will develop high quality research skills and the ability to effectively disseminate them.

Table 6.3 Relation between Courses and Student Profile.

Course	Skills											
	1	2	3	4	5	6	7	8	9	10	11	12
INEL 5046.	x		x	x	x							x
INEL 5205.	x		x	x	x							x
INEL 5206.	x		x	x	x							x
INEL 5207	x		x	x	x							x
INEL 5209.	x		x	x	x							x
INEL 5265	x		x	x	x							x
INEL 5307.	x		x	x	x							x
INEL 5309.	x		x	x	x							x
INEL 5315	X		X	X	X							X

Course	Skills										
	1	2	3	4	5	6	7	8	9	10	11	12
INEL 5327.	x		x	x	x							x
INEL 5406.	x		x	x	x							x
INEL 5407.	x		x	x	x							x
INEL 5408.	x		x	x	x							x
INEL 5415	x		x	x	x							x
INEL 5505.	x		x	x	x							x
INEL 5506.	x		x	x	x							x
INEL 5508.	x		x	x	x							x
INEL 5516.	x		x	x	x							x
INEL 5605.	x		x	x	x							x
INEL 5606.	x		x	x	x							x
INEL 5616.	x		x	x	x							x
INEL 5629.	x		x	x	x							x
INEL 6000.	x		x	x	x							x
INEL 6001.	x		x	x	x							x
INEL 6007.	x		x	x	x							x
INEL 6009.	x		x	x	x							x
INEL 6025.	x		x	x	x							x
INEL 6026.	x		x	x	x							x
INEL 6027.	x		x	x	x							x
INEL 6028.	x		x	x	x							x
INEL 6047	X		X	X	X							x
INEL 6048	X		X	X	X							x
INEL 6049.	x		x	x	x							x
INEL 6050.	x		x	x	x							x
INEL 6055.	x		x	x	x							x
INEL 6058.	x		x	x	x							x
INEL 6059.	x		x	x	x							x
INEL 6066.	x		x	x	x							x
INEL 6075	x		x	x	x							x
INEL 6076.	x		x	x	x							x
INEL 6077.	x		x	x	x							x
INEL 6078.	x		x	x	x							x
INEL 6079.	x		x	x	x							x
INEL 6080.	x		x	x	x							x
INEL 6085.	x		x	x	x							x
INEL 6088.	x		x	x	x							x
INEL 6096	x		x	x	x							x
INEL 6601	x		x	x	x							x
INEL 6605	X		X	X	X							X
INEL 6606	x		x	x	x							x
INEL 6615	x		x	x	x							x
INEL 6668	x		x	x	x							x
INEL 6669	x		x	x	x							x
INEL 6995.	x		x	x	x							x
INEL 8295	x		x	x	x			x	x			x
INEL 8395	x		x	x	x			x	x			x
INEL 8297	x		x	x	x			x	x			x
INEL 8495	x		x	x	x			x	x			x

Course	Skills											
	1	2	3	4	5	6	7	8	9	10	11	12
INEL 8496	x		x	x	x			x	x			x
INEL 8595	x		x	x	x			x	x			x
INEL 8695	x		x	x	x			x	x			x
INEL 8995	x		x	x	x			x	x			x
INEL 8997	x	x	x	x	x			x	x			x
INEL 8998					x	x	x	x	x	x	x	
INEL 8999	x	x		x	x	x		x	x			x
Math Electives	x	x										x

6.6 Assessment of Student Learning

The Department of Electrical and Computer Engineering will establish a permanent committee to be named Committee for the Evaluation of Graduate Programs (CEGP) that will be in charge of the evaluation of graduate programs in the department, including the proposed Doctoral Program in Electrical Engineering. This committee will be composed of three members of the Graduate Committee, the Associate Director for Research and Industry Relations and the Student Affairs Officer II. The evaluation process to be utilized in the program will be based on the best assessment practices as defined by the Accreditation Board of Engineering and Technology (ABET) (www.abet.org) and the Middle States Association Council for Higher Education (www.msache.org).

In terms of the proposed doctoral program in electrical engineering, the CEPG will establish a periodic evaluation plan for the program. The CEPG will utilize internal and external methods to realize periodic evaluations of the proposed Doctoral Program in Electrical Engineering. The following is a preliminary list of the methods to be utilized by CEPG:

- Internal Methods: (a) to evaluate student academic performance by utilizing academic transcripts; (b) to evaluate the results of a poll to determine the satisfaction and accomplishment levels among students who apply for the program's qualifying exams; (g) to evaluate student performance in the qualifying exam, the comprehensive exam and in the thesis dissertation defense; (h) to evaluate student academic portfolios (such as those including: qualifying exam, publications, and presentations) throughout various stages of doctoral studies.

- External methods: (a) to evaluate results of a survey that will determine student levels of satisfaction and development after completing program requirements; (b) to evaluate the results of a survey that will determine student degree of satisfaction and development three years after graduation (graduate survey).

6.7 Course Syllabus

The syllabi for the existing courses in the EE graduate program that will be part of the PhD program can be found in Appendix F and for courses created for the PhD program in Appendix B.

7 Admission, Registration and Graduation

7.1 Admission Requirements

General requirements necessary for admission into the graduate program appear in the section titled NORMS WHICH REGULATE GRADUATE STUDIES AT UPRM which at the moment of writing this proposal are established in Certification 09-09 issued by the UPRM Academic Senate. Specific program requirements are as follows:

- Bachelor or Master's Degree in Electrical Engineering, Computer Engineering or their equivalents from an accredited institution of higher learning. The graduate departmental committee will evaluate each applicant's qualifications and the reputation of their graduating institution to determine if the applicant fulfills admission requirements of the doctoral program and decide on the type of admission to be awarded.
- Applicants with a bachelor degree or a master's degree in other engineering fields, in science, in mathematics or in related areas may be considered for admission into the electrical engineering doctoral program. Depending on the applicant's academic background, admission may be granted with deficiency courses or a master degree in Electrical or Computer Engineering may be recommended before admission into the doctoral program.
- A general grade point average of 3.30/4.0 or its equivalent if the applicant holds a BS degree
- A general grade point average of 3.50/4.0 GPA or its equivalent if the applicant holds an MS degree or a higher degree.
- A minimum mastery of both English and Spanish skills to understand technical literature, and to write technical documents in both languages.

The norms established by the Office of Graduate Studies as well as all previously described admission guidelines to the doctoral program are applicable to transfer students.

7.2 Enrollment Projections

It is estimated that at least five students will be admitted to the program annually during the initial five years. In steady state, we foresee an enrollment of at least 30 students based on the experience with the CISE PhD program and the Master in EE program. At present, the department has the required physical infrastructure to accommodate these students.

7.3 Academic Requirements for Conferring the Degree

The general academic requirements for conferring the doctoral degree are specified in the "Norms that regulate graduate studies at UPRM". Specific requirements for the proposed doctoral program in Electrical Engineering are described below.

7.3.1 Total Credit-Hour Requirement

Students are required to approve a minimum of 49 credits distributed in the following manner:

- 24 credits in graduate or advanced undergraduate level courses within a particular area of emphasis
- 6 credits in graduate or advanced undergraduate level mathematics courses. At least one course must be at the graduate level (6000 or above).
- 6 credits in elective courses outside the area of specialization

- 1 credit in doctoral seminar
- 12 credits in doctoral dissertation

No more than 9 credits at the advanced undergraduate level can be used to complete doctoral degree course requirements. At least 6 credits in advanced graduate courses (8000 or higher) are required within the area of emphasis.

7.3.2 Minimal Academic Index Requirements

In order to obtain a doctoral degree, each student must approve a minimum of 49 credits (according to specifications stated in Section 7.1) with a 3.0 or higher GPA. Students enrolled in the doctoral program may repeat a course with an earned grade of C or lower only once. Courses with a final grade of A or B cannot be repeated. Students must approve all courses in their program of studies with a minimum grade of C.

7.3.3 Maximum Number of Transfer Credits to be Allowed

Courses taken at UPRM in fulfillment of requirements of another graduate program may be used to fulfill the requirements of the doctoral program. Courses taken at other institutions of higher learning may be used to fulfill doctoral program requirements but are subject to residency requirements specified in "Norms that Regulate Graduate Studies at UPRM" which at the moment of writing this proposal require that 60% of the courses to be taken at UPRM. The departmental graduate committee will evaluate and determine in all cases the courses to credit or convalidate. All transfer courses must have been approved with a minimum grade of B. Under no condition may thesis credits be transferred.

7.3.4 Residency

Residency requirements will be those established by Norms that Regulate Graduate Studies at UPRM which at the time of this proposal read as follows:

"Residency requirements at the Doctoral level – a minimum of four semesters for students entering with a Bachelors degree, and a minimum of two semesters for students entering with a Masters degree. In both cases the student will complete at least sixty percent of the course work for the program at UPRM."

7.3.5 Seminar

The seminars are a method to integrate in a coherent manner various research areas linked to the program. Doctoral candidates will be required to register for the Doctoral Seminar in EE for the duration of their doctoral program and will be awarded one credit the semester their dissertation is turned in.

7.3.6 Qualifying Exam

A detailed description, purpose, format, and assesment of the doctoral qualifying examination for the electrical engineering Ph.D. program is given in the Appendix H.

All students will be required to take a Qualifying Exam. This exam will serve to evaluate a candidate's competency in areas related to Electrical Engineering. The exam will be prepared by the department Graduate Committee. This committee will determine the minimum competencies required to pass the exam. Students admitted to the program with a Masters degree should take the exam at the end of the first year of studies. Those admitted with a Bachelors degree should take the exam at the end of the second year of studies. Students must have passed the qualifying exam in order to register for the doctoral dissertation course. Doctoral students who fail this exam will be allowed to repeat the exam only once, and will be suspended after failing twice. Students who fail the qualifying exam twice may not be re-admitted or given a new admission to the program. Once the qualifying exam is passed, the student becomes a doctoral candidate.

7.3.7 Comprehensive Exam

After passing the Qualifying Exam, the student must prepare a research thesis proposal and submit it to his Graduate Committee for approval. After receiving approval, the student will request the Comprehensive Exam. This application must be done no later than the semester following the submission of the proposal.

The student will present his research proposal during this exam and can be evaluated on any topics related to his area of emphasis or research. The exam will be prepared and administered by the members of the student's graduate committee and one representative of the departmental graduate committee appointed by the ECE Graduate Committee Chair. They will decide whether the student passes or fails the exam and will submit a report to the department. Doctoral students may repeat the comprehensive exam only once in case of failure and will be suspended after failing for the second time. Students who fail the comprehensive exam twice may not be re-admitted or given new admission to the program.

7.3.8 Dissertation

All Ph.D. candidates must undertake an independent research project that is a significant contribution to the advancement of knowledge in the area of specialization. All doctoral candidates must pass the oral exam in defense of his dissertation. Students must have passed the qualifying exam in order to register for the doctoral dissertation course, and must have passed the comprehensive exam before defending the thesis. Doctoral students may repeat the dissertation oral exam only in case of failure and will be suspended after failing for the second time. Students who fail the dissertation oral exam twice may not be re-admitted or given new admission to the program.

7.3.9 Language Requirements

This program has no language requirements

7.3.10 Time Limit for Program Completion

The time limit to complete the degree will be determined by the "Norms that Regulate Graduate Studies at UPRM" which at the time of the publication of this proposal are as follows:

- Ten years if the student initiates the program with a Bachelor's degree, even if the student is a transfer from another graduate program or if the student had temporarily suspended studies.
- Eight years if the student initiates the program with a Master's degree, even if the student is a transfer from another graduate program or if the student had temporarily suspended studies.

8 Available Faculty

8.1 Program Faculty Credentials

The Department includes the necessary faculty members to initiate this program. Thirty eight eligible members of the ECE faculty have committed to participate in the proposed program. Faculty in the PhD program must have a consistent publication record of at least two publications (journal or conference) per year and graduated one graduate student during the last 5 years. Junior faculty (less than 5 years) will not be subject to this requirement during the first 5 years of their tenure track position. Table 8.1 summarizes the faculty's academic background and their possible course offerings. All faculty participating in the program is capable of teaching the Special Topics/Problems courses INEL 6995, INEL 8X95, INEL 8X96, and 8997 in topics associated with their research work and area of specialization as well as the Dissertation (INEL 8999) and Seminar (INEL 8998) courses. All program professors in Table 8.1 have either a tenure-track or tenured status. Individual biosketches of participating professors with information about their academic and industrial experience, publications, and research grants and contracts appear on Appendix C.

Table 8.1: EE Ph.D. Program Faculty.

Area	**Rank**	**Name**	**Degree - Year**	**Institution**	**Expected Academic load in credits**	**Courses to teach*** **(all courses are INEL)**
Energy Systems	Associate Professor	ERIC APONTE	D.Eng. 2005	Rensselaer Polytecnic Institute	6	5415, 6025, 6027, 6028, 8495, 8995, 8997, 8998, 8999
Energy Systems	Associate Professor	MARCEL J. CASTRO-SITIRICHE	Ph.D. 2007	Howard University	6	5408, 6059, 6066, 6085, 8496, 8595, 8995, 8997, 8998, 8999
Energy Systems	Associate Professor	EDUARDO I. ORTIZ-RIVERA	Ph.D. 2006	Michigan State University	6	5505, 6000, 6001, 6047, 6085, 6058, 8496, 8595, 8995, 8997, 8998, 8999
Energy Systems	Associate Professor	ANDRES DIAZ	Ph.D. 2000	Michigan State University	6	5408, 6085, 6058, 8496, 8995, 8997, 8998, 8999
Energy Systems	Professor	AGUSTIN A. IRIZARRY-RIVERA	Ph.D. 1996	Iowa State University	6	5406, 6025, 6027, 6028, 8495, 8995, 8997, 8998, 8999
Energy Systems	Professor	EFRAIN O'NEILL-CARRILLO	Ph.D. 1999	Arizona State University	6	6025, 6096, 8495, 8496, 8995, 8997, 8998, 8999
Signal and Systems	Assistant Professor	EMMANUEL ARZUAGA	Ph.D. 2010	Northeastern University	6	6007, 6047, 6076, 6078, 8395, 8595, 8995, 8997, 8998, 8999
Signal and Systems	Assistant Professor	LIZDABEL MORALES	Ph.D. 2009	Virginia Tech.	6	5315, 6078, 8395, 8995, 8997, 8998, 8999
Signal and Systems	Associate Professor	VIDYA MANIAN	Ph.D. 2004	University of Puerto Rico at Mayaguez	6	5046, 5327, 6007, 6088, 8395, 8995, 8997, 8998, 8999
Signal and Systems	Associate Professor	KEJIE LU	Ph.D. 2003	University of Texas - Dallas	6	5315, 8395, 8995, 8997, 8998, 8999
Signal and Systems	Professor	SHAWN D. HUNT	Ph.D. 1992	Michigan State U.	9	5309, 5326, 6000, 6049, 6076, 6078, 8395, 8995, 8997, 8998, 8999
Signal and Systems	Professor	HAMED PARSIANI	Ph.D. 1979	Texas A&M University	6	5307, 5327, 6078, 8395, 8396, 8995, 8997, 8998, 8999
Signal and Systems	Professor	LUIS JIMENEZ	Ph.D. 1996	Purdue University	6	6007, 6047, 6076, 6078, 8395, 8595, 8995, 8997, 8998, 8999

Area	Rank	Name	Degree - Year	Institution	Expected Academic load in credits	Courses to teach* (all courses are INEL)
		Miguel Velez-Reyes	Ph.D. 1992	MIT	6	5309, 5326, 6000, 6049, 6076, 6078, 8395, 8995, 8997, 8998, 8999
Electronics	Associate Professor	GUILLERMO J. SERRANO-RIVERA	2007	Georgia Institute of Technology	6	5265, 8295, 8995, 8997, 8998, 8999
		GLADYS O. DUCOUDRAY	Ph.D. 2003	New Mexico State U.	6	5207, 5265, 6075, 6079, 8395, 8995, 8997, 8998, 8999
		NAYDA G. SANTIAGO	Ph.D. 2003	Michigan State University	6	6009, 8295, 8395, 8995, 8997, 8998, 8999
	Professor	RAUL E. TORRES MUÑIZ	Ph.D. 1998	University of Virginia	6	5505, 5508, 5516, 6001, 6059, 6088, 8395, 8595, 8995, 8997, 8998, 8999
		MANUEL A. JIMENEZ-CEDEÑO	Ph.D 1999	Michigan State University	6	5206, 5265, 6048, 6055, 6075, 6079, 6080, 8295, 8995, 8997, 8998, 8999
		EDUARDO J. JUAN	Ph.D 2001	Purdue University	6	5506, 5205, 5505, 5508, 8295, 8595, 8995, 8997, 8998, 8999
		ISIDORO COUVERTIER	Ph.D. 1996	Louisiana State U.	12	6009, 8295, 8995, 8997, 8998, 8999
Applied Electromagnetics	Assistant Professor	LEYDA LEON	Ph.D. 2009	Colorado State University	6	5306, 5325, 6115, 6105, 8695, 8995, 8997, 8998, 8999
	Professor	RAFAEL A. RODRIGUEZ -SOLIS	Ph.D. 1997	Pennsylvania State University	6	5305, 5306, 5325, 6068, 6105, 8695, 8995, 8997, 8998, 8999
		JOSE G. COLOM-USTARIZ	Ph.D. 1998	Pennsylvania State University	6	5306, 5325, 6115, 6105, 8695, 8995, 8997, 8998, 8999
		SANDRA L. CRUZ-POL	Ph.D. 1998	Pennsylvania State University	6	5305, 5306, 6069, 6216, 8695, 8995, 8997, 8998, 8999

8.1.1 Publications

The available faculty for the proposed program is very active in their area of research as evidenced by the number of publications and the amount of external funding received by the Department in past years. All together, during the last 10 years, they have published 500 publications in journals, conference proceedings, and book chapters in their respective research areas. Appendix D presents a list of publications per track area.

8.1.2 Research

The Department of Electrical and Computer Engineering is one of the leaders in external funding at UPRM. During the last ten years, external funding secured by professors from the department averages over $3 million annually as shown in Figure 8.1.

8.1.3 Ph.D. Program Faculty Selection (minimum criteria)

All faculty participating in the PhD program must have a Ph.D. and an active reseach track record. Faculty in the PhD program must have a consistent publication record of at least two publications (journal or conference) per year and graduate one graduate student during the last 5 years. Junior faculty (less than 5 years) will not be subject to this requirement during the first 5 years of their tenure track position.

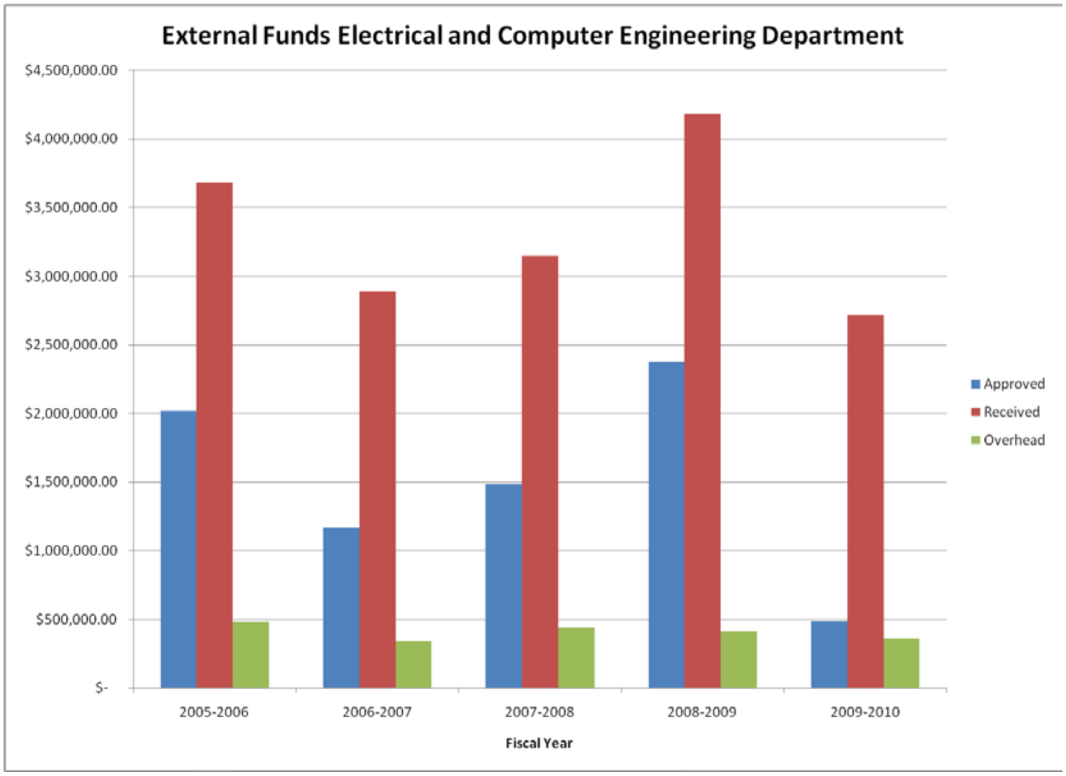

Figure 8.1 External funds received by the ECE Department from FY'06 to FY'10.

8.1.4 Honors and Distinctions

Besides research accomplishments, the caliber of the departmental faculty is evidenced by the high number of awards that have been conferred on them for their numerous contributions to education and research. Among the most outstanding awards are the following:

- **Presidential Early Career Award for Scientists and Engineers**: Each year federal agencies nominate 60 of the top researchers in the United States to the "Presidential Early Career Award for Scientists and Engineers (PECASE)". PECASE gives recognition to outstanding scientists and engineers who early in their careers demonstrate exceptional potential for leadership in the quest for knowledge. This is the highest Presidential Award conferred by the government of the United States of America to scientists and engineers who initiate their careers independently. Dr. Miguel Veléz Reyes was distinguished with a PECASE in 1997 by the White House Office of Science and Technology.

- **NSF CAREER Award Recipients**: The "Early Career Development Program" is a program supported by all NSF directorates, and is the most prestigious award the Foundation has for new faculty members. The "CAREER" program acknowledges and supports professional development activities of those teaching –professors who will probably become the academic leaders of the 21st century. Those awarded with the CAREERS distinction are selected on the basis of their creative professional development endeavors in effectively integrating research and education within the mission of the institution. These plans must build a solid foundation for lifelong integrated contributions in research and education. Six members of our department have been distinguished with "CAREER" awards. Four of them are presently available to participate in the proposed doctoral program.

- **NASA FAR Award Recipient:** The "NASA Faculty Award for Research" provides research funds to universities for basic and applied research in support of NASA's entrepreneurial strategies. FAR's goal is to assist in fulfillment of NASA's mission and at the same time improve cultural diversity among research communities sponsored through NASA. Dr. Sandra Cruz Pol was honored with a NASA FAR Award in 2002.

- **IEEE Walter Fee Outstanding Young Engineer Award**: This award was established in order to recognize engineers younger than 36 years old for outstanding contributions in leading local or international technical activities of the IEEE Power Engineering Society, including community and humanitarian activities and outstanding engineering accomplishments. Dr. Miguel Veléz Reyes received this award in 1998 and Dr. Efraín O'Neill in 2005.

It is important to point of distinctions received by members of the EE Ph.D. faculty from professional association such as Colegio de Ingenieros y Arquitectos de Puerto Rico, The American Society of Engineering Educators (ASEE), the Institute of Electrical and Electronics Engineers (IEEE) and the Society of Photo-Optical Instrumentation Engineers (SPIE) as well as the scientific and engineering communities.

Eight members of the PhD faculty are *Senior Member* of the Institute of Electrical and Electronics Engineers:

1. Dr. Sandra Cruz-Pol
2. Dr. Efrain O'Neill-Carrillo
3. Dr. Kejie Lu
4. Dr. Raúl Torres
5. Dr. Isidoro Couvertier
6. Dr Lionel Orama
7. Dr. Miguel Vélez Reyes
8. Dr. Eduardo Juan

This distinction is awarded to only 7% of the IEEE members. IEEE is the largest professional association in the world.

Dr. Miguel Vélez-Reyes was elected *Fellow of SPIE* in 2010 and inducted to the Puerto Rico Academy of Arts and Sciences in 2005; Received the UPR Distinguished Researcher in Science and Technology, UPR Office of the President, December 2000; 1999 Walter Fee Outstanding Young Engineer Award, IEEE Power Engineering Society; 1998 Distinguished Professor, Puerto Rico Professional Engineers and Land Surveyors Association Mayagüez Chapter; 1998-99 and 2009-10 Distinguished Professor, Department of Electrical and Computer Engineering, UPR Mayagüez..

Dr. Nayda Santiago was selected 2011 (Mujer de Vanguardia) Leading Women of Puerto Rico by the Professional Engineers and Land Surveyors Association (CIAPR), Aguadilla Chapter in May 2011; 2009 Distinguished Alumni Award of the University of Puerto Rico, Mayaguez Campus, Oct 24, 2009; 2008-2009 Distinguished Professor of Electrical and Computer Engineering, University of Puerto Rico, May 2009; 2008 HENAAC Educator Award, of the Hispanic Engineer National Achievement Awards Corporation., October 2008; 2008 Distinguished

Computer Engineer of the Puerto Rico Professional Engineers and Land Surveyors Association (CIAPR).

Dr. Sandra Cruz-Pol was elected Member of the National Academies Committee for Radio Frequencies.

Dr. Eduardo Juan was elected member of the external advisory board for the Weldon School of Biomedical Engineering at Purdue University.

Dr. Agustin Irizarry was a recipient of the “2010 Distinguished UPRM Alumni” from the University of Puerto Rico Mayagüez Alumni Association; 2005 Distinguished Electrical Engineer 2005) from the Electrical Engineering Institute of the Puerto Rico Professional Engineers Society; 2004 Professional Progress in Engineering Award (PPEA) from Iowa State University; 2003-04 Electrical and Computer Engineering Outstanding Faculty Award from the School of Engineering, Mayagüez, Puerto Rico.

Dr. Efrain O’Neill 2009 received the award Outstanding Electrical Engineering Project (PV Lab in Casa Pueblo, Adjuntas), in collaboration with Casa Pueblo, and Solartek (local PV firm) from PR Society of Professional Engineers and Land Surveyors (CIAPR); 2005 Walter Fee Outstanding Young Engineer Award, IEEE Power Engineering Society; Senior Member, IEEE, May 2005; 2004-2005 Outstanding Professor of Electrical and Computer Engineering Award, UPRM; Early Promotion to Full Professor for Exceptional Merit, UPRM, November 2004; 2003 Electrical Engineer of the Year, PR Society of Professional Engineers and Land Surveyors; 2001-2002 Outstanding Professor of Electrical and Computer Engineering Award, UPRM.

It is clear that the faculty available for the proposed doctoral program is highly qualified and brings a large diversity in research endeavors and interests. The proposed program will give the opportunity to the faculty in the program the opportunity to further develop their careers.

9 Program Administration

Departmental Graduate programs are administered by the Department Graduate Committee in coordination with the Associate Department Director for Research and Industry Relations. The Department created the position of ‘Oficial de Asuntos Estudiantiles II’ (Student Affairs Officer II) and Ms. Sandra Montalvo has been the academic advisor for graduate students in the MS programs and will do a similar work for Ph.D. students. Clerical support will be given by the departmental secretaries.

The following describes the tasks of each of the administrative components of the departmental graduate programs.

The Departmental Graduate Committee is responsible for the elaboration of academic regulations applicable to the departmental graduate program. In addition, in accordance with Certification 09-09 Norms for Graduate Studies at UPRM, it has the following responsibilities:

- Evaluate admission, readmission, and transfer applications and submit recommendations to the Faculty Dean for a final decision.
- Award credit-equivalencies for courses taken and approved at other universities.

- Award credit equivalencies for courses approved prior to admission.
- Determine the procedure for the elaboration, administration and evaluation of qualifying and comprehensive exams, as defined by departmental programs.
- Promote the Graduate Program.
- Periodic evaluations of the Graduate Program's progress and rate of success through activities such as, and including, the evaluation of program graduates.

Administrative oversight to all graduate programs in the department is offered by the Associate Director in charge of research and industry relations. In relation to the graduate programs, his responsibilities are:

- Coordinate graduate course offerings in collaboration with the departmental director or his representative and the area coordinators.
- Coordinate student registration in collaboration with the departmental director.
- Process student admission applications or transfer requests in coordination with the departmental graduate committee.
- Provide student orientation regarding academic, research and administrative affairs, as well as information regarding economic aid.
- Coordinate the development of an industry affiliates program and sustain an active partnership with industry, government, community and higher learning institutions which may contribute to fulfill the program's objectives.
- Supervise the program's development and render an annual progress report.
- Coordinate, along with the graduate committee, the periodic evaluation of the graduate program progress and success.
- Supervise the program development and generate an annual report.

The Associate Director will be designated by the Department Director in consultation with the Department's Graduate Committee.

The department has a Student Affairs Officer II, which has the following duties:

- Assist the director in calculating the demand and offerings, establishing capacity and schedules of graduate courses for regular and summer semesters.
- Coordinate preregistration and registration for graduate students. Register graduate students in collaboration with the Associate Director and work on adjustments to these as required. In coordination with the Associate Director, prepare and publish for use on university bulletin boards information and registration instructions. Serve the graduate students during registration and the adjustment periods.
- Work on orientation about the graduate program for graduate students and visitors, including program offerings, admission requirements and academic regulations.
- Counsel graduate students on their programs of study and academic regulations.
- Collaborate with the graduate committee on admission application evaluation and processing. Prepare the applicant profile and in area GPA. Maintain a digital database of applicants for report statistics. Communicate with admitted students to offer information about their admissions, assistantships and registration processes.
- Assist in the assignment of teaching assistantships and graders.

- Maintain a digital database of departmental graduate students for statistical reports and monitor their academic progress.
- Assist in the orientation of new graduate students.
- Assist the Associate Director and area coordinators in the preparing class schedules for newly admitted students and their registration.
- Prepare documents and statistical reports. Provide the projected assistantship budget to the Director. Provide information and statistical reports to the Director as required.
- Assist the Associate Director in preparing and publishing the projected five year graduate course offerings.
- Coordinate the preparation of promotional material and participate in activities which promote the programs as required by the Director.
- Collaborate with the Director and Graduate Committee in activities related to the departmental graduate programs.

10 Information Resources

10.1 Existing Information Resources

UPRM’s General Library holds 217,114 volumes, 6,704 serial periodicals, 1,576 CD-ROM, 2,476 thesis dissertations, and 488,527 microfiche, 17,683 microfilms, 86,218 microcards, 583,155 documents and 3,203 videocassettes. In addition, the library has access to 25, 000 periodicals and 46 databases through Internet subscriptions through Ebscohost, Proquest, H.W. Wilson, Web of Science, Science Direct, Gale, Engineering Information Village2, CRCNetENG, and the electronic library for IEEE/IEE (IEEExplorer). Detailed information regarding Internet services at UPRM may be obtained at http://www.library.uprm.edu/.

The IEEExplorer provides Internet access to the entire collection of publication (magazines, conference proceedings, and standards) of the Institute for Electrical and Electronic Engineers (IEEE) and the Institution of Electrical Engineers (IEE). This is one of the most complete collections of electrical and computer engineering literature. The EBSCo system provides access to 3,200 academic periodicals ranging from social sciences, humanities, language, linguistic, arts, literature, medical sciences and ethnic studies.

In addition to these resources, the library participates in an interlibrary loan program which allows access to books and other publications unavailable at UPRM.

10.2 Access of Other Information Resources

UPRM General Library has access to an interlibrary loan program in order to secure access to books and articles unavailable at UPRM. Additionally, the Internet provides students with access to a host of publications and scientific information. UPRM computer system facilitates student access to these Internet resources.

11 Physical Installation and Equipment

11.1 Inventory of Available Facilities

The department has approximately 58,600 square feet of classroom, office and laboratory space, which are distributed between the Stefani Building and the UPRM Research and Development

Center. The space devoted to research and teaching laboratories that will provide direct support to the doctoral program consists of approximately 8,639 square feet. Research laboratories which includes instrumentation and computer equipment that serve to support the type of research which typically characterizes a doctoral program in Electrical Engineering. This infrastructure has been achieved through a series of proposals submitted to NSF, NASA, the Department of Defense, and industry such as Texas Instruments, Lockheed Martin, Intel, IBM, Raytheon, Kodak, and Hewlett Packard. During the past ten years, over $5M dollars has been employed to improve the Department of Electrical and Computer Engineering's research infrastructure.

The facilities at the Electrical and Computer Engineering Department include five laboratories that support undergraduate and graduate courses. A list of these laboratories is included in Table 11.1.

Table 11.1: Academic Laboratories (http://ece.uprm.edu/labs/index.php).

	Track	**Laboratory**
1	Energy Systems	Electric Energy Processing Systems Laboratory (S-103A & S-103B)
2	Signals and Systems	Communication and Signal Processing Laboratory (S-222) Control System Laboratory (S-216) Robotics and Automation Laboratory (S-102)
3	Applied Electromagnetic	Applied Electromagnetics Laboratory (S-202)
4	Electronics	Integrated Circuit Design Laboratory (S-210B) http://ece.uprm.edu/icdl/Page/

The department houses a total of seventeen laboratories mainly devoted to research that will provide key support to the proposed doctoral program in Electrical Engineering. A list of the facilities classified by track areas is shown in Table 11.2.

Table 11.2: Research Laboratories

Track	**#**	**Laboratory**	**Room**	**Administrator**
Energy Systems	*1*	Power Quality Laboratory	CID-218 & 220	Dr. Efrain O'Neill
	2	Power Electronics Laboratory	S-101	Dr. Eduardo Ortiz
	3	Electric Energy Processing Systems Laboratory	CID-212	Dr. Andres Diaz
Signals and Systems	*4*	Laboratory for Applied Remote Sensing and Image Processing (LARSIP). http://larsip.uprm.edu	CID-F-219, 221, 224, 220	Dr. Luis Jimenez Dr. Emmanuel Arzuaga
	5	Advanced Information Processing (AIP) Laboratory http://www.aip.ece.uprm.edu/AipLab/Welcome.html	CID-R-	Dr. Domingo Rodriguez
Applied Electro-magnetics	*6*	Cloud Microwave Measurements of Atmospheric Events http://ece.uprm.edu/climmate/	S-201	Dra. Sandra Cruz-Pol
	7	Radiation Laboratory http://www.ece.uprm.edu/~radlab	S-120	Dr. Rafael Rodriguez

Track	#	Laboratory	Room	Administrator
Electronics	9	Rapid Prototyping Laboratory (RASP)	S-208	Dr. Manuel Jimenez
	11	Electronic Testing and Characterization Laboratory	S-114B	Dr. Manuel Jiménez
	12	Integrated Circuit Design Laboratory http://ece.uprm.edu/icdl/Page/	S-210B	Dr. Manuel Jimenez
	13	Biomedical Instrumentation Laboratory http://birlab.ece.uprm.edu/	S-214	Dr. Eduardo Juan
	14	Micro and Nano Devices Research Laboratory	CID-H-123	Dr. Gladys Ducodray

A more detailed explanation of the equipment available in each of these laboratory facilities may be found at the links provided in the table and at http://ece.uprm.edu/labs/index.php.

11.2 Program's Impact on Existing Physical Installations

The existing laboratory infrastructure is adequate to provide the necessary resources to support the program. It is our expectation that the doctoral program will serve as a catalyst for obtaining additional external resources that will contribute to the improvement and development of research laboratories.

11.3 Demand for and Availability of Computer Facilities for the New Program

The ECE Department is host to excellent computer facilities. The department net consists of over 500 computers connected to the Web and distributed throughout diverse teaching and research laboratories previously described.

11.4 Copies of Applicable Licenses Required for the Utilization of Physical Installations

All licenses for the use of facilities at UPRM are available from the UPRM Dean of Administration.

12 Student Services

12.1 Student Support and Service System

UPRM provide a wide range of services including health services, guidance and counseling, housing, financial aid, student ombudsperson, placement office, cafeteria, immigration, and state of the art general computing facilities. The UPRM Office of Graduate Studies manages the application and admissions processes.

The ECE department has a Student Affairs Officer II available from 7:45 am to 4:30 pm, which has the following student support duties:

- Coordinate preregistration and registration for graduate students. Register graduate students in collaboration with the Associate Director and work on adjustments to these as required. In coordination with the Associate Director, prepare and publish for use on university bulletin boards information and registration instructions. Serve the graduate students during registration and the adjustment periods.

- Work on orientation about the graduate program for graduate students and visitors, including program offerings, admission requirements and academic regulations.
- Counsel graduate students on their programs of study and academic regulations.
- Collaborate with the graduate committee on admission application evaluation and processing. Prepare the applicant profile and in area GPA. Maintain a digital database of applicants for report statistics. Communicate with admitted students to offer information about their admissions, assistantships and registration processes.
- Assist in the assignment of teaching and grader assistantships.
- Maintain a digital database of departmental graduate students for statistical reports and monitor their academic progress.
- Assist in the orientation of new graduate students.
- Assist the Associate Director and area coordinators in the preparing class schedules for newly admitted students and their registration.

In addition to the formal support structure, there is an ECE Graduate Student Association which provides peer support and help new students in their transition into the graduate program particularly to international students.

As described in Section 6.6, we will send out questionnaires to our students and alumni for student follow up about their experiences in the program and about their professional status. This information will be used to develop strategies to improve our program retention and follow their program while working towards their degree and their professional success.

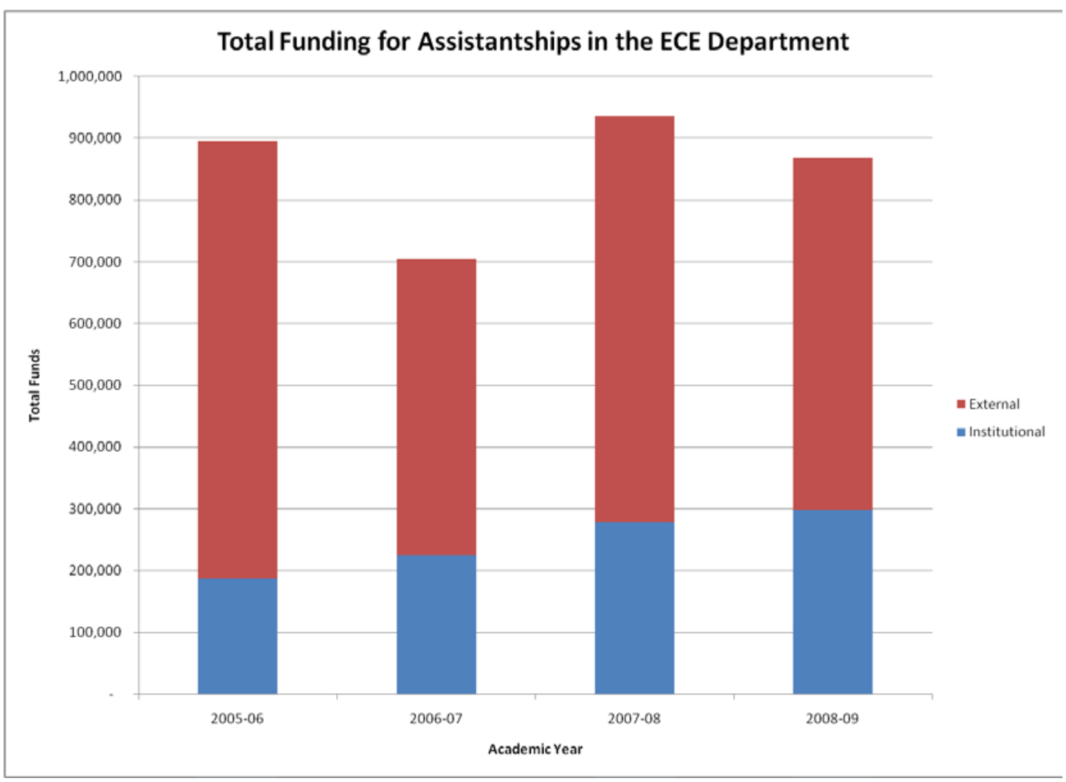

Figure 12.1: Funding for assistantships in the ECE Department (2009-10 and 2010-11 were not available).

12.2 Financial Aid

As shown in Figure 12.1, the ECE department has a strong track record in funding of its graduate students with over $800k/year in assistantships. Over $200k/year are in institutional funds which are primarily used for Teaching Assistantships and over $600k/yr in external funds primarily for research assistantships.

The establishment of the new program will serve as the means to increase research efforts. These new research efforts will serve to augment external funding providing a higher number of assistantships for graduate students.

13 Catalogue and Promotion

The program's description will be included within the Department of Electrical and Computer Engineering section in UPRM's graduate catalogue. The particular textual description appears below.

Doctoral Program in Electrical Engineering

The department offers the degree of Doctor of Philosophy in Electrical Engineering. General requirements for the PHD are described in the REGULATIONS THAT RULE GRADUATE PROGRAMS AT UPRM and in this catalogue. The specific requirements for the doctoral program in Electric Engineering are described below.

Students in the doctoral program in Electric Engineering are required to develop a program of graduate studies and research in one of the following tracks: Power Systems, Electronics, Power Electronics, Signal Processing, Control Systems, and Applied Electromagnetics. The curriculum will consist of at least 37 credits in courses to be distributed as follows:

- 24 credits in graduate or advanced undergraduate courses within the area of specialization
- 6 credits in mathematics courses at the graduate or advanced undergraduate level. At least one course must be at the graduate level.
- 6 credits in elective courses outside the area of specialization.
- 1 credit in the doctoral seminar.
- 12 credits in doctoral dissertation

A maximum of 9 credits in advanced undergraduate courses (5000 level) may be utilized to complete course requirements for the doctoral degree. At least 6 credit at the advanced graduate level (8000 or above) must be taken in the area of specialization. In addition to the courses, a student must take a qualifying exam, a comprehensive exam to determine his potential for original and advanced electrical engineering research. The student must complete independent research that is a significant advancement of knowledge in the field of electrical engineering, prepare a dissertation, and pass an oral defense of the doctoral dissertation.

After the program is approved, an informative program brochure will be prepared, as well as other printed material. A program web page will be created to serve as an orientation and promotion tool. In addition, program representatives will participate in conferences such as those sponsored by SHPE and SACNAS, and in graduate school promotional fair in the United States and in Puerto Rico.

14 Budget Plan

The department can implement the program with existing resources. No additional resources are requested to establish the program.

The department has the administrative and physical infrastructures to support the program. We have a Student Affairs Officer II to support graduate programs in our department. The officer has office space to perform her duties. Office area has been set in the R&D Center Rooms F-217 and F-219, in the Stefani Building room S-114 for graduate students, and in several of the research laboratories. We have obtained over $5M in external funds for research laboratory development in the past 10 years. Laboratory facilities are adequate to support research at the doctoral level.

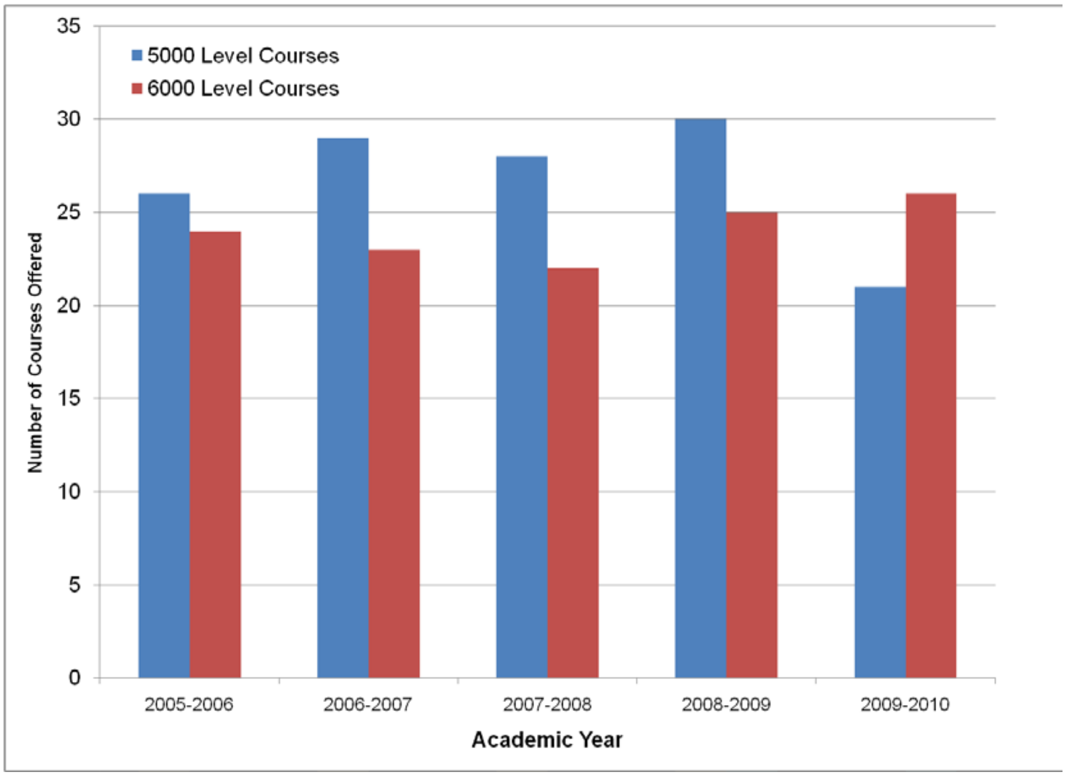

Figure 14.1: Graduate (6000 level) and advanced undergraduate (5000 level) course offering for the last five years.

For course offering, the program takes advantage of the existing graduate programs in Electrical and Computer Engineering. Figure 14.1 shows the graduate and advanced undergraduate course offering for the past five academic years. Most of the existing graduate and advanced undergraduate level courses will be part of the course work for the Ph.D. students. We offer over 20 graduate courses (6000 level and above) and over 25 courses at the advanced undergraduate level

(5000 level) per year. To take care of the additional courses for the Ph.D. program, the advance level graduate courses (8000 or above), will be offered by changing from yearly to every other year the frequency of some graduate elective courses currently being offered. This will have minimal impact on MS students who can opt to take the 8000 level courses as part of their graduate program. Accounting for faculty load due to students in thesis and independent studies will follow rules and regulations established at UPRM under Certification 08-09-309 of the UPRM Administrative Board. Thesis credits of students in projects where the faculty receives release time are not counted as part of the academic load. We expect most of our Ph.D. students to fall under this category.

Figure 8.1 and 12.1 show the success of the ECE Department in obtaining external funds to support research and to provide funding for assistantships and for laboratory improvement. The department administration has agreed to use part of the overhead recovery funds received by the department to support the advisory board visit in years 2 and 4.

15 Evaluation and Assessment Plan

The Department of Electrical and Computer Engineering will establish a permanent committee to be named Committee for the Evaluation of Graduate Programs (CEGP), which will be in charge of the evaluation of graduate programs in the department, including the proposed Doctoral Program in Electrical Engineering. This committee will be composed of three members of the Graduate Committee, the departmental Associate Director for Research and Industry Relations, and the Student Affairs Officer II. The evaluation process to be utilized in the program will be based on the best assessment practices as defined by the Accreditation Board of Engineering and Technology (www.abet.org) and the Middle States Association Council for Higher Education (www.msache.org).

In terms of the proposed doctoral program in electrical engineering, the CEPG will establish a periodic evaluation plan for the program. This plan will implement qualitative and quantitative strategies to determine the department's work, efforts made in reaching goals and specific objectives related to the program's mission and vision and in forming professional engineers with characteristics defined in the graduate profile, as shown in Section 5. This information will be analyzed in order to refocus the strategies and thus improve departmental outcomes in the areas of teaching, physical infrastructure, planning, budgeting, etc.

The CEPG will utilize internal and external methods to realize periodic evaluations of the proposed Doctoral Program in Electrical Engineering. The following is a preliminary list of the methods to be utilized by CEPG:

- <u>Internal Methods:</u> (a) to evaluate student academic performance by utilizing academic transcripts; (b) to evaluate the availability of student assistantships and scholarships for student support and strengthening recruitment, (c) to evaluate job success rates and incomes obtained by program graduates, (d) to evaluate the quality and prestige of those companies registered at UPRM Placement Office which have expressed interest in hiring doctoral program graduates; (e) to evaluate the quality and prestige of those companies which hire doctoral program graduates; (f) to evaluate the results of a poll to determine the satisfaction and accomplishment levels among students who apply for the program's qualifying exams; (g) to evaluate student performance in the qualifying exam, the comprehensive exam and in the thesis dissertation defense; (h) to evaluate student academic portfolios (such as those including: qualifying exam, publications, and presentations) throughout various stages of doctoral studies.

- External methods: (a) to evaluate results of a survey that will determine student levels of satisfaction and development after completing program requirements; (b) to evaluate the results of a survey that will determine student degree of satisfaction and development three years after graduation (graduate survey).

In order to initiate the first evaluation cycle of the proposed doctoral program, the CEPG will establish mechanisms (internal and external methods, as previously defined) to be used to measure the program's success rate in fulfilling its vision and mission, in reaching its goals, specific objectives and in the formation of a professional engineer with the qualities defined in the graduate profile.

Results, success measurement criteria and measurement mechanisms (logically stemming from criteria) relative to the program's specific objectives were specified in Section 5.3. Once the CEPG is constituted, it will proceed to define results, criteria and mechanisms for mission, vision and goal measurement and the graduating student profile. As an example, the following is a list to be used by the CEPG as a starting point for the definition of outcomes and measurement mechanisms associated with determining if the program meets its vision of "Being a program of excellence in research and in the training of doctors in electrical engineering"

- Result #1: Students must be able to perform high quality doctoral level research. Assessment method and success criteria: A minimum of 90% of the graduating students must have published at least one peer-reviewed article based on their doctoral work within two years of receiving their degree.

- Result #2: Graduates gain employment within one year after receiving their degree. Assessment method and success criteria: A minimum of 80% of the graduates have employment or employment offers in areas related to their grade within one year after receiving their degree.

- Result #3: Graduates are satisfied with the academic program and their research experience in the Doctoral Program in Electrical Engineering. Assessment method and success criteria: A minimum of 80% of the graduates polled during the first three years after obtaining their degree indicate they are satisfied with the academic program and recommend it to other students. Comments about the strengths and deficiencies of the program will be requested and analyzed.

- Result #4: Increase research funding in the Electrical and Computer Engineering Department. Assessment method and success criteria: Increase external funding by 50% after five years of establishing the program.

- Result #5: Increase the number of peer reviewed publications in the Department. Assessment method and success criteria: The participating faculty will average two peer-reviewed publications per year.

In addition, during the first five years of the program, there will be an external advisory board (EAB) of four persons, composed of scientists and engineers from academia, industry and government who will assess the program based on visits every two years and statistical reports. The committee will produce a report and submit it to the Department. The graduate committee, along with the Associate Director, will have 90 days to respond to the report and establish a plan to solve any weakness o threats found by the committee. We are planning to have visits of the EAB in years 2 and 4.

16 Development Plan

Many of the elements of the development plan for the proposed program have been discussed in the previous sections. The program implementation is built as a natural evolution of the existing graduate programs in Electrical Engineering and takes advantage of the existing academic, research, and administrative infrastructure already in place to support all graduate programs at the ECE Department. By following this approach, we minimize the risk in implementing and achieving the goal of establishing a doctoral program in Electrical Engineering which can contribute significantly to the technological, scientific and economic development of Puerto Rico and the hemisphere. The structure in place can support the program and is ready to provide the administrative support to meet the evaluation, assessment, and reporting requirements.

Here, we discuss some additional elements not described in previous sections.

16.1 Budget Plan

The budget plan is described in Section 14.

16.2 New courses to create

New courses to be created as part of the program are described in Section 6.2.2.

16.3 Research Funding

Research activities already described in Section 8.1.2.

At present, the exact amount of external funds available for the proposed program cannot be determined. Nevertheless, based on previous experience, it is expected that external funding for the program will be significant. The Department of Electrical Engineering and Computers has brought in an annual average of over $3,000,000 during recent years for research and development projects.

16.4 Faculty Development Plan

16.4.1 Faculty Recruitment Projections for the Next Five Years

Of those professors listed as available in Table 8.1, none will retire in the next five years. Professors who will retire in the next five years have opted not to participate in the program. It is expected that the new professors hired for their replacement will participate in the doctoral program.

16.4.2 Faculty Training Plan

The program's faculty does not require special training. Nevertheless, it is expected that professors will keep up to date in their particular fields of expertise through research and in teaching by participating in training workshops and effective teaching strategies offered at UPRM.

16.5 Plan for the Improvement of Existing Library Resources

Existing Library resources are adequate to support the proposed program. The ECE Library Committee representative will request input from the ECE Faculty for revision and improvement of library resources for book acquisition, serial publication acquisition, audiovisual resources acquisition, and increased electronic access to documentation and databases.

16.5.1 Acquisition of Bibliographical and Audio Visual Resources

Yearly funds are allocated to the ECE Department for acquisition of bibliographical and audiovisual resources. Faculty from the ECE department makes recommendations using the existing on-line system during the fall term. The ECE representative to the library committee will inform the faculty when the period for receiving recommendations begin and will promote submissions by the faculty.

16.5.2 Acquisition of Serial Publications

At the time of writing this proposal, the electronic subscriptions to Ebscohost, Web of Science, Science Direct, Engineering Information Village2, CRCNetENG, and the electronic library for IEEE/IEE (IEEExplorer) provide appropriate access to most technical serial publications (journals and conference proceedings) in electrical and computer engineering and related areas that are needed to support research in the proposed doctoral program.

The departmental representative to the Faculty of Engineering Library Committee will periodically consult the departmental faculty regarding the need to review existing serial subscriptions and publications. Recommendations will be forwarded to the library.

16.5.3 Electronic Database Access

UPRM General Library has developed an infrastructure for electronic documentation and databases access through the local electronic campus web (http://library.uprm.edu). Periodic evaluations of this infrastructure will guarantee appropriate support to the doctoral program. These evaluations will be coordinated through the Departmental Representative at the Faculty Library Committee.

16.6 Proposed Program's Demand

It is estimated that at least five students will be admitted to the program per year during the initial five years. A conservative estimate of program demand can be based on the number of students who graduate de Master program in EE. As shown in Figure 16.1, in the last 5 years, between 15-20 students graduated from the EE Master program. Our experience is that nearly half of these students would have pursued a PhD in EE at UPRM if the program was available. Our Master program in EE is among the programs with the highest number of applicants at UPRM. Figure 16.2 shows the number of applicants, admitted and those who finally registered in the program. Our program in EE receives a large number of applications from Latin American countries in particular Colombia, Dominican Republic, and Peru.

In Puerto Rico, in addition to UPRM students, students from the undergraduate and graduate programs from Universidad Politécnica, Universidad Interamericana en Bayamón, and Universidad del Turabo would be potential candidates for the proposed program. The program will be promoted in Puerto Rico, in the United States, and in Latin America in order to attract qualified candidates via Internet and by promotion at target conferences such as SHPE and SACNAS annual meetings.

16.6.1 Employment Opportunities for Program Graduates

We see great employment options for our graduates in Puerto Rico, the U.S., and the world (in particular Latin America).

According to existing statistics provided by the National Science Foundation, the job market for engineers with doctoral degrees in science and engineering for the past five years is a very healthy one with less than 1.5% unemployment rate. Of those electrical engineering PhD's polled by NSF, approximately 70% had industry-related jobs, 21% were employed by academia and 6% by government agencies. As part of our doctoral seminar we will give seminars about diverse career options to our students and bring Ph.D. from industry and academia to talk about their careers. Furthermore, we will give seminars in how to apply to academic and industrial positions.

In Puerto Rico, with the creation of new industries dedicated to research and development, following the plans of the Government of Puerto Rico for economic transformation, the job marked for engineers with Doctoral degrees in Puerto Rico is expected to be similar to the statistics quoted above. In addition, program graduates have the opportunity to join the electrical and computer engineering faculties of the Polytechnic, Turabo, and Interamerican Universities.

16.7 Evaluation and Assessment Plan

The program evaluation and assessment plan is described in Section 15. Section 6.6 describes the plan to assess student learning.

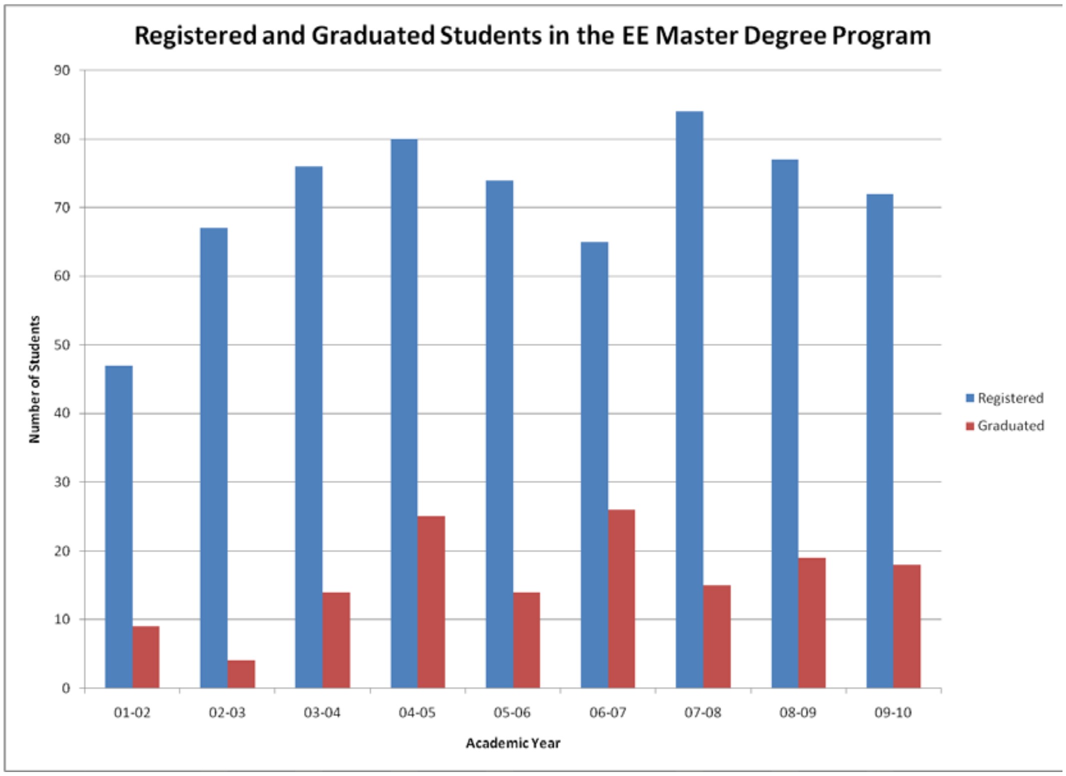

Figure 16.1: Total of registered and graduated students from the EE Master program.

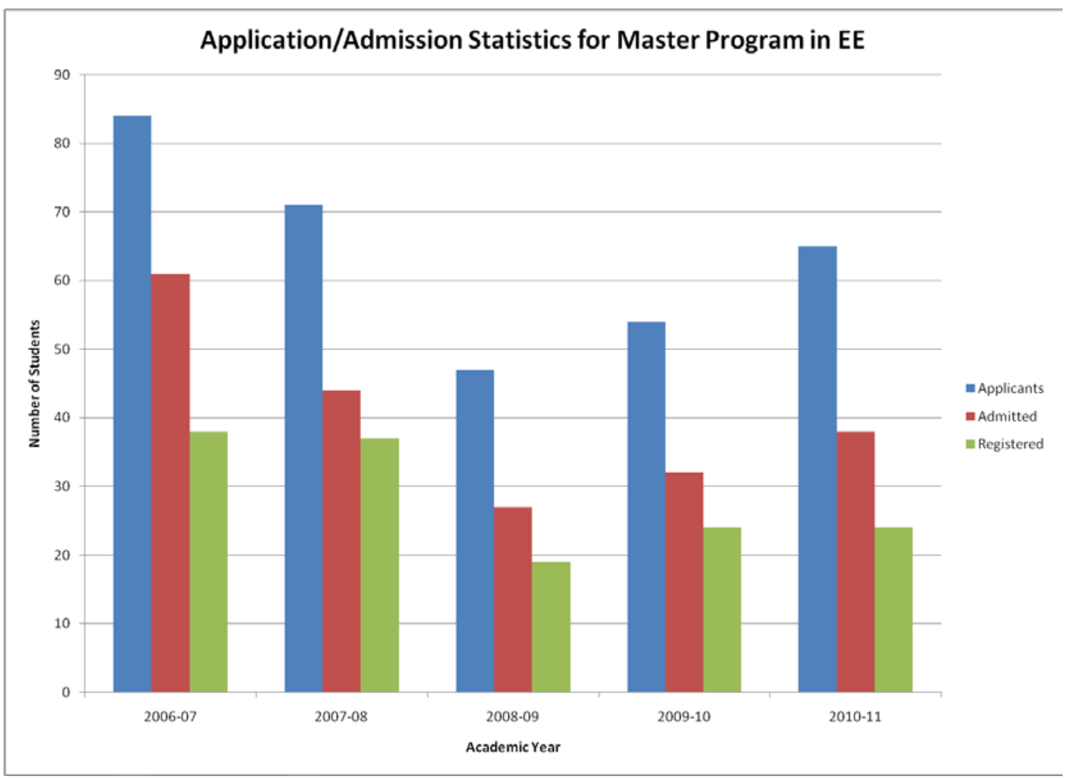

Figure 16.2: Applications and Admissions to the EE Masters Degree Program.

17 References

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National Science Foundation, *Science and Engineering Indicators* http://www.nsf.gov/statistics/seind08/

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Appendix A:
Description of Electrical Engineering
PhD Program Tracks

Doctoral Program in Electrical Engineering: Signals and Systems Track (SST)
Department of Electrical and Computer Engineering
University of Puerto Rico at Mayagüez

Track Summary

This track research concerns itself with a broad spectrum of problems of communication, systems theory and control, and signal processing, as well as the shared methodological underpinnings of—and increasingly the interactions between—these different fields. Research topics range from fundamental principles to application, from analysis to synthesis, and from theory to experiment and simulation. Thesis research can involve different combinations of the above, depending on the student's interests and the nature of the problem.

Academic Background

Most of the SST graduate subjects have a strong mathematical bent and require not just an exposure to, but fluency with, undergraduate background in linear systems, probability, and linear algebra. Students should assure themselves that they have such fluency as a solid foundation for their graduate work.

Course Requirements for the Signals and Systems Track

	Master of Science Plan I		Master of Engineering Plan II		Master of Engineering Plan III		Doctoral Program (proposed)	
Core courses	2-3 courses	6-9 crs	2-3 courses	6-9 crs	2-3 courses	6-9 crs	2-3 courses	6-9 crs
Major courses	3-4 courses	9-12 crs	3-5 courses	9-15 crs	6-8 courses	12-24 crs	5-6 courses	15-18 crs
Elective courses	2-3 courses	6-9 crs	2-3 courses	6-9 crs	2-3 courses	6-9 crs	2 courses	6 crs
Thesis		6 crs						12 crs
Doctoral Seminar								1 cr
Advanced Mathematics							2 courses	6 crs
Project				3-6 crs				
Total		30 crs		30 crs		36 crs		49 crs

The course requirement distribution for each plan of studies for the MS, ME, and PhD (proposed) degrees are shown in the table above. There are 6-9 credits of core courses. Students in MS Plan I or II need to work on thesis or or project. Students in the doctoral program need to complete a doctoral dissertation, and pass the comprehensive and qualifying exams.

Students in MS Plan III will need to take a comprehensive exam after finishing the course requirement. Students in Plan III can register in INTD 6015 Preparation for the Comprehensive exam if they finished the course requirement for the ME program and have not approved the comprehensive exam to maintain active student status.

Track core and elective course requirements for the doctoral program are similar to those of the master degree program. In addition, doctoral students will need to take at least 6 credits in advanced graduate courses (8000 or higher) in the signals and systems track. The doctoral program also requires 6 credits in graduate or advanced undergraduate level mathematics courses (see list below). At least one of which must be at the graduate level. One credit doctoral seminar and need to complete a doctoral dissertation, and pass the comprehensive and qualifying exams.

Any course not listed in the core or major courses can count as a course outside the specialization track even if they are from INEL or ICOM. The list of core courses, major courses and are shown next.

Core Courses:

Signal Processing	**Control Systems**	**Communications**
INEL 5309 Digital Signal Processing ** INEL 6076 Adaptive and Optimal Signal Processing INEL 6078 Estimation, Detection and Stochastic Processes	INEL 5505 Linear Systems Analysis** INEL 6001 Feedback Control Systems I	INEL 5315 Theory of Communications II** INEL 6078 Estimation, Detection and Stochastic Processes

** Can be accredited to the graduate program if taken as part of the BS requirements at UPRM

Major Courses:

INEL 6000 Introduction to Nonlinear Control Systems
INEL 6007 Introduction to Remote Sensing
INEL 6047 Advanced Control System Theory
INEL 6049 Multidimensional Signal Processing
INEL 6050 Advanced Digital Signal Processing Algorithms
INEL 6059 Intelligent Control Systems
INEL 6078 Estimation, Detection and Stochastic Processes
INEL 6088 Computer Vision
INEL 6995 Special Topics (with emphasis in Signals and Systems)
INEL 8395 Advanced Topics in Signal Processing
INEL 8397 Advanced Topics in Communication Systems
INEL 8595: Advanced Topics in Control Systems
INEL 8997 Independent Study (with emphasis in Signals and Systems)

INEL 5046 Pattern Recognition
INEL 5307 Optical Communications
INEL 5318 Routing, Switching and Wide Area Networks
INEL 5355 Introduction to Subsurface Sensing and Imaging
INEL 5327 Image Processing
INEL 5505 Linear Systems Theory

INEL 5506 Process Instrumentation and Control Engineering
INEL 5508 Digital Control Systems
INEL 5516 Automation and Robotics
INEL 5616 Wireless Communication

Recommended Math Elective Courses:

MATE 5150 Linear Algebra
MATE 6025 Numerical Linear Algebra
MATE 6026 Numerical Optimization
MATE 6045 Optimization Theory
MATE 6677 Elementary Partial Differential Equations
MATE 6675 Mathematics of Modern Sciences I
MATE 6676 Mathematics of Modern Sciences II
ESMA 6600 Probability Theory
ESMA 6661 Theory of Statistics I
ESMA 6662 Theory of Statistics II
ESMA 6788 Advanced Probability Theory
ESMA 6789 Stochastic Processes
ININ 6005. EXPERIMENTAL STATISTICS
ININ 6010. MULTIPLE REGRESSION ANALYSIS
ININ 6020. QUEUEING THEORY AND APPLICATIONS
ININ 6025. LINEAR AND DISCRETE OPTIMIZATION
ININ 6036. INTRODUCTION TO TIME SERIES ANALYSIS
CIIC 6005. COMPUTING FOUNDATIONS

and other courses selected by the student graduate committee.

Research

The Signals and Systems faculty is very active in research and has received more than $7 million in research grants since 2000 and is participating in the NSF Engineering Research Center for Subsurface Sensing and Imaging Systems (CenSSIS) and Awareness and Location of Explosives Related Threats DHS Center of Excellence. Current research projects include Remote Sensing using Hyperspectral Imaging; Atmospheric remote sensing using LIDAR; Computational Signal Processing; Architecture and Protocol Design, Performance Evaluation, Network Security; Wireless Communications: Space-time Coding, Channel Capacity; Applying artificial intelligence and machine learning to telecommunication systems, cognitive radio and cognitive networks.

Research is conducted mainly at the Laboratory for Remote Sensing and Image Processing (LARSIP) and the Advanced Information Processing (AIP) Laboratory. In addition, the signals and systems faculty has strong research ties with Northeastern University, University of Houston, and NASA Glenn Research Center among others.

Doctoral Program in Electrical Engineering: Applied Electromagnetics Track
Department of Electrical and Computer Engineering
University of Puerto Rico at Mayagüez

Introduction

This document defines the Applied Electromagnetics Track in the Electrical Engineering Graduate Program at UPRM. The purpose of the document is to provide a description of the option and its associated research and to guide the graduate students in the preparation of their programs of study.

Description of the Area and Research Facilities

The Applied Electromagnetics area deals with the generation, transmission, propagation, scattering and reception of electromagnetic waves, and their applications to telecommunications and remote sensing. Faculty interests in telecommunications applications include r.f., microwave and millimeter-wave systems and circuits, antenna theory and design, and electromagnetic wave propagation and scattering. In terms of remote sensing applications, faculty interests include the design and use of passive and active sensors to gather information on the physical properties of natural and man-made media, as well as the interaction of the electromagnetic waves with such objects. Research areas under the Applied Electromagnetics option include microwave circuits and systems, microwave and millimeter- wave antennas and arrays, microwave remote sensing and radiowave propagation.

There are two main laboratories that serve the Applied Electromagnetics area, the Radiation Laboratory and the Cloud Microwave Measurements of Atmospheric Events (CLiMMATE) Laboratory. In addition, the Applied Electromagnetics Laboratory is used for instructional purposes.

The Radiation Laboratory is a research laboratory developed under several NSF and NASA research projects. This state of the art laboratory houses microwave instrumentation for network testing from 45 MHz to 50 GHz, a near-field antenna measurement facility with a frequency range of 2 to 40 GHz, a milling machine for the fabrication of prototypes at microwave frequencies and several computer workstations for the simulation and modeling of microwave and millimeter-wave circuits and antennas. The CLiMMATE Laboratory has several computer workstations for the analysis of atmospheric phenomena and the development of models for atmospheric absorption of electromagnetic energy. The Applied Electromagnetics Laboratory is primarily an instructional facility, with microwave instrumentation up to 3 GHz. This laboratory is used for demonstrations and laboratory practices for undergraduate and graduate courses.

Academic Background

Students entering the program must have the following background:

1. Integral, differential and vector calculus, including differential equations
2. Plane-wave propagation in lossless and lossy media
3. Plane-wave reflection and transmission at normal and oblique incidence

4. Two-port networks
5. Transmission lines
6. Smith Chart
7. Basic radiation concepts and antenna theory
8. Fourier Transforms
9. Basic Electronics

Students requesting admission without this background will be required to take INEL 4152 (Engineering Electromagnetics II), INEL 4095 (Signals and Systems) or INEL 4301 (Communications Theory), INEL 4201 (Electronics I) and the necessary math courses to make up for their deficiencies.

Core Courses and Area Courses:

Core Course

INEL 6601, Advanced Electromagnetics, is the core course in the Applied Electromagnetics option. All students in the option must approve this course.

Area Courses

The Applied Electromagnetics Area Courses include the courses listed below. These can be used to satisfy the option requirements (M.S.; M.E. Plan II; M.E. Plan III; Ph.D.)

INEL 5629: Telecommunication Electronics
INEL 5605: Antenna Theory and Design
INEL 5606: Microwave Engineering
INEL 5616: Radiowave Propagation in Wireless Communications
INEL 6668: Microwave Antenna Engineering
INEL 6669: Microwave Remote Sensing
INEL 6605: Active Remote Sensing Techniques
INEL 6606: Introduction to Radar Systems
INEL 6615: Active Microwave Circuits
INEL 8695: Advanced Topics in Applied Electromagnetics

Recommended Courses

The following courses are not required but can help students to get a better background in areas related to the remote sensing aspects of applied electromagnetics. This is not a comprehensive list; students must consult their graduate committee to add these or any courses to their programs of study. In addition, these courses can be used to satisfy the option requirements for students in M.E. Plan III.

INEL 6007: Introduction to Remote Sensing
INEL 6078: Estimation, Detection and Stochastic Processes

Guidelines for Programs of Study

Students following the Applied Electromagnetics option must approve INEL 6601, Advanced

Electromagnetics; this is the core course for the option. Master students in Electrical Engineering must approve 30 credits for Plan I (M.S., Thesis) and Plan II (M.E., Project), and 36 credits for Plan III (courses only). Students seeking a Master of Science (M.S.) degree must approve 6 credits of Master Thesis (INEL 6046) and pass an oral examination on their thesis; students seeking a Master of Engineering (M.E.) degree (Plan II) must approve 3-6 credits of Engineering Project (INEL 6045) and pass an oral examination on their project.

Ph.D. students in Electrical Engineering must approve 43 credits beyond their B.S. work. They must approve six (6) credits in Advanced Topics in Applied Electromagnetics (INEL 8695), six (6) credits in graduate (5000 and above) math courses, and 12 credits in Doctoral Dissertation (INEL 8999). In addition, students must register for INEL 8998, Doctoral Seminar, every semester, pass the Qualifying Exam and the Comprehensive Exam, and successfully defend their dissertation.

Students are allowed to take up to nine (9) credits in 5000 level courses. Any course not listed as core or area course can count as an elective course outside the option. Table 1. summarizes the degree requirements for the different graduate programs.

1. Degree Requirements for the Applied Electromagnetics Option

Degree	Ph.D.	Master of Science	Master of Engineering	
		Plan I	Plan II	Plan III
Course Type	Total Credits	Total Credits	Total Credits	Total Credits
Core course (INEL 6601)	3	3	3	3
Area courses	15	15	15-18	24-27
Out-of-Area courses	6	6	6	6-9
Advanced math courses	6	0	0	0
Doctoral course (INEL 8XXX)	6	0	0	0
Doctoral seminar	1	0	0	0
Thesis or project	12	6	3-6	0
Total	43	30	30	36

All graduate students must submit a program of study before registering for a second semester. Also, note that *students **must** present their dissertation, thesis or project proposal before registering on Doctoral Dissertation, Master Thesis or Master Project for a third time*.

Students entering the doctoral program with a B.S. degree must take the qualifying exam by the end of their second year; those entering the program with a M.S. degree must take the qualifying exam by the end of their first year.

Research

The Applied Electromagnetics faculty is very active in research and has received more than $4.5 million in research grants since 2000 and is participating in the NSF Engineering Research Center for Collaborative and Adaptive Sensing of the Atmosphere (CASA). Current research projects include the study of microwave atmospheric absorption in clean air and in the presence of clouds and rain, the development of microwave transceiver modules for phased arrays, the characterization and development of tunable microwave circuits and antennas using electroceramic materials, the validation of rain-rate measurements using NEXRAD data and rain gauges, the modeling of wireless communication channels, the characterization and development of novel slot-like antennas and the development of phased array antennas. Research is conducted mainly at the CLiMMATE Laboratory and the Radiation Laboratory facilities. In addition, the Applied Electromagnetics group has strong research ties with the National Astronomy and Ionosphere Center, the University of Massachusetts at Amherst, the Colorado State University and the University of Colorado at Boulder.

Doctoral Program in Electrical Engineering: Electronics Track
Department of Electrical and Computer Engineering
University of Puerto Rico at Mayagüez

Introduction

The last twenty years have witnessed what could be called a revolution in electronics. The fast pace of advances in solid-state technology, fabrication processes, nano-electronics and circuit techniques have triggered enormous developments, which in turn have expanded human capabilities in many areas of knowledge.

The Electrical Engineering graduate program at the UPRM offers a graduate-level specialization in the electronics track. This track encompasses course offerings and research that embrace contemporary topics in solid state electronics, analog and digital systems design, mixed signal testing, MEMs and computer-aided electronic design. Modern laboratories and computer equipment are available to support both teaching and research activities in this track, preparing professionals for design, analysis and development activities at either the academic or industrial level.

Requirements

To be admitted to the electronics track applicants must minimally have undergraduate courses in the following areas:

- Microprocessors
- Combinational and Sequential Logic Design
- Microelectronics
- Programming Languages
- Differential Equations
- Probability and Statistics

Applicants without the proper preparation in any of these areas will be recommended by the Department's Graduate Committee to take appropriate remedial courses.

Coursework

The coursework in the electronics track is divided into two sets: core and elective courses. A list of the course offering is provided below.

Core Courses (6 crs)

Core courses in electronics include the following offerings :

- INEL 6009 Computer Systems Architecture
- INEL 6055 Solid State Electronics
- INEL 6080 VLSI Systems Design
- INEL 6055 Physics of Semiconductor Devices

Students are required to take two of the three core courses.

Elective Courses

Additional courses in the electronics track includes advanced undergraduate-level classes as well as other graduate-level courses offered on demand.
The list of advanced undergraduate courses include:

- INEL 5205 Instrumentation
- INEL 5206 Digital Systems Design
- INEL 5207 Design with OpAmps and Analog ICs
- INEL 5209 Introduction to Solid State Electronics
- INEL 5265 Analog Integrated Circuit Design

At the graduate level, the list of additional course offerings include:

- INEL 6048 Advanced Microprocessor Interfacing
- INEL 6085 Analysis and Design of Power Semiconductor Circuits
- INEL 6086 Introduction to MEMS
- INEL 6995 Special Topics in Electrical Engineering
- INEL 6079 Advanced IC Design Techniques
- INEL 8295 Advanced Topics in Electronics
- INEL 8296 Advanced Topics in Computer Engineering
- INEL 8997 Independent Study (with emphasis in Electronics)

Course Requirements for the Electronics Track

	Master of Science Plan I		Master of Engineering Plan II		Master of Engineering Plan III		Doctoral Program (proposed)	
Core courses	2 courses	6 crs	2 courses	6 crs	2 courses	6 crs	2 courses	6 crs
Major courses	3-4 courses	9-12 crs	3-5 courses	9-15 crs	7-8 courses	21-24 crs	6 courses	18 crs
Elective courses	2-3 courses	6-9 crs	2-3 courses	6-9 crs	2-3 courses	6-9 crs	2 courses	6 crs
Thesis		6 crs						12 crs
Doctoral Seminar								1 cr
Advanced Mathematics							2 courses	6 crs
Project				3-6 crs				
Total		30 crs		30 crs		36 crs		49 crs

Research Areas

The research interests of the ECE Department electronics faculty fall into diverse areas, many of them corresponding to interdisciplinary categories. Examples of this diversity include Biometrics Systems, Electronic Design Automation, Embedded Systems, Electro-optics, and Advanced Computer Architectures, among others. In addition to this rich diversity of contemporary topics, several faculty members are also active in more classical areas in electronics such as analog and digital VLSI, and circuits and systems.

Facilities

The ECE Department has numerous facilities for instructional and research activities in the electronics track. These include:

- Integrated Circuit Design Laboratory (ICDL)
- Rapid Systems Prototyping Laboratory (RASP)
- Control and Instrumentation Laboratory
- Instructional Computer Aided Design Laboratory (INCADEL)
- Microprocessor Development Systems Laboratory (MDS)
- Power Electronics Laboratory
- Electric Energy Processing Systems Laboratory

These facilities are available in addition to the general purpose computing facilities available for the student body of the ECE Department, which includes several PC and Unix clusters.

Recent Work

Some examples of research projects currently under development or recently completed in the electronics track include:

- Spectral Curves Integrated System for remote hyperspectral data
- Macromodeling of Sigma-Delta Modulators in Oversampled Converters
- 3D Scalability Analysis of Floating-Point Arithmetic Hardware
- Scalable Digital Fuzzy Controller on Reconfigurable Platforms
- Software Power Reduction in Embedded Systems Applications
- Automatic Layout Techniques for Power Electronics PCBs
- Wireless Smart Sensors
- Intelligent Traffic Systems
- Biomedical Devices for the Handicap
- Design of Communication Circuits Using BiCMOS Technology
- Electro Thermal Modeling of Power Electronic Modules

Doctoral Program in Electrical Engineering: Energy System Track
Department of Electrical and Computer Engineering
University of Puerto Rico at Mayagüez

Introduction

The UPRM's ECE Department has identified the academic and research area of Energy Systems as one of the fundamental components for the industrial development of Puerto Rico and the rest of the World. Energy Systems is an important and vital discipline for paving the way to wide-spread integration of renewable and sustainable technologies. The work in the Energy Systems area covers a broad range of activities and evolving issues that are of great importance in the field of sustainable and smart power systems. These activities include courses and research on renewable energy, power systems, power electronics, and electrical machines.

Research:

Energy Systems research at UPRM is aimed at providing major advancements in key areas of electrical design and operation of renewable energy systems, traditional power systems, and sustainable technology. Specific research topics include, but are not limited to, smart grids, modeling and control of inverters for renewable energy sources, innovative protection and control techniques in power systems and electric machine design. Examples of ongoing Energy Systems research activities at UPRM are as follows:

- Renewable generation modeling
- Smart grid control and protection
- Power electronic converters for renewable energy sources
- Impacts of renewable energy on power systems
- Photovoltaic integration to the electric grid
- Electricity market operation with stochastic sources

Facilities

An electric machines laboratory and a power electronics laboratory support teaching and research in energy conversion. The energy systems computational laboratory supports research focused on modeling and simulation. The use of computers is integrated to all courses to enhance the theory presented in class. Research in power engineering is also supported by the Center for Power Electronics (CPES) at UPRM. This is an NSF Research Center that focuses on power electronics research, industrial collaboration, education and technology transfer. UPRM is a member of CPES. Other members include Virginia Tech, RPI, University of Wisconsin-Madison and North Carolina A & T.

Coursework

The Energy Systems Track has two sub-racks: Power Systems and Power Electronics. When a person applies to the Energy Systems track, he/she must identify one sub-track of interest. If the person is admitted to the program, he/she must meet the minimum requirement for the selected option. These requirements are:

Power Systems: INEL 4415 Power System Analysis or equivalent
Power Electronics: Basic knowledge of polyphase circuits and electromechanical energy conversion

These requirements can be met if the student has taken such courses or their equivalent in their previous degree, through continuing education programs or relevant work experience (proof required). Otherwise, students must take such courses during their first year at UPRM.

These sub-racks are meant as guides, not as strict rules, or cages. All students will be considered Power Engineering students, some specializing in power system topics, others in power electronics applications. Students are encouraged to attend courses in both sub-tracks. This will give a better understanding of energy systems and would prepare students for the challenges of working in industry or academia.

Core Courses
Each sub-track has three core courses, all students must attend and pass at least two of these core courses within the sub-track. These are:

For Power Systems (2 out of 3):
INEL 6026 Computational Methods for Power System Analysis
INEL 6027 Power System Dynamics and Control
INEL 6028 Economic Operation of Power Systems
For Power Electronics (2 out of 3):
INEL 6058 High Frequency Power Converters
INEL 6066 Electric Drive Systems
INEL 6085 Advanced Power Electronics

Major Electives
There are seven other courses in power systems and three other courses in power electronics. Graduate students can take up to 9 credits in 5000-level courses (advanced undergraduate courses). The course in Power Quality belongs to both tracks. The courses (other than the core courses) within each track are:

Power Systems
INEL 5406 Transmission and Distribution
INEL 5407 Computer Aided Power System Design
INEL 5415 Power System Protection Design
INEL 6025 Advanced Energy Conversion
INEL 6077 Surge Phenomena
INEL 6096 Power Quality
INEL 8495 Advanced Topics in Electric Power Engineering
INEL 8997 Independent Study (with emphasis in Power Engineering)

Power Electronics
INEL 5408 Motor Control
INEL 6096 Power Quality
INEL 6000 Introduction to Nonlinear Control Systems
INEL 6001 Feedback Control Systems I
INEL 8496 Advanced Topics in Electric Power Electronics
INEL 8997 Independent Study (with emphasis in Power Electronics)

Course Requirements for the Power Engineering Tracks

	Master of Science Plan I		Master of Engineering Plan II		Master of Engineering Plan III		Doctoral Program (proposed)	
Core courses	2 courses	6 crs	2 courses	6 crs	2 courses	6 crs	2 courses	6 crs
Major courses	3-4 courses	9-12 crs	3-5 courses	9-15 crs	7-8 courses	21-24 crs	6 courses	18 crs
Elective courses	2-3 courses	6-9 crs	2-3 courses	6-9 crs	2-3 courses	6-9 crs	2 courses	6 crs
Thesis		6 crs						12 crs
Doctoral Seminar								1 cr
Advanced Mathematics							2 courses	6 crs
Project				3-6 crs				
Total		30 crs		30 crs		36 crs		49 crs

Appendix B: Applications for New Courses

UNIVERSIDAD DE PUERTO RICO
ADMINISTRACIÓN CENTRAL
VICEPRESIDENCIA PARA ASUNTOS ACADÉMICOS E INVESTIGACIÓN

SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A[1]

Unidad: Recinto Universitario de Mayagüez ________ Facultad: Ingeniería ____________

Departamento: Ingeniería Eléctrica y de Computadoras Programa: Doctorado en Ingeniería Eléctrica

Certificación de autorización del programa por: Junta de Síndicos ____________ Consejo de Educación Superior ____________

Fecha de solicitud: 8 de septiembre de 2005 Fecha de vigencia del curso: Agosto de 2006

Título completo en español Temas avanzados en electrónica

(Título abreviado a 26 espacios): Temas Avan. Electrónica

Título completo en inglés: Advanced Topics in Electronics

(Título abreviado a 26 espacios): Adv. Topics Electronics.

Materia principal del curso (en clave alfa): ____INEL____________

Nivel del curso (marque con una X):

_ _ _ _ _ _	_ _ X _
0 1 2 3 4 5	6 7 8 9
Subgraduado	Graduado

Curso de continuación: _____ Sí __X__ No Número de créditos: 1 a 3 por semestre y maximo de 6 crs en total.

Codificación alfanumérica sugerida: INEL 8295

Tipo de créditos: ________ Fijo ____X____ Variable

Puede repetirse con crédito: ____X____ Sí (máximo de créditos___6 en total__) _______No

Horas semanales de:

___1 a 3___Conferencia	_______Laboratorio	________Tutorías
________Discusión	________Taller	________Investigación
________Seminario	________Internado	________Tesis o
________Estudio Independiente	________Práctica Supervisada	________Disertación

Modalidad de educación a distancia (si aplica): ______________________________

____

____

Total de horas a reunirse por periodo lectivo: _____1 a 3_________

Equivalencia en horas crédito para la tarea del profesor (carga académica):[2] ____1 a 3

Patrón académico en que se ofrece el curso:

___ Semestre _____ Trimestre _____Cuatrimestre _____Año ___X___Otro: Demanda

Secuencia Curricular (C = Cuatrimestre; T = Trimestre; S = Semestre)[3]

Periodo: __S1 __S2 ___T1 ___T2 ___T3 ___C1 ___C2 ___C3 ___C4 ___Verano

Año: ___1ero ___2ndo ___3ero ___4to ___5to __X_ Otro (especifique) ___Ph.D.

Tipo de curso:

_____Requisito ___X__Electivo _____Educación Continua

___Temporero o Experimental (fecha de inactivación: _______)

Posibilidad de equivalencia (en la unidad o en otras unidades del sistema):

_____ Sí ____X____No

Cursos:

Unidad(es) que lo ofrece(n): Recinto Universitario de Mayagüez

Número de estudiantes por sección: ___1____Mínimo ___15__Máximo

¿Conlleva cargos por laboratorios? _____ Sí _____X____ No

Descripción en español (que no exceda los 1,000 caracteres):[4] Estudio de temas selectos en electrónica o áreas relacionadas.

Descripción en inglés (que no exceda los 1,000 caracteres):[5] Study of selected topics in electronics or related fields.

Curso prerequisitos	Cursos corequisitos
Permiso del Director	

Requisitos especiales para tomar el curso (destrezas, conocimientos, permisos especiales, equipos, materiales, conocimientos del uso de computadoras o programados específicos, otros): ___Depende de los tópicos a discutirse___

Equipo o instalaciones mínimas requeridas: _______Depende de los tópicos a discutirse_______

Sistema de calificación:[6]

_X__Letra (A, B, C, D ó F) _____Aprobado (S), No aprobado (NS)

_____Aprobado (p), No aprobado (NP) ______Aprobado (PS, PN, PB), No aprobado (NP)

_____Aprobado (P), Fracasado (F) ______Otro (Especifique: ______)

¿Comprende contenido temático de otros cursos?

_______Sí ___X__No

Especifique: ______

¿Se inactivará o eliminará algún curso al crear éste?[7]

_______Sí __X___No

Especifique: ____

____

Aprobación a nivel de la unidad	
Director(a) del Departamento:	Fecha:
Decano(a) de la Facultad:	Fecha:
Decano(a) de Estudios Graduados:[8]	Fecha:
Decano(a) de Asuntos Académicos:	Fecha:

Para uso de la Vicepresidencia para Asuntos Académicos e Investigación . NO escriba bajo este renglón.	
Codificación:	Fecha de codificación:
Funcionario que procesó la solicitud:	Fecha de envío a unidad:

[1]Copia de esta sección será remitida a la unidad de origen del curso después de procesada la solicitud en la Vicepresidencia para Asuntos Académicos e Investigación en la Administración Central.
[2]Según establecido por la Junta Universitaria en la Certificación Núm. 8, 1986-87.
[3] Orden del curso según programa de estudios autorizados.
[4] Debe coincidir con la descripción del curso en el Prontuario del mismo.
[5] Debe coincidir con la descripción del curso en el Prontuario del mismo.
[6] Deberá consultarse a la Oficina del Registrador de la unidad para constatar sistemas permitidos.
[7] El Decano(a) de Asuntos Académicos será responsable de procesar la inactivación o eliminación del mismo y de llevar a cabo los arreglos pertinentes para asegurar que ningún estudiante se vea afectado por esta acción. Además, esta solicitud deberá venir acompañada de la ***Solicitud de Inactivación o Eliminación de Cursos.***
[8] Cuando aplique.

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 8295
Course Title: Advanced Topics in Electronics
Number of credits: 3
Contact Period: Three hours of lecture per week

2. Course Description:

English: Advanced analysis and design techniques of analog, digital, mixed-signal circuits and systems using theoretical analysis and advanced cad tools; physical layout level design of circuits and circuit testing.

Spanish: Técnicas avanzadas de análisis y diseño de circuitos análogos, digitales, de señales mixtas, y sistemas usando análisis teórico y herramientas avanzadas de diseño; diseño de circuitos a nivel del plano físico y prueba de circuitos.

3. Pre/Co-requisites and other requirements:

Prerequisites: INEL 6005

4. Course Objectives:

After completing the course, the students should be able to analyze, design, and implement advanced analog, digital, mixed-signals circuits and systems.

5. Instructional Strategies:

☒conference ☐discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Standard lecturing facilities; the Integrated Circuit Design Laboratory (ICDL)

7. Course time frame and thematic outline

Outline	**Contact Hours**
Semiconductor Devices	4
CAD Circuit Simulation and Physical Design	3
Design of Advanced Analog Circuits	12
Design of Advanced Digital Circuits	12
Design of Mixed Signal Systems	11
Exams	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ Exams	2	50
☒ Final Exam	1	25
☐ Short Quizzes		
☐ Oral Reports		
☐ Monographies		
☐ Portfolio		
☒ Projects		25
☐ Journals		
☐ Other, specify:		
TOTAL:		100%

10. Bibliography:

Textbook:

(1) Hu, W. *Advances in Electric and Electronics*; Springer; 2012. http://dx.doi.org/10.1007/978-3-642-28744-2. [Available via Springer eBooks, UPRM General Library Databases]

Additional References:

(2) Grey, P.R.; Hurst, P.J.; Lewis, S.H.; Meyer, R.G. *Analysis and Design on Analog Integrated Circuits*; 5th ed.; John Wiley and Sons; 2009. [Available at the Circulation Collection (TK7874 .A588 2009), UPRM General Library]

(3) Allen, P. E.; Holberg, D. R.; *CMOS Analog Circuit Design*; 3rd ed.; Oxford Univ. Press; 2012. [Available at the Circulation Collection (TK7874 .A428 2012), UPRM General Library]

11. According to Law 51

Students will identify themselves with the Institution and the instructor of the course for purposes of assessment (exams) accommodations. For more information please call the Student with Disabilities Office which is part of the Dean of Students office (Office #4) at (787) 265-3862 or (787) 832-4040 extensions 3250 or 3258 or by email at virgen.aponte@upr.edu.

Person who prepared this description and date of preparation:

Guillermo J Serrano, Mar 2013

UNIVERSIDAD DE PUERTO RICO
ADMINISTRACIÓN CENTRAL
VICEPRESIDENCIA PARA ASUNTOS ACADÉMICOS E INVESTIGACIÓN

SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A[1]

Unidad: Recinto Universitario de Mayagüez ________________ Facultad: Ingeniería ________________________

Departamento: Ingeniería Eléctrica y de Computadoras Programa: Doctorado en Ingeniería Eléctrica

Certificación de autorización del programa por: Junta de Síndicos _____________ Consejo de Educación Superior ______________

Fecha de solicitud: 8 de septiembre de 2005 Fecha de vigencia del curso: Agosto de 2006

Título completo en español Temas avanzados en procesamiento de señales

(Título abreviado a 26 espacios): Temas Avan. Proc Señales

Título completo en inglés Advanced Topics in Signal Processing

(Título abreviado a 26 espacios): Adv Topics Signal Proc

Materia principal del curso (en clave alfa): _______INEL___________________________

Nivel del curso (marque con una X):

Subgraduado						Graduado			
_	_	_	_	_	_	_	_	X	_
0	1	2	3	4	5	6	7	8	9

Curso de continuación: _____ Sí __X__No Número de créditos: 1 a 3 por semestre y maximo de 6 crs en total.

Codificación alfanumérica sugerida: INEL 8395

Tipo de créditos: ________ Fijo ____X_____ Variable

Puede repetirse con crédito: _____X______ Sí (máximo de créditos___6 en total__) _______No

Horas semanales de:

___1 a 3___Conferencia _______Laboratorio ________Tutorías
________Discusión ________Taller ________Investigación
________Seminario ________Internado ________Tesis o
________Estudio Independiente ________Práctica Supervisada _______Disertación

Modalidad de educación a distancia (si aplica): ____

____

____

Total de horas a reunirse por periodo lectivo: _____1 a 3_________

Equivalencia en horas crédito para la tarea del profesor (carga académica):[2] _____1 a 3

Patrón académico en que se ofrece el curso:

___ Semestre _____ Trimestre _____Cuatrimestre _____Año ___X___Otro: Demanda

Secuencia Curricular (C = Cuatrimestre; T = Trimestre; S = Semestre)[3]

Periodo: __S1 _S2 ___T1 ___T2 ___T3 ___C1 ___C2 ___C3 ___C4 ___Verano

Año: ___1ero ___2ndo __3ero ___4to ___5to __X_ Otro (especifique) ___Ph.D.

Tipo de curso:

_____Requisito ___X__Electivo _____Educación Continua

___Temporero o Experimental (fecha de inactivación: _______)

Posibilidad de equivalencia (en la unidad o en otras unidades del sistema):

_____ Sí ____X____No

Cursos:

Unidad(es) que lo ofrece(n): Recinto Universitario de Mayagüez

Número de estudiantes por sección: ___1____Mínimo ___15__Máximo

¿Conlleva cargos por laboratorios? _____ Sí ____X____ No

Descripción en español (que no exceda los 1,000 caracteres):[4] Estudio de temas selectos en procesamiento de señales o áreas relacionadas.

Descripción en inglés (que no exceda los 1,000 caracteres):[5] Study of selected topics in signal processing or related fields.

Curso prerequisitos	Cursos corequisitos
Permiso del Director	

Requisitos especiales para tomar el curso (destrezas, conocimientos, permisos especiales, equipos, materiales, conocimientos del uso de computadoras o programados específicos, otros): ___Depende de los tópicos a discutirse___

Equipo o instalaciones mínimas requeridas: _______Depende de los tópicos a discutirse___

Sistema de calificación:[6]

_X__Letra (A, B, C, D ó F) _____Aprobado (S), No aprobado (NS)

_____Aprobado (p), No aprobado (NP) ______Aprobado (PS, PN, PB), No aprobado (NP)

_____Aprobado (P), Fracasado (F) ______Otro (Especifique: ________)

¿Comprende contenido temático de otros cursos?

_______Sí ___X__No

Especifique: ________

¿Se inactivará o eliminará algún curso al crear éste?[7]

_______Sí __X___No

Especifique: ____

____

Aprobación a nivel de la unidad	
Director(a) del Departamento:	Fecha:
Decano(a) de la Facultad:	Fecha:
Decano(a) de Estudios Graduados:[8]	Fecha:
Decano(a) de Asuntos Académicos:	Fecha:

Para uso de la Vicepresidencia para Asuntos Académicos e Investigación . NO escriba bajo este renglón.	
Codificación:	Fecha de codificación:
Funcionario que procesó la solicitud:	Fecha de envío a unidad:

---

[1]Copia de esta sección será remitida a la unidad de origen del curso después de procesada la solicitud en la Vicepresidencia para Asuntos Académicos e Investigación en la Administración Central.

[2]Según establecido por la Junta Universitaria en la Certificación Núm. 8, 1986-87.

[3] Orden del curso según programa de estudios autorizados.

[4] Debe coincidir con la descripción del curso en el Prontuario del mismo.

[5] Debe coincidir con la descripción del curso en el Prontuario del mismo.

[6] Deberá consultarse a la Oficina del Registrador de la unidad para constatar sistemas permitidos.

[7] El Decano(a) de Asuntos Académicos será responsable de procesar la inactivación o eliminación del mismo y de llevar a cabo los arreglos pertinentes para asegurar que ningún estudiante se vea afectado por esta acción. Además, esta solicitud deberá venir acompañada de la ***Solicitud de Inactivación o Eliminación de Cursos.***

[8] Cuando aplique.

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 8395
Course Title: Advanced Topics in Signal Processing: Image Analysis and Remote Sensing of Coastal Shallow Waters
Number of credits: 3
Contact Period: Three hours of lecture per week

2. Course Description:

English: Image analysis of the water column and benthic mapping of coastal shallow waters by means of remotely sensed signals and imagery.

Spanish: Análisis de imágenes de la columna de agua y mapas bénticos de aguas costeras por medio de señales e imágenes detectadas por sensores remotos.

3. Pre/Co-requisites and other requirements:

Prerequisites: INEL 6007

4. Course Objectives:

After completing the course, the students should be able to design and implement an algorithm for signal analysis and subsurface detection applied to coastal shallos waters remote sensing.

5. Instructional Strategies:

☒ conference ☐ discussion ☐ computation ☐ laboratory

☐ seminar with formal presentation ☐ seminar without formal presentation ☐ workshop

☐ art workshop ☐ practice ☐ trip ☐ thesis ☐ special problems ☐ tutoring

☐ research ☐ other, please specify:

6. Minimum or Required Resources Available:

Standard lecturing facilities. Radiation laboratory and Applied electromagnetics laboratory.

7. Course time frame and thematic outline

Outline	Contact Hours
Radiative transfer equation	9
Inverse models and atmospheric correction	9
Composition of coastal shallow waters	6
Inverse models and bathimetry	9
Estimation of optical parameters from the water column	9
Exams	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ Exams	2	50
☒ Final Exam	1	25
☐ Short Quizzes		
☐ Oral Reports		
☐ Monographies		
☐ Portfolio		
☒ Projects		25
☐ Journals		
☐ Other, specify:		
TOTAL:		100%

10. Bibliography:

Textbook:

(1) Wang, Y. (Ed.); *Remote Sensing of Coastal Environments*; CRC Press; 2010. http://dx.doi.org/10.1201/9781420094428. [Available via CRCnetBASE, UPRM General Library Databases]

Additional References:

(2) Yang, X.; *Remote Sensing and Geospatial Technologies for Coastal Ecosystem Assessment and Management*; Springer; 2009.

(3) Zhao, Y.; Yongchao, P.; Ruiliang, B.; Susan, S.; Meyer, C.; Bagget, L.; Lesley, P.; Geng, X. (2013). Hyperion Image Optimization in Coastal Waters, *IEEE Transactions on Geoscience and Remote Sensing*, Vol. 51, no.2, 2012, pp. 1025-1036. http://dx.doi.org/10.1109/TGRS.2012.2205262. [Available via IEEE Xplore, UPRM General Library Databases]

(4) González Trilla, G.; Pratolongo, P.; Beget, M.E.; Kandus, P.; Marcovecchio, J.; Di Bella, C. Relating Biophysical Parameters of Coastal Marshes to Hyperspectral Reflectance Data in the Bahia Blanca Estuary, Argentina; *Journal of Coastal Research*; Vol. 29, no.1, 2013, pp. 231-238 . http://dx.doi.org/10.2112/JCOASTRES-D-11-00214.1. [Available via Academic Search Complete, UPRM General Library Databases]

(5) Shanmugan, P.; Sundarabalan, B.; Ahn, Y.H.; Ryu, J.H.; A New Inversion Model to Retrieve the Particulate Backskattering in Coastal/Ocean Waters; *IEEE Transactions on Geoscience and Remote Sensing*; Vol. 49, No. 6, 2011, pp. 2463-2475. http://dx.doi.org/10.1109/TGRS.2010.2103947. [Available via IEEE Xplore, UPRM General Library Databases]

(6) Klemas, V.; Remote Sensing of Coastal Plumes and Ocean Fronts: Overview and Case Study; *Journal of Coastal Research*; Vol.28, no.1A: p. 1 – 7. http://dx.doi.org/10.2112/JCOASTRES-D-11-00025.1. [Available via Academic Search Complete, UPRM General Library Databases]

Classic textbooks:

(7) Richardson, L.L.; LeDrew, E.F. (Eds.); *Remote Sensing of Aquatic Coastal Ecosystem Processes: Science and Management Applications*, Springer, 2006.

(8) Bukata, R.; Jerome, J.H.; Kondratyev, A.S.; Pozdnyakov, D.V. *Optical Properties and Remote Sensing of Inland and Coastal Waters*, CRC Press, 1995. [Available at the Marine Sciences Collection (GC178.2 .O66 1995), UPRM General Library]

11. According to Law 51

Students will identify themselves with the Institution and the instructor of the course for purposes of assessment (exams) accommodations. For more information please call the Student with Disabilities Office which is part of the Dean of Students office (Office #4) at (787) 265-3862 or (787) 832-4040 extensions 3250 or 3258 or by email at virgen.aponte@upr.edu.

Person who prepared this description and date of preparation:

Luis O. Jiménez-Rodríguez, Mar 2013

UNIVERSIDAD DE PUERTO RICO
ADMINISTRACIÓN CENTRAL
VICEPRESIDENCIA PARA ASUNTOS ACADÉMICOS E INVESTIGACIÓN

SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A[1]

Unidad: Recinto Universitario de Mayagüez ________________ Facultad: Ingeniería ________________________

Departamento: Ingeniería Eléctrica y de Computadoras Programa: Doctorado en Ingeniería Eléctrica

Certificación de autorización del programa por: Junta de Síndicos _____________ Consejo de Educación Superior ______________

Fecha de solicitud: 8 de septiembre de 2005 Fecha de vigencia del curso: Agosto de 2006

Título completo en español Temas avanzados en electromagnética aplicada

(Título abreviado a 26 espacios): Temas Avan. Electromag Apl

Título completo en inglés: Advanced Topics in Applied Electromagnetics

(Título abreviado a 26 espacios): Adv Topics Appl Electromag

Materia principal del curso (en clave alfa): _______INEL___________________________

Nivel del curso (marque con una X):

_	_	_	_	_	_		_	_	X	_
0	1	2	3	4	5		6	7	8	9
Subgraduado							Graduado			

Curso de continuación: _____ Sí __X__ No Número de créditos: 1 a 3 por semestre y maximo de 6 crs en total.

Codificación alfanumérica sugerida: INEL 8695

Tipo de créditos: ________ Fijo ____X_____ Variable

Puede repetirse con crédito: _____X______ Sí (máximo de créditos ___6 en total__) _______No

Horas semanales de:

___1 a 3___Conferencia _______Laboratorio ________Tutorías
________Discusión ________Taller ________Investigación
________Seminario ________Internado ________Tesis o
________Estudio Independiente ________Práctica Supervisada _______Disertación

Modalidad de educación a distancia (si aplica): ____

____

____

Total de horas a reunirse por periodo lectivo: _____1 a 3_________

Equivalencia en horas crédito para la tarea del profesor (carga académica):[2] _____1 a 3

Patrón académico en que se ofrece el curso:

__ Semestre _____ Trimestre _____Cuatrimestre _____Año ___X___Otro: Demanda

Secuencia Curricular (C = Cuatrimestre; T = Trimestre; S = Semestre)[3]

Periodo: __S1 _S2 ___T1 ___T2 ___T3 ___C1 ___C2 ___C3 ___C4 ___Verano

Año: ___1[ero] ___2[ndo] __3[ero] ___4[to] ___5[to] __X_ Otro (especifique) ___Ph.D.

Tipo de curso:

_____Requisito ___X__Electivo _____Educación Continua

__Temporero o Experimental (fecha de inactivación: _______)

Posibilidad de equivalencia (en la unidad o en otras unidades del sistema):

_____ Sí ____X____No

Cursos:

Unidad(es) que lo ofrece(n): Recinto Universitario de Mayagüez

Número de estudiantes por sección: ___1____Mínimo ___15__Máximo

¿Conlleva cargos por laboratorios? _____ Sí _____X____ No

Descripción en español (que no exceda los 1,000 caracteres):[4] Estudio de temas selectos en electromagnética aplicada o áreas relacionadas.

Descripción en inglés (que no exceda los 1,000 caracteres):[5] Study of selected topics in Applied Electromagnetics or related fields.

Curso prerequisitos	Cursos corequisitos
Permiso del Director	

Requisitos especiales para tomar el curso (destrezas, conocimientos, permisos especiales, equipos, materiales, conocimientos del uso de computadoras o programados específicos, otros): ___Depende de los tópicos a discutirse_______________________________________

____

____

Equipo o instalaciones mínimas requeridas: _______Depende de los tópicos a discutirse_______________________________________

____

Sistema de calificación:[6]

_X__Letra (A, B, C, D ó F) _____Aprobado (S), No aprobado (NS)

_____Aprobado (p), No aprobado (NP) ______Aprobado (PS, PN, PB), No aprobado (NP)

_____Aprobado (P), Fracasado (F) ______Otro (Especifique: ___________________________________)

¿Comprende contenido temático de otros cursos?

_______Sí ___X__No

Especifique: ____

____

¿Se inactivará o eliminará algún curso al crear éste?[7]

_______Sí __X__No

Especifique: ____

____

Aprobación a nivel de la unidad	
Director(a) del Departamento:	Fecha:
Decano(a) de la Facultad:	Fecha:
Decano(a) de Estudios Graduados:[8]	Fecha:
Decano(a) de Asuntos Académicos:	Fecha:

Para uso de la Vicepresidencia para Asuntos Académicos e Investigación . NO escriba bajo este renglón.	
Codificación:	Fecha de codificación:
Funcionario que procesó la solicitud:	Fecha de envío a unidad:

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[1]Copia de esta sección será remitida a la unidad de origen del curso después de procesada la solicitud en la Vicepresidencia para Asuntos Académicos e Investigación en la Administración Central.

[2]Según establecido por la Junta Universitaria en la Certificación Núm. 8, 1986-87.

[3] Orden del curso según programa de estudios autorizados.

[4] Debe coincidir con la descripción del curso en el Prontuario del mismo.

[5] Debe coincidir con la descripción del curso en el Prontuario del mismo.

[6] Deberá consultarse a la Oficina del Registrador de la unidad para constatar sistemas permitidos.

[7] El Decano(a) de Asuntos Académicos será responsable de procesar la inactivación o eliminación del mismo y de llevar a cabo los arreglos pertinentes para asegurar que ningún estudiante se vea afectado por esta acción. Además, esta solicitud deberá venir acompañada de la ***Solicitud de Inactivación o Eliminación de Cursos.***

[8] Cuando aplique.

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 8695
Course Title: Advanced Topics in Applied Electromagnetics: Printed Microwave and Millimeter-Wave Antennas
Number of credits: 3
Contact Period: Three hours of lecture per week

2. Course Description:

English: Analysis and design of printed microwave and milimeter-wave antennas.

Spanish: Análisis y diseño de antenas impresas de microondas y ondas milimétricas

3. Pre/Co-requisites and other requirements:

Prerequisites: INEL 6668

4. Course Objectives:

After completing the course, the students should be able to analyze and design various types of printed circuit antennas for microwave and millimeter wave frequencies.

5. Instructional Strategies:

☒ conference ☐ discussion ☐ computation ☐ laboratory

☐ seminar with formal presentation ☐ seminar without formal presentation ☐ workshop

☐ art workshop ☐ practice ☐ trip ☐ thesis ☐ special problems ☐ tutoring

☐ research ☐ other, please specify:

6. Minimum or Required Resources Available:

Standard lecturing facilities. Radiation laboratory and Applied electromagnetics laboratory.

7. Course time frame and thematic outline

Outline	**Contact Hours**
Printed antenna elements: microstrip patches, slots and dipoles	15
Cavity backing	6
Techniques for circular polarization	6
Band broadening and tuning	9
Fabrication techniques	6
Exams	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ Exams	2	50
☒ FinalExam	1	25
☐ ShortQuizzes		
☐ OralReports		
☐ Monographies		
☐ Portfolio		
☒ Projects		25
☐ Journals		
☐ Other, specify:		
TOTAL:		100%

10.Bibliography:

Textbook:

(1) Fujimoto, K.; James, J.R. *Mobile Antenna Systems Handbook*, 2nd ed.; Artech House; 2008.

Additional References:

(2) Sanchez-Hernandez, D. A. *Multiband Integrated Antennas for 4G Terminals*, Artech House, 2008. [Available at the Circulation Collection (TK5102.5 .D83 1985), UPRM General Library]

(3) Rabinovich, V.; Alexandrov, N.; *Antenna*; *Arrays and Automotive Applications*; Springer; 2013. http://dx.doi.org/10.1007/978-1-4614-1074-4. [Available via Springer eBooks, UPRM General Library Databases]

(4) Yarman, B. S.; *Design of Ultra Wideband Antenna Matching Networks*; Springer; 2008. http://dx.doi.org/10.1007/978-1-4020-8418-8. [Available via Springer eBooks, UPRM General Library Databases]

(5) Minin, I.V.; Minin, O.; *Basic Principles of Fresnel Antenna Arrays*; Springer; 2008. http://dx.doi.org/10.1007/978-3-540-79559-9. [Available via Springer eBooks, UPRM General Library Databases]

(6) *IEEE Transactions on Antennas and Propagation*. http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=8

(7) *IEEE Antennas and Wireless Propagation Letters*: http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=7727

(8) Deshmukh, A.A.; Ray, K.P.; Formulation of Resonance Frequencies for Dual-Band Slotted Rectangular Microstrip Antennas; *IEEE Antennas and Propagation Magazine*; Vol.54, no.4, 2012, pp.78-97. http://dx.doi.org/10.1109/MAP.2012.6309159. [Available via IEEE Xplore, UPRM General Library Databases]

(9) Ghorbani, A., Ansarizadeh, M., Abd-Alhameed, R.A.; Bandwidth Limitations on Linearly Polarized Microstrip Antennas; *IEEE Transactions on Antennas and Propagation*; Vol.58, no.2, 2010, pp.250-257. http://dx.doi.org/10.1109/TAP.2009.2037768. [Available via IEEE Xplore, UPRM General Library

11.According to Law51

Students will identify themselves with the Institution and the instructor of the course for purposes of assessment (exams) accommodations. For more information please call the Student with Disabilities Office which is part of the Dean of Students office (Office #4) at (787) 265-3862 or (787) 832-4040 extensions 3250 or 3258 or by email at virgen.aponte@upr.edu.

Personwho prepared thisdescription and date ofpreparation:

Rafael A. Rodriguez Solis, Jan2013

UNIVERSIDAD DE PUERTO RICO
ADMINISTRACIÓN CENTRAL
VICEPRESIDENCIA PARA ASUNTOS ACADÉMICOS E INVESTIGACIÓN

SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A[1]

Unidad: Recinto Universitario de Mayagüez ________________ Facultad: Ingeniería ________________________

Departamento: Ingeniería Eléctrica y de Computadoras Programa: Doctorado en Ingeniería Eléctrica

Certificación de autorización del programa por: Junta de Síndicos _____________ Consejo de Educación Superior ______________

Fecha de solicitud: 8 de septiembre de 2005 Fecha de vigencia del curso: Agosto de 2006

Título completo en español Temas avanzados en Sistemas de Comunicaciones

(Título abreviado a 26 espacios): Temas Avan. Sist Com

Título completo en inglés: Advanced Topics in Communication Systems

(Título abreviado a 26 espacios): Adv. Topics Comm Syst

Materia principal del curso (en clave alfa): _______INEL___________________________

Nivel del curso (marque con una X):

	Subgraduado	Graduado
	_ _ _ _ _ _	_ _ X _
	0 1 2 3 4 5	6 7 8 9

Curso de continuación: _____ Sí __X__ No Número de créditos: 1 a 3 por semestre y maximo de 6 crs en total.

Codificación alfanumérica sugerida: INEL 8397

Tipo de créditos: ________ Fijo ____X_____ Variable

Puede repetirse con crédito: _____X______ Sí (máximo de créditos___6 en total__) _______No

Horas semanales de:

___1 a 3___Conferencia	_______Laboratorio	________Tutorías
________Discusión	________Taller	________Investigación
________Seminario	________Internado	________Tesis o
________Estudio Independiente	________Práctica Supervisada	________Disertación

Modalidad de educación a distancia (si aplica): ____

Total de horas a reunirse por periodo lectivo: _____1 a 3_________

Equivalencia en horas crédito para la tarea del profesor (carga académica):[2] _____1 a 3

Patrón académico en que se ofrece el curso:

___ Semestre _____ Trimestre _____Cuatrimestre _____Año ___X___Otro: Demanda

Secuencia Curricular (C = Cuatrimestre; T = Trimestre; S = Semestre)[3]

Periodo: __S1 _S2 ___T1 ___T2 ___T3 ___C1 ___C2 ___C3 ___C4 ___Verano

Año: ___1ero ___2ndo __3ero ___4to ___5to __X_ Otro (especifique) ___Ph.D.

Tipo de curso:

_____Requisito ___X__Electivo _____Educación Continua

__Temporero o Experimental (fecha de inactivación: _______)

Posibilidad de equivalencia (en la unidad o en otras unidades del sistema):

_____ Sí ____X____No

Cursos:

Unidad(es) que lo ofrece(n): Recinto Universitario de Mayagüez

Número de estudiantes por sección: ___1____Mínimo ___15__Máximo

¿Conlleva cargos por laboratorios? _____ Sí _____X____ No

Descripción en español (que no exceda los 1,000 caracteres):[4] Estudio de temas selectos en sistemas de comunicaciones o áreas relacionadas.

Descripción en inglés (que no exceda los 1,000 caracteres):[5] Study of selected topics in communication systems or related fields.

Curso prerequisitos	Cursos corequisitos
Permiso del Director	

Requisitos especiales para tomar el curso (destrezas, conocimientos, permisos especiales, equipos, materiales, conocimientos del uso de computadoras o programados específicos, otros): ___Depende de los tópicos a discutirse___

Equipo o instalaciones mínimas requeridas: ________Depende de los tópicos a discutirse___

Sistema de calificación:[6]

_X__Letra (A, B, C, D ó F) _____Aprobado (S), No aprobado (NS)

_____Aprobado (p), No aprobado (NP) ______Aprobado (PS, PN, PB), No aprobado (NP)

_____Aprobado (P), Fracasado (F) ______Otro (Especifique: ________)

¿Comprende contenido temático de otros cursos?

_______Sí ___X__No

Especifique: ________

¿Se inactivará o eliminará algún curso al crear éste?[7]

_______Sí __X__No

Especifique: ____

____

Aprobación a nivel de la unidad	
Director(a) del Departamento:	Fecha:
Decano(a) de la Facultad:	Fecha:
Decano(a) de Estudios Graduados:[8]	Fecha:
Decano(a) de Asuntos Académicos:	Fecha:

Para uso de la Vicepresidencia para Asuntos Académicos e Investigación . NO escriba bajo este renglón.	
Codificación:	Fecha de codificación:
Funcionario que procesó la solicitud:	Fecha de envío a unidad:

[1]Copia de esta sección será remitida a la unidad de origen del curso después de procesada la solicitud en la Vicepresidencia para Asuntos Académicos e Investigación en la Administración Central.
[2]Según establecido por la Junta Universitaria en la Certificación Núm. 8, 1986-87.
[3] Orden del curso según programa de estudios autorizados.
[4] Debe coincidir con la descripción del curso en el Prontuario del mismo.
[5] Debe coincidir con la descripción del curso en el Prontuario del mismo.
[6] Deberá consultarse a la Oficina del Registrador de la unidad para constatar sistemas permitidos.
[7] El Decano(a) de Asuntos Académicos será responsable de procesar la inactivación o eliminación del mismo y de llevar a cabo los arreglos pertinentes para asegurar que ningún estudiante se vea afectado por esta acción. Además, esta solicitud deberá venir acompañada de la ***Solicitud de Inactivación o Eliminación de Cursos.***
[8] Cuando aplique.

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 8397
Course Title: Advanced Topics in Communications: Software Defined Radio, Cognitive Radio and Cognitive Networks
Number of credits: 3
Contact Period: Three hours of lecture per week

2. Course Description:

English: This course examines the emergent technologies of Software Defined Radio, Cognitive Radio and Cognitive Networks while exploring Dynamic Spectrum Access, a major motivating application of these technologies.

Spanish: Análisis y diseño de tecnologías emergentes como radio definido en "software", radio cognitivo y redes cognitivas mientras explora el acceso dinámico del espectro.

3. Pre/Co-requisites and other requirements:

None

4. Course Objectives:

After completing the course, the students should be able to analyze and design various types of cognitive radio systems and networks.

5. Instructional Strategies:

☒conference ☒discussion ☒computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Standard lecturing facilities. Digital Signal Processing laboratory.

7. Course time frame and thematic outline

Outline	**Contact Hours**
Dynamic Spectrum Access	3
Introduction to SDR	6
Introduction to CR	3
The Cognition Cycle	3
Introduction to Cognitive Networks	12
Artificial Intelligence for Communication Networks	3
Hardware Platforms	3
Software Platforms	3
Spectrum Policy	3
Future Challenges	3
Exams	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ Exams	2	50
☒ Final Exam	1	25
☐ Short Quizzes		
☐ Oral Reports		
☐ Monographies		
☐ Portfolio		
☒ Projects		25
☐ Journals		
☐ Other, specify:		
TOTAL:		100%

10. Bibliography:

Textbook:

1. Zeng, D.; Advances in Control and Communication; Springer; 2012

References:

2. Wu, Y.; Advances in Computer, Communication, Control and Automation; Springer; 2012
3. Zhang, T.; Future Computer, Communication, Control and Automation; Springer; 2012
4. Khodakarami, H.; Shieh, W.; On the Energy Efficiency of Modulation Formats for Optical Communications; IEEE Photonics Technology Letters; Vol. 25 Issue 3; 2013; pp. 275-278 http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6387262&tag=1
5. IEEE Journal on Selected Areas in Communications
6. IEEE Communications Magazine
7. IEEE Transactions on Wireless Communications
8. IEEE Transactions on Mobile Computing

11. According to Law 51

Students will identify themselves with the Institution and the instructor of the course for purposes of assessment (exams) accommodations. For more information please call the Student with Disabilities Office which is part of the Dean of Students office (Office #4) at (787) 265-3862 or (787) 832-4040 extensions 3250 or 3258 or by email at virgen.aponte@upr.edu.

Person who prepared this description and date of preparation:

Lizdabel Morales Tirado, June 2013

UNIVERSIDAD DE PUERTO RICO
ADMINISTRACIÓN CENTRAL
VICEPRESIDENCIA PARA ASUNTOS ACADÉMICOS E INVESTIGACIÓN

SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A[1]

Unidad: Recinto Universitario de Mayagüez ________ Facultad: Ingeniería ________

Departamento: Ingeniería Eléctrica y de Computadoras Programa: Doctorado en Ingeniería Eléctrica

Certificación de autorización del programa por: Junta de Síndicos ______ Consejo de Educación Superior ______

Fecha de solicitud: 8 de septiembre de 2005 Fecha de vigencia del curso: Agosto de 2006

Título completo en español Temas avanzados en ingeniería de potencia eléctrica

(Título abreviado a 26 espacios): Temas Avan Ing Pot Elect

Título completo en ingles: Advanced Topics in Electric Power Engineering

(Título abreviado a 26 espacios): Adv Topics Elec Power Eng

Materia principal del curso (en clave alfa): ____INEL________

Nivel del curso (marque con una X):

	Subgraduado	Graduado
	_ _ _ _ _ _	_ _ X _
	0 1 2 3 4 5	6 7 8 9

Curso de continuación: _____ Sí __X__ No Número de créditos: 1 a 3 por semestre y maximo de 6 crs en total.

Codificación alfanumérica sugerida: INEL 8495

Tipo de créditos: ________ Fijo ____X____ Variable

Puede repetirse con crédito: ____X____ Sí (máximo de créditos ___6 en total__) _______No

Horas semanales de:

__1 a 3__ Conferencia	______ Laboratorio	______ Tutorías
______ Discusión	______ Taller	______ Investigación
______ Seminario	______ Internado	______ Tesis o
______ Estudio Independiente	______ Práctica Supervisada	______ Disertación

Modalidad de educación a distancia (si aplica): ____

____

____

Total de horas a reunirse por periodo lectivo: ____1 a 3________

Equivalencia en horas crédito para la tarea del profesor (carga académica):[2] ____1 a 3

Patrón académico en que se ofrece el curso:

___ Semestre _____ Trimestre _____Cuatrimestre _____Año ___X___Otro: Demanda

Secuencia Curricular (C = Cuatrimestre; T = Trimestre; S = Semestre)[3]

Periodo: __S1 __S2 ___T1 ___T2 ___T3 ___C1 ___C2 ___C3 ___C4 ___Verano

Año: ___1[ero] ___2[ndo] __3[ero] ___4[to] ___5[to] __X_ Otro (especifique) ___Ph.D.

Tipo de curso:

_____Requisito ___X__Electivo _____Educación Continua

__Temporero o Experimental (fecha de inactivación: _______)

Posibilidad de equivalencia (en la unidad o en otras unidades del sistema):

_____ Sí ____X____No

Cursos:

Unidad(es) que lo ofrece(n): Recinto Universitario de Mayagüez

Número de estudiantes por sección: ___1____Mínimo ___25__Máximo

¿Conlleva cargos por laboratorios? _____ Sí _____X____ No

Descripción en español (que no exceda los 1,000 caracteres):[4] Estudio de temas selectos en ingeniería de potencia eléctrica o áreas relacionadas.

Descripción en inglés (que no exceda los 1,000 caracteres):[5] Study of selected topics in electric power engineering or related fields.

Curso prerequisitos	Cursos corequisitos
Permiso del Director	

Requisitos especiales para tomar el curso (destrezas, conocimientos, permisos especiales, equipos, materiales, conocimientos del uso de computadoras o programados específicos, otros): ___Depende de los tópicos a discutirse____________________________________

Equipo o instalaciones mínimas requeridas: _______Depende de los tópicos a discutirse______________________

Sistema de calificación:[6]

_X__Letra (A, B, C, D ó F) _____Aprobado (S), No aprobado (NS)

_____Aprobado (p), No aprobado (NP) ______Aprobado (PS, PN, PB), No aprobado (NP)

_____Aprobado (P), Fracasado (F) ______Otro (Especifique: ________________________________)

¿Comprende contenido temático de otros cursos?

_______Sí ___X__No

Especifique: ____

¿Se inactivará o eliminará algún curso al crear éste?[7]

_______Sí __X__No

Especifique: ____

____

Aprobación a nivel de la unidad	
Director(a) del Departamento:	Fecha:
Decano(a) de la Facultad:	Fecha:
Decano(a) de Estudios Graduados:[8]	Fecha:
Decano(a) de Asuntos Académicos:	Fecha:

Para uso de la Vicepresidencia para Asuntos Académicos e Investigación . NO escriba bajo este renglón.	
Codificación:	Fecha de codificación:
Funcionario que procesó la solicitud:	Fecha de envío a unidad:

[1]Copia de esta sección será remitida a la unidad de origen del curso después de procesada la solicitud en la Vicepresidencia para Asuntos Académicos e Investigación en la Administración Central.
[2]Según establecido por la Junta Universitaria en la Certificación Núm. 8, 1986-87.
[3] Orden del curso según programa de estudios autorizados.
[4] Debe coincidir con la descripción del curso en el Prontuario del mismo.
[5] Debe coincidir con la descripción del curso en el Prontuario del mismo.
[6] Deberá consultarse a la Oficina del Registrador de la unidad para constatar sistemas permitidos.
[7] El Decano(a) de Asuntos Académicos será responsable de procesar la inactivación o eliminación del mismo y de llevar a cabo los arreglos pertinentes para asegurar que ningún estudiante se vea afectado por esta acción. Además, esta solicitud deberá venir acompañada de la ***Solicitud de Inactivación o Eliminación de Cursos.***
[8] Cuando aplique.

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL8495
Course Title: Advanced Topics In Electric Power Engineering: Power Engineering Analysis
Number of credits: 3
Contact Period: Three hours of lecture per week

2. Course Description:

English: Development of mathematical models for the main components of the power system based on their properties and physical aspects.

Spanish: Desarrollo de modelos matemáticos para los componentes principales del sistema de potencia a partir de las propiedades y comportamiento físico de los mismos.

3. Pre/Co-requisites and other requirements:

Prerequisites:

4. Course Objectives:

After completing the course, the students should be able to understand the interaction between major components of a power system and predict their behavior.

5. Instructional Strategies:

☒ conference ☐ discussion ☐ computation ☐ laboratory

☐ seminar with formal presentation ☐ seminar without formal presentation ☐ workshop

☐ art workshop ☐ practice ☐ trip ☐ thesis ☐ special problems ☐ tutoring

☐ research ☐ other, please specify:

6. Minimum or Required Resources Available:

Standard lecturing facilities.

7. Course timeframe and thematic outline

Outline	Contact Hours
Transmission Lines	9
Single Phase Transformers	9
Balanced Three Phase systems	6
Unbalanced Three Phase Systems	9
Symmetrical Components	9
Exams	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**2**	**50**
☒ **FinalExam**	**1**	**25**
☐ **ShortQuizzes**		
☐ **OralReports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**		**25**
☐ **Journals**		
☐ **Other, specify:**		
TOTAL:		**100%**

10.Bibliography:

Textbook:

(1) Degeneff, R.C.; Hesse, M.J.; *Principles of Power Engineering Analysis*; CRC; 2011.

Additional References:

(2) *IEEE Transaction on Power Delivery*. http://ieeexplore.ieee.org/servlet/opac?punumber=61. [Available via IEEE Xplore, UPRM General Library Databases]

(3) *IEEE Transactions on Power Systems*. http://ieeexplore.ieee.org/servlet/opac?punumber=59. [Available via IEEE Xplore, UPRM General Library Databases]

(4) Stojkovic, Z.; *Computer-Aided Design in Power Engineering*; Springer; 2012. http://dx.doi.org/10.1007/978-3-642-30206-0. [Available via Springer eBooks, UPRM General Library Databases]

(5) Panigrahi, B.K.; Abraham, A.; Das, S.; *Computational Intelligence in Power Engineering*; Springer; 2010. http://dx.doi.org/10.1007/978-3-642-14013-6. [Available via Springer eBooks, UPRM General Library Databases]

(6) Zelinka, I.; Vasant, P.; Barsoum.; *Power, Control and Optimization*; Springer; 2013

11.According to Law51

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Personwho prepared thisdescription and date ofpreparation:

Erick E. Aponte Bezares, Mar 2013

UNIVERSIDAD DE PUERTO RICO
ADMINISTRACIÓN CENTRAL
VICEPRESIDENCIA PARA ASUNTOS ACADÉMICOS E INVESTIGACIÓN

SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A[1]

Unidad: Recinto Universitario de Mayagüez ________________ Facultad: Ingeniería ________________________

Departamento: Ingeniería Eléctrica y de Computadoras Programa: Doctorado en Ingeniería Eléctrica

Certificación de autorización del programa por: Junta de Síndicos _____________ Consejo de Educación Superior ______________

Fecha de solicitud: 8 de septiembre de 2005 Fecha de vigencia del curso: Agosto de 2006

Título completo en español Temas avanzados en electrónica de potencia

(Título abreviado a 26 espacios): Temas Avan. Elect Potencia

Título completo en inglés Advanced Topics in Power Electronics

(Título abreviado a 26 espacios): Adv Topics Power Elect

Materia principal del curso (en clave alfa): _______INEL___________________________

Nivel del curso (marque con una X):

Subgraduado						Graduado			
_	_	_	_	_	_	_	_	X	_
0	1	2	3	4	5	6	7	8	9

Curso de continuación: _____ Sí __X__No Número de créditos: 1 a 3 por semestre y maximo de 6 crs en total.

Codificación alfanumérica sugerida: INEL 8496

Tipo de créditos: ________ Fijo ____X_____ Variable

Puede repetirse con crédito: _____X______ Sí (máximo de créditos___6 en total__) _______No

Horas semanales de:

___1 a 3___Conferencia _______Laboratorio ________Tutorías
________Discusión ________Taller ________Investigación
________Seminario ________Internado ________Tesis o
________Estudio Independiente ________Práctica Supervisada _______Disertación

Modalidad de educación a distancia (si aplica): ____

Total de horas a reunirse por periodo lectivo: _____1 a 3_________

Equivalencia en horas crédito para la tarea del profesor (carga académica):[2] _____1 a 3

Patrón académico en que se ofrece el curso:

__ Semestre _____ Trimestre _____Cuatrimestre _____Año ___X___Otro: Demanda

Secuencia Curricular (C = Cuatrimestre; T = Trimestre; S = Semestre)[3]

Periodo: __S1 _S2 ___T1 ___T2 ___T3 ___C1 ___C2 ___C3 ___C4 ___Verano

Año: ___1ero ___2ndo __3ero ___4to ___5to __X_ Otro (especifique) ___Ph.D.

Tipo de curso:

_____Requisito ___X__Electivo _____Educación Continua

___Temporero o Experimental (fecha de inactivación: _______)

Posibilidad de equivalencia (en la unidad o en otras unidades del sistema):

_____ Sí ____X____No

Cursos:

Unidad(es) que lo ofrece(n): Recinto Universitario de Mayagüez

Número de estudiantes por sección: ___1____Mínimo ___25__Máximo

¿Conlleva cargos por laboratorios? _____ Sí _____X____ No

Descripción en español (que no exceda los 1,000 caracteres):[4] Estudio de temas selectos en electrónica de potencia o áreas relacionadas.

Descripción en inglés (que no exceda los 1,000 caracteres):[5] Study of selected topics in power electronics or related fields.

Curso prerequisitos	Cursos corequisitos
Permiso del Director	

Requisitos especiales para tomar el curso (destrezas, conocimientos, permisos especiales, equipos, materiales, conocimientos del uso de computadoras o programados específicos, otros): ___Depende de los tópicos a discutirse____________________________________

Equipo o instalaciones mínimas requeridas: ________Depende de los tópicos a discutirse____________________________________

Sistema de calificación:[6]

_X__Letra (A, B, C, D ó F) _____Aprobado (S), No aprobado (NS)

_____Aprobado (p), No aprobado (NP) ______Aprobado (PS, PN, PB), No aprobado (NP)

_____Aprobado (P), Fracasado (F) ______Otro (Especifique: ____________________)

¿Comprende contenido temático de otros cursos?

_______Sí ___X__No

Especifique: ____

¿Se inactivará o eliminará algún curso al crear éste?[7]

_______Sí __X__No

Especifique: ____

____

Aprobación a nivel de la unidad	
Director(a) del Departamento:	Fecha:
Decano(a) de la Facultad:	Fecha:
Decano(a) de Estudios Graduados:[8]	Fecha:
Decano(a) de Asuntos Académicos:	Fecha:

Para uso de la Vicepresidencia para Asuntos Académicos e Investigación . NO escriba bajo este renglón.	
Codificación:	Fecha de codificación:
Funcionario que procesó la solicitud:	Fecha de envío a unidad:

[1]Copia de esta sección será remitida a la unidad de origen del curso después de procesada la solicitud en la Vicepresidencia para Asuntos Académicos e Investigación en la Administración Central.

[2]Según establecido por la Junta Universitaria en la Certificación Núm. 8, 1986-87.

[3] Orden del curso según programa de estudios autorizados.

[4] Debe coincidir con la descripción del curso en el Prontuario del mismo.

[5] Debe coincidir con la descripción del curso en el Prontuario del mismo.

[6] Deberá consultarse a la Oficina del Registrador de la unidad para constatar sistemas permitidos.

[7] El Decano(a) de Asuntos Académicos será responsable de procesar la inactivación o eliminación del mismo y de llevar a cabo los arreglos pertinentes para asegurar que ningún estudiante se vea afectado por esta acción. Además, esta solicitud deberá venir acompañada de la ***Solicitud de Inactivación o Eliminación de Cursos.***

[8] Cuando aplique.

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 8496
Course Title: Advanced Topics in Power Electronics
Number of credits: 3
Contact Period: Three hours of lecture per week

2. Course Description:

English: Advanced analysis power semiconductor devices and circuits; design and implementation of power converters and DSP controlled system with emphasis in renewable energy, automotive, aerospace, and utility applications.

Spanish: Análisis avanzado de semiconductores y circuitos de alta potencia; desino e implementación de convertidores de potencia y sistemas de control digital con énfasis en aplicaciones de energía renovable, automotriz, aeroespacial y uitilidades.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

After completing the course, the students should be able to design and implement advanced power electronic circuits and systems.

5. Instructional Strategies:

☒conference ☐discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Standard lecturing facilities; the Power Electronics Laboratory.

7. Course time frame and thematic outline

Outline	Contact Hours
Power semiconductor devices, circuit control, and applications	9
Power converter and inverter analysis and design	9
Wavelet inverters analysis and design	6
DSP control and implementation.	9
Renewable energy, automotive, aerospace, and utility applications.	9
Exams	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ Exams	2	50
☒ Final Exam	1	25
☐ Short Quizzes		
☐ Oral Reports		
☐ Monographies		
☐ Portfolio		
☒ Projects		25
☐ Journals		
☐ Other, specify:		
TOTAL:		100%

10. Bibliography:

Textbook:

(1) Baliga, B. J. *Advanced High Voltage Power Device Concepts*; 2012; Springer. http://dx.doi.org/10.1007/978-1-4614-0269-5. [Available via Springer eBooks, UPRM General Library Databases]

Additional References:

(2) Rashid, M. H.; *Power Electronics Handbook*; 3rd ed.; Butterworth-Heinemann Publications; 2010. [Available at the Circulation Collection (TK7881.15 .P6733 2011), UPRM General Library]

(3) Pressman, A.; Billings, K.; Taylor, M. *Switching Power Supply Design*; 3rd ed.; McGraw-Hill; 2009.

(4) Wilamowski, B.; *Power Electronics and Motor Drives*; 2nd ed.; CRC Press; 2011. http://dx.doi.org/10.1201/b10643. [Available via ElectricalENGINEERINGnetBASE, UPRM General Library Databases]

(5) Liu, Y.; *Power Electronic Packaging: Design, Assembly Process, Reliability and Modeling*; 1rst ed.; Springer. 2012. http://dx.doi.org/10.1007/978-1-4614-1053-9. [Available via Springer eBooks, UPRM General Library Databases]

(6) Hart, D.; *Power Electronics*; 1st ed.; McGraw-Hill; 2010.

11. According to Law 51

Students will identify themselves with the Institution and the instructor of the course for purposes of assessment (exams) accommodations. For more information please call the Student with Disabilities Office which is part of the Dean of Students office (Office #4) at (787) 265-3862 or (787) 832-4040 extensions 3250 or 3258 or by email at virgen.aponte@upr.edu.

Person who prepared this description and date of preparation:

Eduardo Ortiz, Mar 2013

UNIVERSIDAD DE PUERTO RICO
ADMINISTRACIÓN CENTRAL
VICEPRESIDENCIA PARA ASUNTOS ACADÉMICOS E INVESTIGACIÓN

SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A[1]

Unidad: Recinto Universitario de Mayagüez ________________ Facultad: Ingeniería________________________

Departamento: Ingeniería Eléctrica y de Computadoras Programa: Doctorado en Ingeniería Eléctrica

Certificación de autorización del programa por: Junta de Síndicos _____________ Consejo de Educación Superior ______________

Fecha de solicitud: 8 de septiembre de 2005 Fecha de vigencia del curso: Agosto de 2006

Título completo en español Temas avanzados en sistemas de control

(Título abreviado a 26 espacios): Temas Avan. Sist Control

Título completo en inglés Advanced Topics in Control Systems

(Título abreviado a 26 espacios): Adv Topics Control Syst

Materia principal del curso (en clave alfa): _______INEL___________________________

Nivel del curso (marque con una X):	_ _ _ _ _ _	_ _ X _
	0 1 2 3 4 5	6 7 8 9
	Subgraduado	Graduado

Curso de continuación: _____ Sí __X__No Número de créditos: 1 a 3 por semestre y maximo de 6 crs en total.

Codificación alfanumérica sugerida: INEL 8595

Tipo de créditos: ________ Fijo ____X_____ Variable

Puede repetirse con crédito: _____X______ Sí (máximo de créditos___6 en total__) _______No

Horas semanales de:

___1 a 3___Conferencia	_______Laboratorio	________Tutorías
________Discusión	________Taller	________Investigación
________Seminario	________Internado	________Tesis o
________Estudio Independiente	________Práctica Supervisada	_______Disertación

Modalidad de educación a distancia (si aplica): ____

____

____

Total de horas a reunirse por periodo lectivo: _____1 a 3_________

Equivalencia en horas crédito para la tarea del profesor (carga académica):[2] _____1 a 3

Patrón académico en que se ofrece el curso:

__ Semestre _____ Trimestre _____Cuatrimestre _____Año ___X___Otro: Demanda

Secuencia Curricular (C = Cuatrimestre; T = Trimestre; S = Semestre)[3]

Periodo: __S1 _S2 ___T1 ___T2 ___T3 ___C1 ___C2 ___C3 ___C4 ___Verano

Año: ___1ero ___2ndo __3ero ___4to ___5to __X_ Otro (especifique) ___Ph.D.

Tipo de curso:

_____Requisito ___X__Electivo _____Educación Continua

___Temporero o Experimental (fecha de inactivación: _______)

Posibilidad de equivalencia (en la unidad o en otras unidades del sistema):

_____ Sí ____X____No

Cursos:

Unidad(es) que lo ofrece(n): Recinto Universitario de Mayagüez

Número de estudiantes por sección: ___1____Mínimo ___25__Máximo

¿Conlleva cargos por laboratorios? _____ Sí _____X____ No

Descripción en español (que no exceda los 1,000 caracteres):[4] Estudio de temas selectos en sistemas de control o áreas relacionadas.

Descripción en inglés (que no exceda los 1,000 caracteres):[5] Study of selected topics in control systems or related fields.

Curso prerequisitos	Cursos corequisitos
Permiso del Director	

Requisitos especiales para tomar el curso (destrezas, conocimientos, permisos especiales, equipos, materiales, conocimientos del uso de computadoras o programados específicos, otros): ___Depende de los tópicos a discutirse___________________________________

Equipo o instalaciones mínimas requeridas: _______Depende de los tópicos a discutirse____________________

Sistema de calificación:[6]

_X__Letra (A, B, C, D ó F) _____Aprobado (S), No aprobado (NS)

_____Aprobado (p), No aprobado (NP) ______Aprobado (PS, PN, PB), No aprobado (NP)

_____Aprobado (P), Fracasado (F) ______Otro (Especifique: ________________________)

¿Comprende contenido temático de otros cursos?

_______Sí ___X__No

Especifique: ____

¿Se inactivará o eliminará algún curso al crear éste?[7]

_______Sí __X___No

Especifique: ____

____

Aprobación a nivel de la unidad	
Director(a) del Departamento:	Fecha:
Decano(a) de la Facultad:	Fecha:
Decano(a) de Estudios Graduados:[8]	Fecha:
Decano(a) de Asuntos Académicos:	Fecha:

Para uso de la Vicepresidencia para Asuntos Académicos e Investigación . NO escriba bajo este renglón.	
Codificación:	Fecha de codificación:
Funcionario que procesó la solicitud:	Fecha de envío a unidad:

---

[1]Copia de esta sección será remitida a la unidad de origen del curso después de procesada la solicitud en la Vicepresidencia para Asuntos Académicos e Investigación en la Administración Central.

[2]Según establecido por la Junta Universitaria en la Certificación Núm. 8, 1986-87.

[3] Orden del curso según programa de estudios autorizados.

[4] Debe coincidir con la descripción del curso en el Prontuario del mismo.

[5] Debe coincidir con la descripción del curso en el Prontuario del mismo.

[6] Deberá consultarse a la Oficina del Registrador de la unidad para constatar sistemas permitidos.

[7] El Decano(a) de Asuntos Académicos será responsable de procesar la inactivación o eliminación del mismo y de llevar a cabo los arreglos pertinentes para asegurar que ningún estudiante se vea afectado por esta acción. Además, esta solicitud deberá venir acompañada de la ***Solicitud de Inactivación o Eliminación de Cursos.***

[8] Cuando aplique.

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 8595
Course Title: Advanced Topics in Control Systems: Adaptive Control
Number of credits: 3
Contact Period: Three hours of lecture per week

2. Course Description:

English: Advanced analysis and design of control systems using model reference adaptive control in continuous and discrete time, Lyapunov and hyperstability techniques, adaptive observers, self-tuning regulators, minimum variance and LQG control.

Spanish: Análisis avanzado y diseño de sistemas de control usando control de modelo de referencia adaptiva en tiempo continuo y discreto, técnicas de Lyapunov e hiperestabilidad, obsevadores adaptivos, reguladores automodificables, variancia minima y control LQG.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

After completing the course, the students should be able to design and implement advanced control systems.

5. Instructional Strategies:

☒conference ☐discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Standard lecturing facilities; Control Systems Laboratory.

7. Course time frame and thematic outline

Outline	Contact Hours
Model reference adaptive control in continuous and discrete time.	9
Lyapunov and hyperstability approaches, adaptive observers.	9
Design using pole zero assignments.	6
Self-tuning regulators	9
Minimum variance and LQG control.	9
Exams	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ Exams	2	50
☒ Final Exam	1	25
☐ Short Quizzes		
☐ Oral Reports		
☐ Monographies		
☐ Portfolio		
☒ Projects		25
☐ Journals		
☐ Other, specify:		
TOTAL:		100%

10. Bibliography:

Textbook:

(1) Åström, K.; Wittenmark , B.; *Adaptive Control*; 2nd ed.; Dover Publications; 2008.

Additional References:

(2) Sastry, S.; Bodson, M.; *Adaptive Control: Stability, Convergence, and Robustness*; Dover Publications; 2011.

(3) Lavrestsky, E.; Wise, A. *Robust and Adaptive Control with Aerospace Applications*; Springer; 2012.

(4) Ioaonnou, P.; Sun, J.; *Robust Adaptive Control*; Dover Publications; 2012.

(5) Landau, I.; Lozano, R.; M'Saad, M.; Karimi A.; *Adaptive Control: Algorithm, Analysis, and Applications*; Springer; 2011. http://dx.doi.org/10.1007/978-0-85729-664-1. [Available via Springer eBooks, UPRM General Library Databases]

(6) Astolfi, A.; Karagiannis, D.; Ortega, R.; *Nonlinear and Adaptive Control with Applications*; Springer; 2008. http://dx.doi.org/10.1007/978-1-84800-066-7. [Available via Springer eBooks, UPRM General Library Databases]

11. According to Law 51

Students will identify themselves with the Institution and the instructor of the course for purposes of assessment (exams) accommodations. For more information please call the Student with Disabilities Office which is part of the Dean of Students office (Office #4) at (787) 265-3862 or (787) 832-4040 extensions 3250 or 3258 or by email at virgen.aponte@upr.edu.

Person who prepared this description and date of preparation:

Eduardo Ortiz, October 2013

UNIVERSIDAD DE PUERTO RICO
ADMINISTRACIÓN CENTRAL
VICEPRESIDENCIA PARA ASUNTOS ACADÉMICOS E INVESTIGACIÓN

SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A[1]

Unidad: Recinto Universitario de Mayagüez ________________ Facultad: Ingeniería ________________________

Departamento: Ingeniería Eléctrica y de Computadoras Programa: Doctorado en Ingeniería Eléctrica

Certificación de autorización del programa por: Junta de Síndicos _____________ Consejo de Educación Superior ______________

Fecha de solicitud: 8 de septiembre de 2005 Fecha de vigencia del curso: Agosto de 2006

Título completo en español Temas avanzados

(Título abreviado a 26 espacios): Temas Avanzados

Título completo en inglés Advanced Topics

(Título abreviado a 26 espacios): Advanced Topics

Materia principal del curso (en clave alfa): _______INEL___________________________

Nivel del curso (marque con una X):

	Subgraduado	Graduado
	_ _ _ _ _ _	_ _ X _
	0 1 2 3 4 5	6 7 8 9

Curso de continuación: _____ Sí __X__ No Número de créditos: 1 a 3 por semestre y maximo de 6 crs en total.

Codificación alfanumérica sugerida: INEL 8995

Tipo de créditos: ________ Fijo ____X_____ Variable

Puede repetirse con crédito: _____X______ Sí (máximo de créditos___6 en total__) _______No

Horas semanales de:

___1 a 3___Conferencia	_______Laboratorio	________Tutorías
________Discusión	________Taller	________Investigación
________Seminario	________Internado	________Tesis o
________Estudio Independiente	________Práctica Supervisada	_______Disertación

Modalidad de educación a distancia (si aplica): ____

____

____

Total de horas a reunirse por periodo lectivo: _____1 a 3_________

Equivalencia en horas crédito para la tarea del profesor (carga académica):[2] _____1 a 3

Patrón académico en que se ofrece el curso:

___ Semestre _____ Trimestre _____Cuatrimestre _____Año ___X___Otro: Demanda

Secuencia Curricular (C = Cuatrimestre; T = Trimestre; S = Semestre)[3]

Periodo: __S1 _S2 ___T1 ___T2 ___T3 ___C1 ___C2 ___C3 ___C4 ___Verano

Año: ___1ero ___2ndo __3ero ___4to ___5to __X_ Otro (especifique) ___Ph.D.

Tipo de curso:

_____Requisito ___X__Electivo _____Educación Continua

__Temporero o Experimental (fecha de inactivación: _______)

Posibilidad de equivalencia (en la unidad o en otras unidades del sistema):

_____ Sí ____X____No

Cursos:

Unidad(es) que lo ofrece(n): Recinto Universitario de Mayagüez

Número de estudiantes por sección: ___1____Mínimo ___25__Máximo

¿Conlleva cargos por laboratorios? _____ Sí _____X____ No

Descripción en español (que no exceda los 1,000 caracteres):[4] Estudio de temas selectos en ingeniería eléctrica o áreas relacionadas.

Descripción en inglés (que no exceda los 1,000 caracteres):[5] Study of selected topics in electrical engineering or related areas.

Curso prerequisitos	Cursos corequisitos
Permiso del Director	

Requisitos especiales para tomar el curso (destrezas, conocimientos, permisos especiales, equipos, materiales, conocimientos del uso de computadoras o programados específicos, otros): ___Depende de los tópicos a discutirse___

Equipo o instalaciones mínimas requeridas: ________Depende de los tópicos a discutirse___

Sistema de calificación:[6]

_X__Letra (A, B, C, D ó F) _____Aprobado (S), No aprobado (NS)

_____Aprobado (p), No aprobado (NP) ______Aprobado (PS, PN, PB), No aprobado (NP)

_____Aprobado (P), Fracasado (F) ______Otro (Especifique: ________________)

¿Comprende contenido temático de otros cursos?

_______Sí ___X__No

Especifique: ________________

¿Se inactivará o eliminará algún curso al crear éste?[7]

_______Sí __X__No

Especifique: ____

____

Aprobación a nivel de la unidad	
Director(a) del Departamento:	Fecha:
Decano(a) de la Facultad:	Fecha:
Decano(a) de Estudios Graduados:[8]	Fecha:
Decano(a) de Asuntos Académicos:	Fecha:

Para uso de la Vicepresidencia para Asuntos Académicos e Investigación . NO escriba bajo este renglón.	
Codificación:	Fecha de codificación:
Funcionario que procesó la solicitud:	Fecha de envío a unidad:

---

[1]Copia de esta sección será remitida a la unidad de origen del curso después de procesada la solicitud en la Vicepresidencia para Asuntos Académicos e Investigación en la Administración Central.
[2]Según establecido por la Junta Universitaria en la Certificación Núm. 8, 1986-87.
[3] Orden del curso según programa de estudios autorizados.
[4] Debe coincidir con la descripción del curso en el Prontuario del mismo.
[5] Debe coincidir con la descripción del curso en el Prontuario del mismo.
[6] Deberá consultarse a la Oficina del Registrador de la unidad para constatar sistemas permitidos.
[7] El Decano(a) de Asuntos Académicos será responsable de procesar la inactivación o eliminación del mismo y de llevar a cabo los arreglos pertinentes para asegurar que ningún estudiante se vea afectado por esta acción. Además, esta solicitud deberá venir acompañada de la ***Solicitud de Inactivación o Eliminación de Cursos.***
[8] Cuando aplique.

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachellor of Science in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 8995
Course Title: ADVANCED TOPICS
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: Advance Topics and Research Works In Electrical Engineering Or Related Fileds. Open to Doctoral Students and Outstanding Electrical Engineering Students.

Spanish: Temas Avanzados y Trabajos de Investigación de Ingeniería Eléctrica y Ramas Afines. Abierto a estudiantes doctorales y a estudiantes sobresalientes de Ingeniería Eléctrica.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

Students will compare and contrast the theoretical aspects of electrical engineering with the real world practice. They will apply the fundamental concepts taught in the classroom and recognize their value in real practice. Students will experience and be exposed to advance topics and state-of-the-art research works on electrical engineering.

5. Instructional Strategies:

☒conference ☒discussion ☒computation ☐laboratory

☒seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☒special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Materials, equipment, and physical facilities needed to fulfill the course objectives.

7. Course time frame and thematic outline

Outline	Contact Hours
Varies with assignment	15-45
Total hours: (equivalent to contact period)	15-45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**varies**	**40**
☐ **Final Exam**		
☐ **Short Quizzes**		
☐**Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**varies**	**20**
☐**Journals**		
☒**Other, specify: Reports**	**varies**	**40**
TOTAL:		**100%**

(Suggested): The faculty member teaching the course will provide the student with the evaluation strategy he/she will be using throughout the semester. This will be done within the first week of classes.

10. Bibliography:
1. Selected articles from various databases available online the UPRM General Library. http://www.uprm.edu/library *2. IEEE Xplore*. http://ieeexplore.ieee.org (Electronic Publications of the IEEE) *3. ScienceDirect.* http://www.sciencedirect.org (Additional references are determined by the faculty member teaching the course.)
11. According to Law 51
Students will identify themselves with the Institution and the instructor of the course for purposes of assessment (exams) accommodations. For more information please call the Student with Disabilities Office which is part of the Dean of Students office (Office #4) at (787) 265-3862 or (787) 832-4040 extensions 3250 or 3258 or by email at virgen.aponte@upr.edu. .

Person(s) who prepared this description and date of preparation: Eduardo I. Ortiz-Rivera, June 15, 2013
Revision: Eduardo I. Ortiz-Rivera, October 11, 2013

UNIVERSIDAD DE PUERTO RICO
ADMINISTRACIÓN CENTRAL
VICEPRESIDENCIA PARA ASUNTOS ACADÉMICOS E INVESTIGACIÓN

SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A[1]

Unidad: Recinto Universitario de Mayagüez________________ Facultad: Ingeniería________________________

Departamento: Ingeniería Eléctrica y de Computadoras Programa: Doctorado en Ingeniería Eléctrica

Certificación de autorización del programa por: Junta de Síndicos _____________ Consejo de Educación Superior ______________

Fecha de solicitud: 8 de septiembre de 2005 Fecha de vigencia del curso: Agosto de 2006

Título completo en español:______Estudio Independiente_____

(Título abreviado a 26 espacios):___Estudio Independiente_____

Título completo en inglés:________Independent Study________

(Título abreviado a 26 espacios):___Independent Study________

Materia principal del curso (en clave alfa): _______INEL___________________________

Nivel del curso (marque con una X):

Subgraduado	Graduado
_ _ _ _ _ _	_ _ X _
0 1 2 3 4 5	6 7 8 9

Curso de continuación: _____ Sí __X__No Número de créditos: 1 a 3 por semestre.

Codificación alfanumérica sugerida: INEL 8997

Tipo de créditos: ________ Fijo ____X_____ Variable

Puede repetirse con crédito: _____X______ Sí (máximo de créditos___3 en total__) _______No

Horas semanales de:

_______Conferencia	_______Laboratorio	________Tutorías
_________Discusión	_________Taller	________Investigación
________Seminario	_________Internado	________Tesis o
___1 a 3 Estudio Independiente	_________Práctica Supervisada	_______Disertación

Modalidad de educación a distancia (si aplica): ____

____

____

Total de horas a reunirse por periodo lectivo: _____1 a 3_________

Equivalencia en horas crédito para la tarea del profesor (carga académica):[2] _____1 a 3___

Patrón académico en que se ofrece el curso:

___ Semestre _____ Trimestre _____Cuatrimestre _____Año ___X___Otro: Demanda

Secuencia Curricular (C = Cuatrimestre; T = Trimestre; S = Semestre)[3]

Periodo: __S1 _S2 ___T1 ___T2 ___T3 ___C1 ___C2 ___C3 ___C4 ___Verano

Año: ___1^{ero} ___2^{ndo} __3^{ero} ___4to ___5to __X_ Otro (especifique) ___Ph.D.

Tipo de curso:

_____Requisito ___X__Electivo _____Educación Continua

__Temporero o Experimental (fecha de inactivación: _______)

Posibilidad de equivalencia (en la unidad o en otras unidades del sistema):

_____ Sí ____X____No

Cursos:

Unidad(es) que lo ofrece(n): Recinto Universitario de Mayagüez

Número de estudiantes por sección: ___1____Mínimo ___25__Máximo

¿Conlleva cargos por laboratorios? _____ Sí _____X____ No

Descripción en español (que no exceda los 1,000 caracteres):[4] Investigación independiente en ingeniería eléctrica y áreas afines.

Descripción en inglés (que no exceda los 1,000 caracteres):[5] Individual student research in electrical engineering and related fields.

Curso prerequisitos	Cursos corequisitos
Permiso del Director	

Requisitos especiales para tomar el curso (destrezas, conocimientos, permisos especiales, equipos, materiales, conocimientos del uso de computadoras o programados específicos, otros): ___Depende de los tópicos a investigar____

Equipo o instalaciones mínimas requeridas: _______Depende de los tópicos a investigar______________________________

Sistema de calificación:[6]

_X__Letra (A, B, C, D ó F) _____Aprobado (S), No aprobado (NS)

_____Aprobado (p), No aprobado (NP) ______Aprobado (PS, PN, PB), No aprobado (NP)

_____Aprobado (P), Fracasado (F) ______Otro (Especifique: ___________________________________)

¿Comprende contenido temático de otros cursos?

_______Sí ___X__No

Especifique: ____

¿Se inactivará o eliminará algún curso al crear éste?[7]

_______Sí __X___No

Especifique: ____

____

Aprobación a nivel de la unidad	
Director(a) del Departamento:	Fecha:
Decano(a) de la Facultad:	Fecha:
Decano(a) de Estudios Graduados:[8]	Fecha:
Decano(a) de Asuntos Académicos:	Fecha:

Para uso de la Vicepresidencia para Asuntos Académicos e Investigación . NO escriba bajo este renglón.	
Codificación:	Fecha de codificación:
Funcionario que procesó la solicitud:	Fecha de envío a unidad:

[1]Copia de esta sección será remitida a la unidad de origen del curso después de procesada la solicitud en la Vicepresidencia para Asuntos Académicos e Investigación en la Administración Central.
[2]Según establecido por la Junta Universitaria en la Certificación Núm. 8, 1986-87.
[3] Orden del curso según programa de estudios autorizados.
[4] Debe coincidir con la descripción del curso en el Prontuario del mismo.
[5] Debe coincidir con la descripción del curso en el Prontuario del mismo.
[6] Deberá consultarse a la Oficina del Registrador de la unidad para constatar sistemas permitidos.
[7] El Decano(a) de Asuntos Académicos será responsable de procesar la inactivación o eliminación del mismo y de llevar a cabo los arreglos pertinentes para asegurar que ningún estudiante se vea afectado por esta acción. Además, esta solicitud deberá venir acompañada de la ***Solicitud de Inactivación o Eliminación de Cursos.***
[8] Cuando aplique.

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 8997
Course Title: INDEPENDENT STUDY
Number of credits: 3
Contact Period: Independent studies

2. Course Description:

English: Individualized study advance projects in electrical engineering and/or related areas under supervision of a member of the faculty. The student develops a plan including faculty consultation, learning objectives, progress, and evaluation.

Spanish: Estudios avanzados individualizados en ingeniería eléctrica y/o áreas relacionadas bajo la supervisión de un miembro de la facultad. El estudiante desarrollará un plan que incluirá consultas con la facultad, objetivos de aprendizaje, progreso, y evaluación.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

Evaluate the state of the art and identify gaps in the current state of knowledge in a particular topic in Electrical Engineering. Select and construct a well-organized bibliography on specific Electrical Engineering topics using library resources and the internet.

5. Instructional Strategies:

☒conference ☐discussion ☒computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☒other, please specify: Independent studies

6. Minimum or Required Resources Available:

Campus library. Other resources dependent on the particular topics being studied.

7. Course time frame and thematic outline

Dependent on the particular topics being studied

8. Grading System

☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

(Suggested): The faculty member teaching the course will provide the student with the evaluation strategy.

	Quantity	Percent
☒ **Exams**	**TBD**	**0-100**
☒ **Final Exam**	TBD	**0-100**
☐ **Short Quizzes**		
☒ **Oral Reports**	TBD	**0-100**
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	TBD	**0-100**
☐ **Journals**		
☒ **Homework**	TBD	**0-100**
☒ **Other, specify: Papers review**	TBD	**0-100**
TOTAL:		**100%**

10. Bibliography:

1. *Selected articles from various databases available online the UPRM General Library*. http://www.uprm.edu/library
2. *IEEE Xplore*. http://ieeexplore.ieee.org (Electronic Publications of the IEEE)
3. *ScienceDirect.* http://www.sciencedirect.org
(Additional references are determined by the faculty member teaching the course.)

11. According to Law 51

Students will identify themselves with the Institution and the instructor of the course for purposes of assessment (exams) accommodations. For more information please call the Student with Disabilities Office which is part of the Dean of Students office (Office #4) at (787) 265-3862 or (787) 832-4040 extensions 3250 or 3258 or by email at virgen.aponte@upr.edu.

Person who prepared this description and date of preparation:

Eduardo I. Ortiz-Rivera, November 24, 2013

UNIVERSIDAD DE PUERTO RICO
ADMINISTRACIÓN CENTRAL
VICEPRESIDENCIA PARA ASUNTOS ACADÉMICOS E INVESTIGACIÓN

SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A[1]

Unidad: Recinto Universitario de Mayagüez ________ Facultad: Ingeniería ________

Departamento: Ingeniería Eléctrica y de Computadoras Programa: Doctorado en Ingeniería Eléctrica

Certificación de autorización del programa por: Junta de Síndicos ______ Consejo de Educación Superior ______

Fecha de solicitud: 8 de septiembre de 2005 Fecha de vigencia del curso: Agosto de 2006

Título completo en español; Seminario Doctoral

(Título abreviado a 26 espacios): Seminario Doctoral

Título completo en inglés Doctoral Seminar

(Título abreviado a 26 espacios): Doctoral Seminar

Materia principal del curso (en clave alfa): INEL

Nivel del curso (marque con una X):

Subgraduado						Graduado			
_	_	_	_	_	_	_	_	X	_
0	1	2	3	4	5	6	7	8	9

Curso de continuación: ____ Sí X No Número de créditos: 0 a 1 crédito por semestre y maximo de 1 crédito en total.

Codificación alfanumérica sugerida: INEL 8998

Tipo de créditos: ______ Fijo X Variable

Puede repetirse con crédito: X Sí (máximo de créditos 1 en total) ______No

Horas semanales de:

______Conferencia	______Laboratorio	______Tutorías
______Discusión	______Taller	______Investigación
1 Seminario	______Internado	______Tesis o
______Estudio Independiente	______Práctica Supervisada	______Disertación

Modalidad de educación a distancia (si aplica): ________

Total de horas a reunirse por periodo lectivo: 1

Equivalencia en horas crédito para la tarea del profesor (carga académica):[2] 1 a 3

Patrón académico en que se ofrece el curso:

__ Semestre ____ Trimestre ____Cuatrimestre ____Año X Otro: Demanda

Secuencia Curricular (C = Cuatrimestre; T = Trimestre; S = Semestre)[3]

Periodo: __S1 __S2 ___T1 ___T2 ___T3 ___C1 ___C2 ___C3 ___C4 ___Verano

Año: ___1ero ___2ndo ___3ero ___4to ___5to __X_ Otro (especifique) ___Ph.D.

Tipo de curso:

__X__Requisito _____Electivo _____Educación Continua

__Temporero o Experimental (fecha de inactivación: _______)

Posibilidad de equivalencia (en la unidad o en otras unidades del sistema):

_____ Sí ___X___No

Cursos:

Unidad(es) que lo ofrece(n): Recinto Universitario de Mayagüez

Número de estudiantes por sección: ___1___Mínimo ___25__Máximo

¿Conlleva cargos por laboratorios? _____ Sí ____X____ No

Descripción en español (que no exceda los 1,000 caracteres):[4] Presentaciones orales sobre temas de investigación en ingeniería eléctrica..

Descripción en inglés (que no exceda los 1,000 caracteres):[5] Oral presentations in research topics in electrical engineering.

Curso prerequisitos	Cursos corequisitos
Permiso del director	

Requisitos especiales para tomar el curso (destrezas, conocimientos, permisos especiales, equipos, materiales, conocimientos del uso de computadoras o programados específicos, otros): ___Ser estudiante regular del programa doctoral_______________

Equipo o instalaciones mínimas requeridas: _______Sala para reuniones_con equipo audiovisual_______________

Sistema de calificación:[6]

__X__Letra (A, B, C, D ó F) _____Aprobado (S), No aprobado (NS)

_____Aprobado (p), No aprobado (NP) ______Aprobado (PS, PN, PB), No aprobado (NP)

_____Aprobado (P), Fracasado (F) ______Otro (Especifique: _______________)

¿Comprende contenido temático de otros cursos?

_______Sí __X__No

Especifique: _______________

¿Se inactivará o eliminará algún curso al crear éste?[7]

_______Sí   __X___No

Especifique: ____

____

Aprobación a nivel de la unidad	
Director(a) del Departamento:	Fecha:
Decano(a) de la Facultad:	Fecha:
Decano(a) de Estudios Graduados:[8]	Fecha:
Decano(a) de Asuntos Académicos:	Fecha:

Para uso de la Vicepresidencia para Asuntos Académicos e Investigación . NO escriba bajo este renglón.	
Codificación:	Fecha de codificación:
Funcionario que procesó la solicitud:	Fecha de envío a unidad:

---

[1]Copia de esta sección será remitida a la unidad de origen del curso después de procesada la solicitud en la Vicepresidencia para Asuntos Académicos e Investigación en la Administración Central.
[2]Según establecido por la Junta Universitaria en la Certificación Núm. 8, 1986-87.
[3] Orden del curso según programa de estudios autorizados.
[4] Debe coincidir con la descripción del curso en el Prontuario del mismo.
[5] Debe coincidir con la descripción del curso en el Prontuario del mismo.
[6] Deberá consultarse a la Oficina del Registrador de la unidad para constatar sistemas permitidos.
[7] El Decano(a) de Asuntos Académicos será responsable de procesar la inactivación o eliminación del mismo y de llevar a cabo los arreglos pertinentes para asegurar que ningún estudiante se vea afectado por esta acción. Además, esta solicitud deberá venir acompañada de la ***Solicitud de Inactivación o Eliminación de Cursos.***
[8] Cuando aplique.

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachellor of Science in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 8998
Course Title: DOCTORAL SEMINAR
Number of credits: Zero to One Credit hours
Contact Period: 1 hour of lecture per week

2. Course Description:

English: Study and dissemination of current research topics in electrical engineering and related areas. Forum to provide professional and academic advice to students participating in the doctoral program.

Spanish: Estudio y diseminación de tópicos actualizados de investigación en ingeniería eléctrica y áreas afines. Foro para proveer orientación profesional y académica a los estudiantes participantes en el programa doctoral.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

Expose students to a wide range of research activities in electrical engineering. Improve communication skills. Provide orientation about professional and academic careers in electrical engineering. Provide orientation to students about the process of proposal preparation and research funding. Discuss ethical issues in research, publications and intellectual property. Provide orientation about the doctoral program: academic progress, qualifying exam, comprehensive exam, proposal and thesis preparation, and research expectations. Train the student to conduct research in electrical engineering.

5. Instructional Strategies:

☐conference ☐discussion ☐computation ☐laboratory

☒seminar with formal presentation ☒seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Materials, equipment, and physical facilities needed to fulfill the course objectives.

7. Course time frame and thematic outline

Outline	**Contact Hours**
Topics vary with faculty interests but examples of topics might include:	
How to give effective oral presentations.	2
Proposal preparation.	2
Thesis preparation.	2
How to present and publish your research work.	2
Academic careers in electrical engineering.	2
How to use electronic resources and the WEB to conduct literature searches.	2
How to conduct research.	1
Requirements for the doctoral program: Qualifying exam, Comprehensive exam	1
Academic Progress	1
Total hours: (equivalent to contact period)	15

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☐ **Exams**		
☐ **Final Exam**		
☐ **Short Quizzes**		
☒ **Oral Reports**	**varies**	**40**
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**varies**	**20**
☐ **Journals**		
☒ **Other, specify: Reports**	**varies**	**40**
TOTAL:		**100%**

(Suggested): The faculty member teaching the course will provide the student with the evaluation strategy he/she will be using throughout the semester. This will be done within the first week of classes.

10. Bibliography:

Textbook:

(1) Blaxter, L.; Hughes, C.; Tight, M.; *How to Research*; Open University Press, 4th ed.; 2010.

(2) Davis, G. B.; Parker, C. A.; Straub, D. W.; *Writing the Doctoral Dissertation: A Systematic Approach*, Barron's Educational Series, 3rd ed., 2012.

(3) Gustavii, B.; *How to Prepare a Scientific Doctoral Dissertation Based on Research Articles*; Cambridge University Press; 2012.

(4) *UPRM-Redacción de Tesis*. http://grad.uprm.edu/oeg/RecursosDocumentos/#reda

(Additional references are determined by the faculty member teaching the course. The UPRM's library offers several online databases for the use of the faculty and students. http://www.uprm.edu/library)

IEEE Xplore. http://ieeexplore.ieee.org (Electronic Publications of the IEEE)

ScienceDirect. http://www.sciencedirect.org

Annual Reviews [Available online via Annual Reviews, UPRM General Library]

ProQuest Dissertations & Theses Database [Available online via ProQuest, UPRM General Library]

(Additional references are determined by the faculty member teaching the course.)

11. According to Law 51

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Person(s) who prepared this description and date of preparation: Eduardo I. Ortiz-Rivera, August 21, 2013

UNIVERSIDAD DE PUERTO RICO
ADMINISTRACIÓN CENTRAL
VICEPRESIDENCIA PARA ASUNTOS ACADÉMICOS E INVESTIGACIÓN

SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A[1]

Unidad: Recinto Universitario de Mayagüez ________________ Facultad: Ingeniería ________________________

Departamento: Ingeniería Eléctrica y de Computadoras Programa: Doctorado en Ingeniería Eléctrica

Certificación de autorización del programa por: Junta de Síndicos _____________ Consejo de Educación Superior ______________

Fecha de solicitud: 8 de septiembre de 2005 Fecha de vigencia del curso: Agosto de 2006

Título completo en español; ______ Disertación Doctoral ______

(Título abreviado a 26 espacios): ___ Disertación Doctoral ______

Título completo en inglés ________ Doctoral Dissertation _____

(Título abreviado a 26 espacios): ___ Doctoral Dissertation _____

Materia principal del curso (en clave alfa): _______ INEL ___________________________

Nivel del curso (marque con una X):

_ _ _ _ _ _	_ _ X _
0 1 2 3 4 5	6 7 8 9
Subgraduado	Graduado

Curso de continuación: _____ Sí __X__ No Número de créditos: 0 a 12 por semestre y maximo de 12 crs en total.

Codificación alfanumérica sugerida: INEL 8999

Tipo de créditos: ________ Fijo ____X_____ Variable

Puede repetirse con crédito: _____X______ Sí (máximo de créditos ___12 en total__) _______No

Horas semanales de:

________Conferencia	_______Laboratorio	________Tutorías
_________Discusión	_________Taller	________Investigación
________Seminario	_________Internado	________Tesis o
_________Estudio Independiente	_________Práctica Supervisada	__0 a 12__Disertación

Modalidad de educación a distancia (si aplica): ____

____

____

Total de horas a reunirse por periodo lectivo: _____N/A_________

Equivalencia en horas crédito para la tarea del profesor (carga académica):[2] ____1 a 3___

Patrón académico en que se ofrece el curso:

___ Semestre _____ Trimestre _____Cuatrimestre _____Año ___X___Otro: Demanda

Secuencia Curricular (C = Cuatrimestre; T = Trimestre; S = Semestre)[3]

Periodo: __S1 _S2 ___T1 ___T2 ___T3 ___C1 ___C2 ___C3 ___C4 ___Verano

Año: ___1ero ___2ndo ___3ero ___4to ___5to __X_ Otro (especifique) ___Ph.D.

Tipo de curso:

__X__Requisito _____Electivo _____Educación Continua

__Temporero o Experimental (fecha de inactivación: ______)

Posibilidad de equivalencia (en la unidad o en otras unidades del sistema):

_____ Sí ___X___No

Cursos:

Unidad(es) que lo ofrece(n): Recinto Universitario de Mayagüez

Número de estudiantes por sección: ___1___Mínimo ___N/A__Máximo

¿Conlleva cargos por laboratorios? _____ Sí ____X____ No

Descripción en español (que no exceda los 1,000 caracteres):[4] Desarrollo, preparación y defensa de una disertación basada en un proyecto de investigación original en ingeniería eléctrica que constituya un adelanto en el área de especialización.

Descripción en inglés (que no exceda los 1,000 caracteres):[5] Development, preparation, and defense of a dissertation based on an original research project in electrical engineering that represents a significant contribution in the area of specialization.

Curso prerequisitos	Cursos corequisitos
Aprobación del examen calificador del programa doctoral.	

Requisitos especiales para tomar el curso (destrezas, conocimientos, permisos especiales, equipos, materiales, conocimientos del uso de computadoras o programados específicos, otros): ___Haber aprobado el examen calificador del programa doctoral______________________________

Equipo o instalaciones mínimas requeridas: _______Depende del trabajo a realizarse____________________

Sistema de calificación:[6]

_____Letra (A, B, C, D ó F) _____Aprobado (S), No aprobado (NS)

__X__Aprobado (p), No aprobado (NP) ______Aprobado (PS, PN, PB), No aprobado (NP)

_____Aprobado (P), Fracasado (F) ______Otro (Especifique: ______________________)

¿Comprende contenido temático de otros cursos?

_______Sí ___X__No

Especifique: ____

¿Se inactivará o eliminará algún curso al crear éste?[7]

_______Sí __X___No

Especifique: ____

____

Aprobación a nivel de la unidad	
Director(a) del Departamento:	Fecha:
Decano(a) de la Facultad:	Fecha:
Decano(a) de Estudios Graduados:[8]	Fecha:
Decano(a) de Asuntos Académicos:	Fecha:

Para uso de la Vicepresidencia para Asuntos Académicos e Investigación . NO escriba bajo este renglón.	
Codificación:	Fecha de codificación:
Funcionario que procesó la solicitud:	Fecha de envío a unidad:

[1]Copia de esta sección será remitida a la unidad de origen del curso después de procesada la solicitud en la Vicepresidencia para Asuntos Académicos e Investigación en la Administración Central.
[2]Según establecido por la Junta Universitaria en la Certificación Núm. 8, 1986-87.
[3] Orden del curso según programa de estudios autorizados.
[4] Debe coincidir con la descripción del curso en el Prontuario del mismo.
[5] Debe coincidir con la descripción del curso en el Prontuario del mismo.
[6] Deberá consultarse a la Oficina del Registrador de la unidad para constatar sistemas permitidos.
[7] El Decano(a) de Asuntos Académicos será responsable de procesar la inactivación o eliminación del mismo y de llevar a cabo los arreglos pertinentes para asegurar que ningún estudiante se vea afectado por esta acción. Además, esta solicitud deberá venir acompañada de la ***Solicitud de Inactivación o Eliminación de Cursos.***
[8] Cuando aplique.

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Ph.D. in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 8999
Course Title: DOCTORAL DISSETATION
Number of credits: Zero to twelve credit hours.
Contact Period: Variable (based on the amount of enrolled academic credits)

2. Course Description:

English: Development, preparation and defense of a dissertation based on an original research project which represents a significant contribution to the state of knowledge in Electrical Engineering.

Spanish: Desarrollo, preparación y defensa de una disertación basada en un proyecto de investigación original que representa una contribución significativa al conocimiento en Ingeniería Eléctrica.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

To develop a dissertation that represents a novel and significant contribution to the state knowledge in Electrical Engineering. To present a report documenting the findings of the research.

5. Instructional Strategies:

☐conference ☐discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☒thesis ☐special problems ☐tutoring

☒research ☐other, please specify:

6. Minimum or Required Resources Available:

Materials, equipment, and physical facilities needed to fulfill the course objectives.

7. Course time frame and thematic outline

This is not a lecture based course. Students will meet with faculty advisor and faculty in their graduate committee as needed to advance the research project. Note that the contact hours will vary depending on the enrolled credit hours (i.e. 1 credit is equivalent to 15 contact hours).

Outline	**Contact Hours**
Dissertation research topics vary with faculty and student interests.	Varies
Total hours: (equivalent to contact period)	Varies

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	**Percent**
☒ **Exams**	**1**	**15**
☒ **Final Exam**	**1**	**15**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☒ **Research Reports**	**1**	**10**
☐ **Portfolio**		
☐ **Projects**		
☒ **Journals**	**3**	**60**
☐ **Other, specify:**		
TOTAL:		**100%**

10. Bibliography:

References:

(1) Levin, P.; *Excellent Dissertations!; Student-friendly Guides*. 2nd ed.; McGraw-Hill. 2011. [Available via EBSCO eBooks, UPRM General Library Databases]

(2) Gustavii, B.; *How to Prepare a Scientific Doctoral Dissertation Based on Research Articles*; Cambridge University Press; 2012.B. Gustavii, How to Prepare a Scientific Doctoral Dissertation Based on Research Articles, Cambridge University Press, 2012

(3) Blaxter, L.; Hughes, C.; Tight, M.; *How to Research*; Open University Press, 4th ed.; 2010.

(4) Davis, G. B.; Parker, C. A.; Straub, D. W.; *Writing the Doctoral Dissertation: A Systematic Approach*, Barron's Educational Series, 3rd ed., 2012.

(5) *UPRM-Redacción de Tesis*. http://grad.uprm.edu/oeg/RecursosDocumentos/#reda

(Additional references are determined by the faculty member teaching the course. The UPRM's library offers several online databases for the use of the faculty and students. http://www.uprm.edu/library)

IEEE Xplore. http://ieeexplore.ieee.org (Electronic Publications of the IEEE)

ScienceDirect. http://www.sciencedirect.org

Annual Reviews [Available online via Annual Reviews, UPRM General Library]

ProQuest Dissertations & Theses Database [Available online via ProQuest, UPRM General Library]

11. According to Law 51

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Person(s) who prepared this description and date of preparation: Eduardo I. Ortiz-Rivera, August 21, 2013

Appendix C:Faculty Biosketches

Erick E. Aponte Bezares

(i) Professional Preparations:

D. Eng., Electrical Engineering, Rensselaer Polytechnic Institute, Troy NY, 12/2005
M Eng, Electrical Engineering, Rensselaer Polytechnic Institute, Troy NY, 05/2000
BS, Electrical Engineering, University of Puerto Rico Mayagüez, Mayagüez, PR, 07/1997
AD, Applied Electronics, University of Puerto Rico Humacao, Humacao, PR, 12/1992

(ii) Appointments:

01/2006 - present Assistant Professor, University of Puerto Rico-Mayagüez, PR
- Acting Associate Director (01/2010-present)

01/1999 – 12/2005 Instructor, Rensselaer Polytechnic Institute, Troy NY
08/1997 - 12/1998 Instructor, University of Puerto Rico- Mayagüez, PR

(iii) Relevant Publications:

1. Performance analysis of positive-feedback-based active anti-islanding schemes for inverter-based distributed generators Pengwei Du; Aponte, Erick E.; Nelson, J. Keith; Transmission and Distribution Conference and Exposition, 2010 IEEE PES Digital Object Identifier: 10.1109/TDC.2010.5484525 Publication Year: 2010 , Page(s): 1 - 9
2. Positive-Feedback-Based Active Anti-Islanding Schemes for Inverter-Based Distributed Generators: Basic Principle, Design Guideline and Performance Analysis :Pengwei Du; Zhihong Ye; Aponte, E.E.; Nelson, J.K.; Lingling Fan; Power Electronics, IEEE Transactions on Volume: 25 , Issue: 12 Digital Object Identifier: 10.1109/TPEL.2010.2057446 Publication Year: 2010 , Page(s): 2941 - 2948
3. E.E. Aponte and J.K. Nelson, "Time Optimal Load Shedding for Distributed Power Systems," *IEEE. Trans. Power Syst., vol. 21, no. 1, pp. 269-277, Feb 2006*
4. E.E. Aponte, "Time Optimal Load Shedding for Power Systems with Distributed Resources", Rensselaer Polytechnic Institute, Doctoral Dissertation, Dec. 2005.

(iv) Synergistic Activities

- Advisor of the UPRM Solar Decathlon Team sponsored by US DoE.
- Paper Reviewer for the IEEE Transactions in Power Systems.
- Paper Reviewer for the IASTED Transactions in Power Quality.
- Advised 10 undergraduate students on 6 different undergraduate research projects at UPRM.
- Photovoltaic, Wind Energy, Fuel Cells, Power Electronics, and Control researches.

(v) Collaborators

Dr. J. Keith Nelson, Rensselaer Polytechnic Institute
Dr. Efraín O'Neill, Dr. Miguel Velez, Dr. Miguel Figueroa and Dr. Eduardo Ortiz, UPRM
Dr. Cathy Mazak, UPRM

(vi) Advisors

Dr. J. Keith Nelson, Rensselaer Polytechnic Institute

(vii) Graduate Students Supervised (Since 2001)

Ariel Rivera Colón , Edwin Berrios, Damian Galarza, Abdiel Alicea at the University of Puerto Rico-Mayagüez.

(viii) Honors, Awards and Patents:

- Bill and Melinda Gate Millennium Scholarship Program (8/00-1/04)
- Grainger Foundation Award for Electric Power Engineering Students (8/00)
- Puerto Rico Economic Development Administration Scholarship Program (8/97-7/98

(ix) Courses Taught:

- INEL 6028 Optimization and Economic Operation of Power Systems.
- INEL 5195 Major Design Experience in Electrical Engineering
- INEL 4415 Power System Analysis
- INEL 4103 Electronics System Analysis III
- INEL 4085 Fundamentals of Transformers and Electric Machinery
- INEL 4075 Fundamentals of Electrical Engineering
- INEL 3115 Introduction to Electrical Engineering

(x) Current Research Activities:

- Grad Student: Damian Galarza: Distributed Generation(graduated may 2009)
    - **STABILITY OPTIMIZATION INSTALLING DISTRIBUTED GENERATION IN THE ELECTRICAL SYSTEM OF PUERTO RICO**
- Grad Student: Edwin Berrios: Islanding Detection(July, 2011)
    - **ISALSNDING DETECTION TO SUPPORT DISTRIBIUTED GENERATION**
- **Grad Student: Abdiel Alicea: Distributed Generation(July, 2011)**
    - Optimal Hybrid Renewable Systems Allocation for Load Following Scenarios
-

(xi) External Funded Projects:

- (05-2007) Xantrex Technology Inc. – Solar Decathlon 2007 ($12,000) Equipment Sponsorship
- (08-2007) State Energy Office (PREAA) Solar Decathlon 2007 ($35,000)

Andrés J. Diaz Castillo

(i) Professional Preparations:

Ph.D, Electrical Engineering, Michigan State University, East Lansing, MI 08/2000
MS, Electrical Engineering, University of Puerto Rico, Mayaguez, PR, 05/1992
BS, Electrical Engineering, Universidad Nacional Pedro Henriquez Ureña, Sto. Dgo, RD, 11/1988

(ii) Appointments:

08/2007 to present	Assistant Professor, University of Puerto Rico-Mayagüez, PR
08/2000 - 07/2007	Associate Professor Interamerican University , Aguadilla, PR,
08/1996 – 07/2000	Research Assistant, Michigan State University, East Lansing, MI
08/1992 - 07/1996	Instructor Interamerican University , Aguadilla, PR,
01/1989 – 07/1992	Research Assistant, University of Puerto Rico, MI
01/1987 - 01/1989	Electrical Engineer at Industrial Beta, Sto. Dgo. RD
06/1986 - 01/1987	Electrical Engineer at PRC Harris Inc, Sto.Dgo. RD

(iii) 8 Relevant Publications:

1- **Diaz, Andrés J**.; Saltares, Roger; Rodríguez, Christian; Nuñez, Roberto; Ortiz-Rivera, Eduardo I.; Gonzalez, Jesús; "<u>Induction Motor Equivalent Circuit for Dynamic Simulation</u>" IEEE International Machines and Drives Conference, Miami, FL, May 3-6, 2009.
2- Gonzalez-Llorente, Jesús; Ortiz-Rivera, Eduardo I.; **Diaz, Andrés J**.; "<u>A Maximum Power Point Tracker using Positive Feedforward Control based on the DC Motor Dynamics and PVM Mathematical Model"</u> IEEE International Machines and Drives Conference, May 3-6, 2009
3- Ortiz-Rivera, Eduardo I.; **Diaz, Andrés J**.; "<u>An Approximation of a PVM Model using Integer Polynomials</u>" 34th Annual Conf. of the IEEE Industrial Electronics Soc, November 10-13, 2008
4- **Diaz, Andres J**. ; Jimenez, Manuel; Strangas, Elias; Shamblat, Michael<u>; Integer Pair Representation of Binary Terms and Equations</u> (IEEE MWCCS 98) .
5- **Diaz, Andres J.;** Strangas Elias; Multilevel Three Phase PWM for Induction Motors (ICEM 98)
6- **Díaz, Andrés J**. ; Strangas, Elias; <u>New Wide Overmodulation Method (IEEE APEC-2000</u>)
7- **Diaz Andres J**. K. Venkatesan; <u>Design a Flyback Converter in a Power Factor Correction</u> Junior Technical Meeting Cayey PR
8- **Diaz Andres J**. Intelligent Test Generator (1^{st} Electro technology International Symposium 2002)

(iv) Synergistic Activities

- Member of directors of IEEE Western Chapters, Puerto Rico
- IEEE new student member advisor and recruiting counselor
- Paper Reviewer for the IEEE Midwest Circuits and Systems.
- Advised 6 undergraduate students on 3 different undergraduate research projects at UPRM.
- Motor Control, Photovoltaic, Fuel Cells, Power Electronics,

(v) Collaborators

Dr. Efraín O'Neill, Dr. Marcel Castro and Dr. Eduardo Ortiz, UPRM
Dr. Elias Strangas Michigan State University

(vi) Advisors

Dr. Elias Strangas, Ph.D. Advisor, Michigan State University, East Lansing, MI
Dr. K. Venkatesan, MS Advisor, University of Puerto Rico, Mayaguez, MI

(vii) Graduate Students Supervised (Since 2006)

Oscar Guzmán, Juan Elias Olivo, Roger Sartares, Christian Rodriguez, Jorge Santiago, Harry Oneal at the University of Puerto Rico-Mayagüez.

(viii) Honors, Awards and Patents:

- Distinguished Professor of Science Departments (Inter-American Science Department 2001).
- Distinguished Professor in Research (Inter-American Science Department 2001) Mathematical.
- Dean's List (1990).
- National Minorities College Leadership Award. (NMCAA, May. 1992).
- Tau Beta Pi member

MARCEL J. CASTRO-SITIRICHE
Electrical and Computer Engineering Department
University of Puerto Rico at Mayagüez
Call Box 9000 – Mayagüez, Puerto Rico 00681-9000
787-832-4040 Ext. 3023; marcel.castro@ece.uprm.edu

ACADEMIC PREPARATION

University of Puerto Rico at Mayagüez (UPRM)	B.S.E.E., June 2000
Howard University, Electrical Engineering	Ph.D., August 2007

PROFESSIONAL EXPERIENCE

August 2008 - present, Assistant Professor, Electrical and Computer Engineering Department, University of Puerto Rico at Mayagüez

Summer 2010, Guest Faculty Researcher, Argonne National Laboratory University of Puerto Rico at Mayagüez

August 2007 – July 2008, Adjunct Faculty, Electrical and Computer Engineering Department, Howard University

PUBLICATIONS

Castro-Sitiriche, M., C. Papadopoulos, and H. Huyke, "WIP: Interdisciplinary Integration of Philosophy of Technology." In *Proceedings of the 40th IEEE/ASEE Frontiers in Education Conference*, Washington, DC, October, 2010.

Castro-Sitiriche, M., E. O'Neill-Carrillo, C. Papadopoulos, C. Pomales, A. Santiago, J. Seguel, "WIP: Leveraging on Accreditation Activities to Foster Innovation in Engineering Education." In *Proceedings of the 40th IEEE/ASEE Frontiers in Education Conference*, Washington, DC, October 2010.

Castro-Sitiriche, Marcel J., Chris Papadopoulos and Héctor J. Huyke, "Creating Interdisciplinary Forums in Philosophy of Technology at UPRM", Forum on Philosophy, Engineering & Technology (fPET 2010), Golden, CO, May 2010.

Ortiz-Rivera, Eduardo I. and Castro-Sitiriche, Marcel; "Integration of Hands on Laboratory Experience of Power Electronics and Renewable Energy Applications: Work in Progress"; In *Proceedings of the 39th IEEE/ASEE Frontiers in Education Conference*, San Antonio, TX, October 18-21, 2009.

A. Rubaai, M.J. Castro-Sitiriche, and A. Ofoli; "DSP-Based Laboratory Implementation of Hybrid Fuzzy-PID Controller Using Genetic Optimization for High Performance Motor Drives"; IEEE Trans. on Industry Applications, vol. 44 pp. 1977-1986 Nov-Dec. 2008.

A. Rubaai, M.J. Castro-Sitiriche, and A. Ofoli; "Design and Implementation of Parallel Fuzzy PID Controller for High Performance Brushless Motor Drives: An Integrated Environment for Rapid Control"; IEEE Trans. on Industry Applications, vol. 44 pp. 1090-1098 July-Aug. 2008.

A. Rubaai, M.J. Castro-Sitiriche, and A. Ofoli; "DSP-Based Implementation of Fuzzy-PID Controller Using Genetic Optimization for High Performance Motor Drives"; IEEE Industry Applications Conference, 2007, 42th IAS Annual Meeting. New Orleans, LA. 23-27 Sept. 2007. Third place prize paper award.

MARCEL J. CASTRO-SITIRICHE - UPRM

A. Rubaai, M.J. Castro-Sitiriche, M. Garuba, and L. Burge; "Implementation of Artificial Neural Network-Based Tracking Controller for High Performance Stepper Motor Drives"; IEEE Trans. on Industrial Electronics, vol. 54, pp. 218-227 Feb. 2007.

A. Rubaai, A. Ofoli, M. Castro; "dSPACE DSP-based Rapid Prototyping of Fuzzy PID Controls for High Performance Brushless Servo Drives"; IEEE Industry Applications Conference, 2006, 41th IAS Annual Meeting. Tampa, FL. 8-12 Oct. 2006.

A. Rubaai, M. Castro; "Experimental Implementation of an Adaptive Neural Network Tracking Controller for Motion Control of Step Motors"; IEEE Industry Applications Conference, 2005, 40th IAS Annual Meeting. Conference Record of the 2005, Volume 1, 2-6 Oct. 2005 Pages: 693–699.

J. Tharakan, M. Castro, J. Trimble, B. Stephenson, and C. Verharen; "Diversifying Engineering Education: A Seminar Course on Ethics and Philosophy of Appropriate Technology"; Global Journal of Engineering Education, Australia, UICEE 2005.

J. Tharakan, M. Castro, J. Trimble, D. Schwartzman, B. Stephenson, T. Broome and C. Verharen; "Broadening Horizons for our Students: An Elective Seminar Course on Ethics and Philosophy of Appropriate Technology"; 8th UICEE Annual Conference on Engineering Education, Kingston Jamaica, 7-11 February 2005. Second Place Paper Award.

EXTERNAL FUNDING

Project Title: Graduate Research and Education for Appropriate Technology (GREAT): Inspiring Direct Engagement and Agency (IDEA), National Science Foundation, University of Puerto Rico - Mayagüez, Award #: 1033028, Project Duration: 09/01/10 - 08/31/13, Award Amount: $299,864.

PROFESSIONAL ACTIVITIES

Chair Institute of Electrical and Electronics Engineers (IEEE) Society on Social Implications of Technology and Education Society Joint Chapter of the Western Puerto Rico Section. Principal duties include: to design and coordinate activities that provide a social context to professional engineers, students and faculty.

Reviewer Institute IEEE Transactions of Industry Applications. Also amember of the following IEEE Societies: Industry Applications Society, Power Electronics Society, Education Society, Society on Social Implications of Technology.

Member - Scientific Review Committee of the International Conference of Appropriate Technology (ICAT). Principal duties include promote the conference among the Caribbean Universities and Technology Institutions, and review conference papers.

Member - International Network on Appropriate Technology (INAT). Active network organizing symposiums once a year, an international conference every two years.

Co-coordinator of Social, Ethical, and Global Issues (SEGI) in Engineering Group, College of Engineering, UPRM. Principal duties include the design of ethics modules for sophomore engineering students; the design of module on social and global issues in engineering for undergraduate research students; develop plans to institutionalize the modules; integrate SEGI efforts with other groups on campus.

Recently Supervised Students at UPRM: E. Arce, E. Caraballo, R. Darbali, C. Fernández, C. Gómez, R. Maldonado, J. Ocasio, N. Oliveras, V. Rivera, O. Torres

COLOM-USTARIZ, JOSÉ G.

Academic rank: Professor

Degrees with fields, institution, and date:

BS	Electrical Engineering	University of Puerto Rico, Mayagüez Campus	1988
MS	Electrical Engineering	University of Massachusetts	1991
Ph. D.	Electrical Engineering	University of Pennsylvania	1998

Faculty service at UPRM:

Instructor:	1991 to 1994
Assistant Professor:	1998 to 2001
Associate Professor:	2001 to 2006
Professor	2006 to Present

Principal publications of last five years: (FY 2002-2003 - 2007-2008)

1. Jose Colom, S. Cruz-Pol, M. Cordoba, W. Castellano, V. Acaron, J. Maldonado, Y. Quiles, J. Rosario, and B. De Jesus. "Off-the-Grid radar design and implementation for Remote Sensing Education" 91st American Meteorological Society Annual Meeting, Seattle, 2011.
2. Gianni Alexis Pablos, J. G. Colom, J. Ortiz, S. Cruz-Pol, and J. Trabal. "Development of low cost X-Band Radar for rain reflectivity measurements in the western region of Puerto Rico" 91st American Meteorological Society Annual Meeting, Seattle, 2011.
3. *Gianni Pablos MSEE, Sandra Cruz-Pol PhDEE, Dr. José Colom PhDEE, María Córdoba MSEE, Wilson Castellanos, Melisa Acosta, Benjamín De Jesús, "*Red de Radares Meteorológicos con Energía Solar", Corriente Verde
4. José G. Colom, Sandra Cruz-Pol, Gianni Pablos, María F. Córdoba, Wilson Castellanos, Melisa Acosta, José A. Ortiz, Benjamín de Jesús, "UPRM Weather Radars at the Central American and Caribbean Games at Mayagüez 2010," GRS Newsletters, Sept. 2010.
5. Arocho Meaux, S., A. Mercado Vargas, G. A. Pablos-Vega, E. W. Harmsen, S. Cruz-Pol and J. Colom Ustáriz, "Calibration and validation of CASA radar rainfall estimation" Proceedings of the AWRA Summer Specialty Conference, Tropical Hydrology and Sustainable Water Resources in a Changing Climate. San Juan, Puerto Rico., 2010
6. *M. Trabal[1,2], Gianni A. Pablos-Vega[2], José A. Ortiz[2], José G. Colom-Ustariz[2], Sandra Cruz-Pol[2], David J. McLaughlin[1] and V. Chandrasekar[3] ,"* Off-the-Grid Weather Radar Network for Precipitation Estimation and Monitoring in the Island of Puerto Rico", WRaH Conference 2011, England. Submitted
7. *Gianni A. Pablos-Vega[1], José G. Colom-Ustáriz[1], Sandra Cruz-Pol[1], Jorge M. Trabal[2], V. Chandrasekar[3], Jim George[3], and Francesc Junyent[3], "*DEVELOPMENT OF AN OFF-THE-GRID X-BAND RADAR FOR WEATHER APPLICATIONS ", IGARSS 2010, Hawaii
8. *Miguel B. Gálvez1, Jose Colom2, V. Chandrasekar1, Francesc Junyent1, Sandra Cruz-Pol2, Rafael Rodriguez " SALIENT FEATURES OF THE RADAR NODES IN THE PUERTO RICO TROPICAL WEATHER TESTBED", IGARSS 2009, South Africa*
9. *M. Vega, J.G. Colom, "Student Developed Meteorological Radar Network for the Western Puerto Rico: First Node,", IGARSS 2007, Barcelona, Spain*
10. *J.G. Colom, L. Giraldo, "Phase Shifter System Using Vector Modulation for Phased Array Radars," IGARSS 2007, Barcelona, Spain.*
11. *M. Sanchez, JG. Colom, "Microstrip Corporate Feed with Taylor Distribution for an X-Band Radar Antenna," IASTED 2005 International Conference on Antennas, Radar, and Wave Propagation, Ontario, Canada.*
12. *McLaughlin, D.J., V. Chandrasekar, K. Droegemeier, S. Frasier, J. Kurose, F. Junyent, B. Philips, S. Cruz-Pol, and J. Colom. 2005: Distributed Collaborative Adaptive Sensing (DCAS) for Improved Detection, Understanding, and Prediction of Atmospheric Hazards, 9th Symp. Integrated Obs. Assim. Systems - Atmos. Oceans, Land Surface (IOASAOLS), Amer. Meteor. Soc., San Diego, CA.*
13. *J.G. Colom, S.C. Pol, V.N. Bringi, K. Droegemier, "Multi-Campus Course via Video Conference: Assesment," ITHET 2005, Dominican Republic, 2005.*
14. *Colom, J. G., R. Medina and R. Rodriguez-Solis, "Design of Tunable Balanced Amplifier Using Ferroelectric Materials," Integrated Ferroelectrics, 56: 1097-1106, 2003.*
15. *Colom, J. G., R. Medina and Y. Perez, "Simulation of Single-Stage Tunable Amplifier Using Ferroelectric Materials," Integrated Ferroelectrics, 56: 1131-1140, 2003.*
16. *Toledo, M. and J. Colom , "An Undergraduate Research Program Sponsored by Industry," ASEE 2003 Conference, Nashville, TN, June 2003.*
17. *Colom, J. G., R. Medina and R. Rodriguez-Solis, "Introduction to Electrical Engineering: A New Freshman Course at UPR Mayaguez," ASEE 2003 Conference, Nashville, TN, June 2003.*

Thesis Advisor

- Gianni Pablos (MSEE 2010 CASA) - "OFF THE GRID X-BAND RADAR NODE DEVELOPMENT FOR WEATHER APPLICATIONS"
- Ricardo Rios (MSEE 2009) – "THREE-RADAR NETWORK DEPLOYMENT SITE SURVEY FOR THE WESTERN REGION OF PUERTO RICO"
- Carlos Rodriguez (MSEE 2009 CASA) – "Calibration and Validation of the First Node of the Meteorological X-Band Radar Network for the West Coast of Puerto Rico"
- Omar Rivera (MSEE 2009 CASA) – "A VISUALIZATION PORLET FOR ATMOSPHERIC SENSING APPLICATIONS"
- Manuel Vega (MSEE 2007, CASA) – "Student Developed Meteorological Radar Network for the Western Part of Puerto Rico: First Node"
- Víctor Marrero (Co-Advisor) (MSEE 2007, CASA) – "Design and Development of Dual Pol X-Band Antenna for the OTG Radar"
- Luis Giraldo, MSEE "PHASE SHIFTER SYSTEM USING VECTOR MODULATION FOR PHASED ARRAY RADAR APPLICATIONS"
- Mauricio Sanchez (MSEE 2005, CASA) –"DESIGN AND IMPLEMENTATION OF A TRANSCEIVER AND A MICROSTRIP CORPORATE FEED FOR SOLID STATE X-BAND RADAR"
- Rafael Medina (MSEE 2003, TA) –"Design and Development of Tunable Microwave Components Using Ferroelectric Materials"
- German Rosero (MSEE 2002, CenSSIS) – "Development of Ultra Broadband Switching Matrix for Spiral Antennas used in Water Plume Applications"
- Norma Y. Soto (MSEE 2001, Raytheon) – "Modeling of MMIC Passive Structures for MM-Wave Applications"
- Jorge Trabal (Co-Advisor) – "PUERTO RICO DEPLOYABLE RADAR NETWORK DESIGN; SITE SURVEY AND RADAR DESIGN "

Courses Created at UPRM:
Introduction to Electrical Engineering (freshmen), Introduction to Radar Systems (Graduate), Microwave Active Circuits (Graduate)

Courses Taught at UPRM:
Introduction to Electrical Engineering, Circuit Analysis (non-majors), Circuit Analysis I and II, Electromagnetics I and II, Microwave Engineering, Applied Electromagnetics Capstone, Microwave Active Circuits, Advanced EM, Introduction to Radar Systems, Circuits for Wireless Communication Applications.

References

Stephen Sekeslsky, PhD - Senior Director, SEKELSKY@Telephonics.com
Jose Colucci, PhD, Professor UPRM – biodieselpr1@aol.com
Lynn Carpenter, PhD – lac5@psu.edu
Hamed Parsiani, PhD – parsiani@ece.uprm.edu

Grants or externally funded project active during the last five years: (FY 2002-2003 - 2007-2008)

Collaborative Adaptive Center of Atmosphere NSF ERC Center, TropiNet NSF MRI

Scientific and professional societies of which a member:

IEEE, Tau Beta PI

Community service activities: (FY 2002-2003 - 2007-2008)

Science Fair Judge, UNICEF, Green Campus Activities

ISIDORO COUVERTIER-REYES PROFESSOR

icouver@ece.uprm.edu

Degrees:

Ph.D. Electrical Engineering (Computer Engineering), Lousiana State University, 1996
M.S. Electrical Engineering (Computer Engineering), University of Wisconsin-Madison,1983
B.S. Electrical Engineering, University of Puerto Rico-Mayagüez, 1980

Service on Faculty:

10 years in the Electrical and Computer Engineering Department since 2000
Last rank promotion (Professor) July 2004
Chairman ECE Department (2004-2009)
Coordinator for the Computer Engineering Program at UPRM (2004-2009)
Associate Director ECE Department (2000-2004)

Other Related Experience:

Original appointment in 1985 at UPR-Aguadilla, then UPR-Arecibo in 1987 thru 1991 where I was appointed as Chairman of the Computer Science Department. Started in UPRMayaguez in 1996 after five (5) years on leave of study as an Assistant Professor in the General Engineering Department. Worked for Hewlett-Packard as a Product and Design Engineer from 1983 to 1985. Also worked for McDonnel-Douglas Aircraft Corporation 1981.

Consulting, patents, etc.:

Have served as consultant for Hewlett-Packard.

State(s) in which Registered:

Puerto Rico

Principal Publications:

1- Juan Solá-Sloan and Isidoro Couvertier. A TCP offload engine emulator for estimating the impact of removing protocol processing from a host running Apache HTTP server. In Proceedings of the ACM SIGSIM SCS CNS'09 12th Communications and Networking Simulation Symposium, pages 1–5, March 2009.

2- I. Couvertier, J. Santos "Using Technology to Increase Students Participation in the Learning Process", Fourth LACCEI International Latin American and Caribbean Conference for Engineering and Technology, Mayagüez, Puerto Rico, June 2006

3- Couvertier, I., M. Jiménez, and Palomera R. "Integrating Concepts and Practice in Teaching Embedded Systems Design", International Conference on Engineering Education, Gainesville, Florida, October 16-21, 2004

4- Solá, Juan and I. Couvertier "A parallel TCP/IP offloading framework for TOE devices," in Proceedings of the Applied Telecommunication Symposium, Orlando, FL, Mar. 2003, pp. 115–121

5- J. M. Solá-Sloan and I. Couvertier, “A parallel TCP/IP offloading framework for a TCP/IP offloading implementation,” in Proceedings of IPSOC Based Design, Grenoble, France, Oct. 2002.

Number of graduate students supervised during last 5 years:
Four (4), one (1) PhD.

Scientific and Professional Societies of which a Member:
Institute of Electrical and Electronic Engineers, IEEE Computer Society, IEEE Education
Society, CIAPR

Honors and Awards:
IEEE Senior Member (2004) IEEE Student Chapter Award (2004)
Cisco Academy Instructor Award
IAAP Ejecutivo del Año (2005)

Institutional and Professional Service in the Last Five Years:
Started the Cisco Networking Academy in 2004 which resulted in the development of courses in computer networking and the establishment of the Computer Networking Laboratory.
Member of the “Atrevete” iniciative at UPR-Mayaguez

Professional Development Activities:
Optimizing Data Centers, IEEE, October 2010
Academic Management Workshops at UPR-Mayaguez (six total)
Networkers 2005, Las Vegas Summer
NSF Faculty Enhancement Workshop, UCF, Olando, FL 2003, 2005
Implementing a Risk-Based Approach to Part 11 Compliance – Advanced Level, July, 2004

Others
Five (5) courses from Cisco Advanced Training Center in Venezuela at the Network
Associate Level
Two (2) courses from Cisco Advanced Training Center in Costa Rica at the Professional Level
Cisco Certified Academy Instructor (2004)
Legal Main Contact at the University of Puerto Rico-Mayaguez for the Cisco Certified
Networking Academy

Sandra Cruz-Pol

PROFESSIONAL PREPARATION

University of Puerto Rico	Electrical Engineering	B.S. 1987 (Magna Cum Laude)
University of Massachusetts Amherst	Electrical Engineering	M.S. 1991 (Magna Cum Laude)
Penn State University	Electrical Engineering	Ph.D. 1998 (Magna Cum Laude)

APPOINTMENTS

2004 – present	Professor, University of Puerto Rico at Mayagüez
1998 – 2004	Associate Professor, University of Puerto Rico at Mayagüez
1991 – 1998	Instructor, University of Puerto Rico at Mayagüez
1987 – 1991	Research Assistant, Microwave Remote Sensing Laboratory, Amherst, MA

PUBLICATIONS

Publications Relevant to Project

Colom J., S. Cruz-Pol, M. Cordoba, W. Castellano, V. Acaron, J. Maldonado, Y. Quiles, J. Rosario, and B. De Jesus. "*Off-the-Grid radar design and implementation for Remote Sensing Education*" 91st American Meteorological Society Annual Meeting, Seattle, 2011.

Pablos G.A., J. G. Colom, J. Ortiz, S. Cruz-Pol, and J. Trabal. "*Development of low cost X-Band Radar for rain reflectivity measurements in the western region of Puerto Rico*" 91st American Meteorological Society Annual Meeting, Seattle, 2011.

Pablos G.A., José G. Colom-Ustáriz, Sandra Cruz-Pol, Jorge M. Trabal, V. Chandrasekar, Jim George, and Francesc Junyent, 2010: "*Development Of An Off-The-Grid X-Band Radar For Weather Applications*", 2010: IEEE Geoscience and Remote Sensing Symposium, Honolulu, Hawaii, USA

Colom. J. G., S. Cruz-Pol, V. Marrero, V. Bringi, and K. Droegemeier, , 2005: "*Multi-Campus Courses Via video conference: An Assesment*," ITHET 05, Dominican Replublic. 2005

Arocho-Meaux S. A., Ariel Mercado-Vargas, Gianni A. Pablos-Vega, Eric W. Harmsen and Sandra Cruz-Pol, "*Calibration And Validation Of Casa Radar Rainfall Estimation*", AWRA Summer Specialty Conference, San Juan, PR, Aug 2010.

Pablos-Vega G., José G. Colom-Ustáriz, Sandra Cruz-Pol, Jorge M. Trabal, V. Chandrasekar, Jim George, and Francesc Junyent, "*Development Of An Off-The-Grid X-Band Radar For Weather Applications"* IEEE IGARSS 2010, Hawaii, July 2010.

Colom J.G., S. Cruz-Pol, G. Pablos, M. F. Córdoba, W. Castellanos, M. Acosta, J. A. Ortiz, B. de Jesús*, UPRM Weather Radars at the Central American and Caribbean Games at Mayagüez 2010,* IEEE GRS Newsletter, Sept 2010.

Cruz-Pol, Sandra, "*Come para Frenar el Cambio Climático*", Corriente Verde, Sept 2010

Cruz-Pol, Sandra y Roberto Torres-Martínez, *Consecuencias del Bajo porciento de Reducción de basura de de reciclaje en Puerto Rico,* Corriente Verde, Abril 2010

Cruz-Pol, Sandra, *¿Cuánto Sabes …de Reciclaje?,* Corriente Verde, Abril 2010

Galvez, Miguel B. , José G. Colom, V. Chandrasekar, Francesc Junyent, Sandra Cruz-Pol, Rafael Rodriguez, "*Salient Features of The Radar Nodes In The Puerto Rico Tropical Weather Testbed*" IGARSS 2009, Cape Town, South Africa, July 15, 2009.

Nazario D. Ramirez , S. Cruz-Pol, R. J. Kuligowski, J. M. Castro, and X. Ortiz, "*Validation of the hydro-estimator rainfall retrieval algorithm over Puerto Rico*" , 22nd Conference on Hydrology, The AmericanMeteorological Society, Jan 2008

Ortíz, Xiomara, Nazario Ramírez and Sandra Cruz Pol, "*An algorithm to improve the NEXRAD rain rate estimates*", IGARSS 2007, Barcelona, Spain, 2007.

Margarita Baquero, Sandra Cruz-Pol, V. N. Bringi, and V. Chandraseka, "*Use of Disdrometer data for X-Band Polarimetric Radar Simulation and Tropical Rain Characterization"*, IEEE IGARSS 06, Denver, CO, 2006.

McLaughlin, D., D. Pepyne, V. Chandrasekar, B. Philips, J. Kurose, M. Zink, K. Droegemeier, S. Cruz-Pol, F. Junyent, J. Brotzge, D. Westbrook, N. Bharadwaj, Y. Wang, E. Lyons, K. Hondl, Y. Liu, E. Knapp, M. Xue, A. Hopf, K. Kloesel, A. Defonzo, P. Kollias, K. Brewster, R. Contreras, B. Dolan, T. Djaferis, E. Insanic, S. Frasier, and F. Carr, 2009: *Short-Wavelength Technology and the Potential For Distributed Networks of Small Radar Systems.* Bull. Amer. Meteor. Soc., 90, 1797–1817. 2009

Sionel A. Arocho-Meaux, Ariel Mercado-Vargas, Gianni A. Pablos-Vega, Eric W. Harmsen and Sandra Cruz-Pol, "*Calibration And Validation Of Casa Radar Rainfall Estimation*", AWRA Summer Specialty Conference, San Juan, PR, Aug 2010.

Miguel B. Galvez, José G. Colom, V. Chandrasekar, Francesc Junyent, Sandra Cruz-Pol, Rafael Rodriguez, "*Salient Features of The Radar Nodes In The Puerto Rico Tropical Weather Testbed*" IGARSS 2009, Cape Town, South Africa, July 15, 2009.

McLaughlin, David J., V. Chandrasakar , Jim Kurose, Kelvin Droegemeier and Sandra Cruz-Pol, "Short Wavelength Technology and the Potential for Distributed Networks of Short-Range Radar Systems", IEEE IGARSS 06, Colorado, 2006.

Maeso, José, Cruz Pol, S. L., Margarita Baquero "*DSD characterization and computations of expected reflectivity using data from a Two-Dimensional Video Disdrometer deployed in a Tropical Environment*", IEEE IGARSS 05, Korea. .

Baquero, Margarita, Cruz Pol, S. L., José Maeso, "*Rain-rate estimate algorithm evaluation and Rainfall characterization in Tropical environments using 2DVD , rain gauges and TRMM*", IEEE IGARSS 05, Korea. .

McLaughlin, D. , V. Chandrasekar, K. Droegemeier, S. J. Frasier, J. Colom, J. Kurose, and S. Cruz-Pol, "*Distributed Collaborative Adaptive Sensing (DCAS) for Improved Detection, Understanding, and Prediction of Atmospheric ",* 2005 American Meteorological Society (85th AMS Annual Meeting), Ninth Symposium on Integrated Observing and Assimilation Systems for the Atmosphere, Oceans, and Land Surface (IOAS-AOLS), 2005.

<u>Other Significant Publications</u>

Cruz Pol, S. L., C. S. Ruf and S. J. Keihm, "*Improved 20-32 GHz Atmospheric Absorption Model,*" Radio Science, Vol. 33, No. 5, pp. 1319-1333, September-October 1998.

Cruz Pol, S. L., and C. S. Ruf, "*A Modified Model for the Sea Surface Emissivity at Microwave Frequencies,*" IEEE Trans. on Geoscience and Remote Sensing, Vol.38, no. 2, March 2000.

Cruz-Pol, S., "*Built your Own Electronic Piano Workshop for K-12 students*", International Conference on Engineering Education (ICEE 04), FL, Oct 18-20 2004.

Cruz Pol, S., M. Vélez, J. Colom, R. Rodríguez, H. Parsiani, L. Jiménez, R. Vásquez, "*Laboratory for Remote Sensing and Image Processing*", IEEE Geoscience and Remote Sensing Newsletter, Dec. 2001.

Colom, J., Cruz-Pol S. and Sekelsky S., "*An Undergraduate/Graduate Research Collaboration between UMASS and UPRM,* "ASEE 2003 International Conference on Engineering Education (ICEE'03), Valencia, Spain, 2003.

SYNERGISTIC ACTIVITIES

- Member of the National Academies Committee on Radio Frequencies CORF.
- Associate Editor for University Profiles for the IEEE Geoscience and Remote Sensing Society Newsletter. and IEEE Senior Member.
- General Co-Chair for the International Conference on Engineering Education (ICEE2066)
- Local Arrangements Chair for the MicroRad 06 radiometry conference, both in San Juan, PR.
- Coordinator Green Campus initiative at UPRM, 2007 to present
- Calibrated Microwave Atmospheric Attenuation model recommended by JPL for future NASA microwave radiometric missions to measure water vapor in troposphere.
- Received the Outstanding Achievements in Mentoring from the National Consortium for Minorities Education in Engineering and Sciences (GEM), San Diego, 2001.
- Developed a Microwave Remote Sensing module to be included in an Electromagnetics course to increase understanding and interest of students in a very difficult course. Developed modules for Outreach program for Elementary High School students on Electricity, Electronics, El Niño Radars, and Remote Sensing

COLLABORATORS & OTHER AFFILIATIONS

a. **Collaborators and Co-Editors**
Adriano Camps (Polytechnic University of Catalonia)
V. Chandrasekhar, (Colorado State University)
Eric Knapp, (Univ. of Massachusetts)
Stephen Reising (Colorado State University)
Israel Matos (National Weather Service)

b. **Graduate and Postdoctoral Advisors**
Christopher Ruf, (Michigan Univ. in Ann Harbor)

Gladys O. Ducoudray-Acevedo

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PROFESSIONAL PREPARATION:

Ph.D.	EE	2003	New Mexico State University
M.S.	EE	1997	Oregon Graduate Institute of Science and Technology
B.S.	PHYS	1986	Universidad de Puerto Rico at Río Piedras

APPOINTMENTS:

2005-Present	Electronics Committee Chair
2010-Present	Technical Chair in Analog Area of IEEE MWSCAS 2010
January 2009	Tenured Professor, ECE Department, University of Puerto Rico at Mayagüez
Summer 2006	Invited Researcher at Texas Instruments High Performance Analog
2004 - Present	Assistant Professor, ECE Department, University of Puerto Rico at Mayagüez
Summer 2004	Invited Professor, Engineering and Technology School, APEC University, Dominican Republic
2001 - 2003	Research Assistant, ECE Department, New Mexico State University, Las Cruces, NM
Jan-Aug 2001	Research Test Engineer, Manufacture Test Business Unit Division, Agilent Corp., Loveland, CO
1997-2000	Teaching Assistant, ECE Department, New Mexico State University, Las Cruces, NM
1994 - 1996	Electronics Instructor, ECE Department, University of Puerto Rico at Río Piedras PR
Summer 1993	Fermi National Accelerator Lab, Hardware Division, Batavia, IL

RECENT PUBLICATIONS:

1. "High Resolution Low Power o.6um CMOS 40 MHZ Dynamic Latch Comparator" Carlos Solis, GO Ducoudray, *IEEE Midwest Symposium of Circuits and Systems 2010(MWSCAS):* Aug 1-3, 2010, Vancouver, Canada,.
2. "Is Design Overemphasized in Engineering Education?"R. Palomera, **M. Jimenez**, and G.O. Ducoudray;, In Proceedings of the International Conference on Engineering Education, Budapest,Hungary, Aug. 2008
3. "Analog Rank Order Filters to Reduce Computational Needs in Processing Hyperspectral Images: Coding and Storing of Rank Order Data", Adriana Melendez-Bague, G. O. Ducoudray, *44th ACS Junior Technical Meeting, 29th Puerto Rico Interdisciplinary Scientific Meeting (PRISM)*, February 2009, Rio Piedras, Puerto Rico
4. "Digital to Analog Converter Modules with Offset Cancellation Using Floating-Gate Transistors"Marcelo Quiles, G.O. Ducoudray*" 44th ACS Junior Technical Meeting, 29th Puerto Rico Interdisciplinary Scientific Meeting (PRISM)*, February 2009, Rio Piedras, Puerto Rico.
5. "Analog Rank Order Filters to Reduce Computational Needs in Processing Hyperspectral Images: Analog Circuit Design" Andrey Reyes Caballero, G.O. Ducoudray, , *44th ACS Junior Technical Meeting, 29th Puerto Rico Interdisciplinary Scientific Meeting (PRISM)*, February 2009, Rio Piedras, Puerto Rico
6. "Class AB Floating Gate OTA Module for DAC Implementation", Jose Rivera Galarza, G.O. Ducoudray, *44th ACS Junior Technical Meeting, 29th Puerto Rico Interdisciplinary Scientific Meeting (PRISM)*, February 2009, Rio Piedras, Puerto Rico.
7. "Built-in Analog Supply Current Sensor for Analog and Mixed Signal Integrated Circuits" Melissa Rivera Rivera, G.O. Ducoudray, *44th ACS Junior Technical Meeting, 29th Puerto Rico Interdisciplinary Scientific Meeting (PRISM)*, February 2009, Rio Piedras, Puerto Rico.

8. “Highly linear Wide Input Range CMOS OTA Architectures Operating in Subthreshold and Strong Inversion J. Ramirez-Angulo, C. Durbha, G.O. Ducoudray-Acevedo , RG. Carvajal and Antonio J. Lopez-Martin, special issue on *"VLSI Design and Test", Microelectronic Engineering*, vol. 84 (2007) 273–279 (available at www.sciencedirect.com)
9. “High Accuracy self biasing Cascoded Current Mirror” Laura Sanchez and Gladys O. Ducoudray, *2006 Midwest Symposium of Circuits and Systems*: Aug 6-9, 2006 San Juan Puerto Rico, VI pp 465-468.
10. “Low Voltage High Performance Voltage Mode and Current mode WTA Circuits Based On Flipped Voltage Follower,” J. Ramírez-Angulo, G. Ducoudray-Acevedo, R. G. Carvajal and A. López-Martín, *IEEE Transactions on Circuits and Systems II,* vol. 52, No. 7, July 2005, pp. 420-423.
11. “Hi-Speed High-precision Analog Rank Order Filter with O(n) complexity in CMOS Technology,” R G. Carvajal, J. Ramirez-Angulo, G. O. Ducoudray, and A. López-Martin *IEEE Journal of Solid State Circuits,* Vol. 40, No. 6, June 2005.
12. Gladys O. Ducoudray Acevedo, Ramon Gonzalez Carvajal, Jaime Ramírez Angulo, “A High-Speed Dynamic Current Sensor for iDD Test Based on the Flipped Voltage Follower”, JETTA Journal of electronic Testing Theory and Applications, *In Print*.
13. Gladys Omayra Ducoudray, Ramón Gonzalez Carvajal, Jaime Ramírez-Angulo, “High-Speed High-Precision Analog Rank Order Filter in CMOS Technology” ISCAS 2004, Vancouver Canada, May 23-26, 2004.
14. Jaime Ramírez-Angulo, Gladys Omayra Ducoudray, Ramon Carvajal, “New low-voltage high performance WTA circuits based on flipped voltage followers”. *Transactions of the IECE of Japan,Accepted Feb 2004.*
15. Gladys Omayra Ducoudray, Ramón Gonzalez Carvajal, Jaime Ramírez-Angulo, “High-Speed Dynamic Current Scheme Sensor for iDD Test Based on the Flipped Voltage Follower and Applications of the scheme”, *The International Journal of Integrated Computer-Aided Engineering* submitted for review.
16. Jaime Ramírez-Angulo[1], Ramon Gonzalez-Carvajal , Gladys Omayra Ducoudray, Antonio J. López-Martín, and Antonio Torralba, “New Compact CMOS continuous-time Low-Voltage analog rank-order Filter architecture”. *IEEE Transactions on Circuits and Systems,* (in print)
17. Jaime Ramírez-Angulo, R. Gonzalez-Carvajal and Gladys Omayra Ducoudray “New Very Compact Continuous-Time Low-Voltage Analog Rank-Order Filter Architecture“„ ISCAS 2003, May 25-28, Bangkok, Thailand
18. J. Ramírez-Angulo , C. Durbha, G. O. Ducoudray-Acevedo and R.G. Carvajal, “Low Voltage Wide gm Adjustment Range Highly Linear BiCMOS OTA,” 11th Annual NASA Symposium on VLSI Design , Moscow, Idaho May 28-29, 2003
19. Gladys Omayra Ducoudray Acevedo and Jaime Ramírez-Angulo, “Innovative Built-In Self-Test Schemes for On-Chip Diagnosis, Compliant with the IEEE 1149.4 Mixed-Signal Test Bus Standard,” *Journal of Electronic Testing and Applications*, vol. 19, issue 1, January 2003

SYNERGISTIC ACTIVITIES:

- Reviewer of IEE Transactions of Circuits and Systems
- Reviewer of Journal of Electronic Tester Circuits and Systems
- Coordinator of MOSIS Integrated Circuit Prototype Fabrication at ECE Department, UPRM
- Electronics Committee Coordinator at ECE Department, UPRM
- IAP committee member
- Graduate Committee member
- Planning Committee member
- FEMPROF Co PI
- Technical Chair MWSCAS of 2010
- Publication Chair of MWSCAS of 2006

COLLABORATORS & OTHER AFFILIATIONS:

Collaborators and Co-Editors:

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Antonio López-Martín, Departamento de Ingenieria Eléctrica, Universidad Pública de Navarra, Navarra, España
Antonio Torralba, Departamento de Ingeniería Electrónica, Escuela Técnica Superior de Ingenieros Industriales, Sevilla, Spain

Graduate and Postdoctoral Advisors:

Dr. Jaime Ramírez-Angulo, Ph.D. New Mexico State University
Dr. Anthony Bell, M.S., Oregon Graduate Institute of Science and Technology, Portland, OR

Thesis Advisor to:

Carlos Vega, Laura Sanchez, Melissa Rivera UPRM

Shawn D. Hunt

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Date of Birth: November 2, 1964

Academic Rank: Professor (Full-Time)

Education: Ph.D., Electrical Engineering, Michigan State University, 1992.
MSEE, Electrical Engineering, Michigan State University, 1989.
BSEE, Electrical Engineering, Tulane University, 1986.

UPRM Service:

1988-1992	Academic Leave of Absence
1992-1995	Assistant Professor
1995-2000	Associate Professor
2000-present	Professor

Academic Activities:

Courses Taught and/or Developed:

INEL 3105 Electrical Systems Analysis I
INEL 4095 Signals and Systems
INEL 4102 Electrical Systems Analysis II
INEL 4075 Fundamentals of Electrical Engineering
INEL 4301 Communication Theory I
INEL 4505 Introduction to Control Systems
INEL 5309 Digital Signal Processing
INEL 5505 Linear System Analysis
INEL 5327 Image Processing
INEL 5326 Communication System Design: Signal Processing
INEL 6010 Elements of Statistical Communication Theory
INEL 6049 Multidimentional Signal Processing
INEL 6076 Adaptive and Optimal Signal Processing

Faculty and Department Committees:

Personnel Committee (Department,1997-99,2004-06
Chair 2005-2006)
Industrial Affiliates Program Committee (Department, 1993-97,1999-
2002)

Communication and Signal Processing Committee	(Department, 1992-present, Chair 1997-2004)
Control Systems Committee	(Department, 1992-present)
Graduate Committee	(Department, 1995-1997,2000-08, 2009-2010)
Curricular Revision Committee	(Department, 1995-1996)
Planning Committee	(Department, 1997-2004)
Computational Resources Committee	(Faculty, 1995-2000)

Administrative:

University Academic Senate	(1999-2003)

Funded and Supervised Research:

Selected MS Theses and graduate research:

"Study on the use of Complexity measures for the estimation of Percentage Correct Classification in Hyperspectral Images," Osmarh Marintez, Graduation date December 2009. Funded by CenSSIS grant and depatment teaching assistantship.

"Denoising of Raman Spectrosopy Signals," Luis Quintero, Graduation date December 2008. Funded by CenSSIS grant and depatment teaching assistantship.

"Adaptive Dither for one Dimentional Signals," Carlos Fabian Benitez, Graduation date June 2007. Funded by CenSSIS grant.

"Implementation of a Phased Array Antenna using Digital Beamforming," Juan Torres, Graduation date December 2005. Funded by CASA grant.

"Determining Noise in Hyperspectral Imagery for the Application of Oversampling to Supervised Classification," Jaime Laracuente, Graduation date December 2005. Funded by CenSSIS grant.

"Lossless Compression of Hyperspectral Imagery," Leila Rivera, begun Spring 2002. Graduation date Dec. 2003. Funded by NASA grant.

MS Thesis "Feedback in Pattern Recognition" by Diego Rivera, December 2002. Funded by Censsis grant.

MS Thesis "Automatic Sub-pixel classification of AVHRR images using Neural Networks," by Ricardo Figueroa,1998. Funded by NASA grant.

MS Thesis "Feed-forward Neural Networks for Isolated Speech Recognition Using Four different Back-propagation training Algorithms," by Rafael Torres, 1996. Funded by NSF grant.

Selected Funded Proposals:

CO-I in " PR NASA EPSCoR: Hyperspectral imaging for biodiversity assessment of coastal and terrestrial ecosystems", sponsored by NASA, 2 years starting July 2009, $750k.

Researcher in "An Engineering Research Center for Subsurface Sensing and Imaging Systems," 5 years starting August 2006, $12,607,755.00.

PI in "Servo-Feedback control of an Audio Subwoofer," sponsored by the Industrial Affiliates Program, 1 year starting July, 2003, $1201.89.

PI in "Digital Signal Processing Project Development and Implementation: Active Digital Speaker Correction," sponsored by the Industrial Affiliates Program, 1 year starting July, 2002, $2982.00.

PI in "Supplement of Proposal for the Communication and Signal Processing Laboratory," sponsored by Texas Instruments, December 2002, $2,475.05.

PI in "Proposal for the Communication and Signal Processing Laboratory," sponsored by Texas Instruments, August 2001, $16,445.00.

Researcher in "An Engineering Research Center for Subsurface Sensing and Imaging Systems," 5 years starting August 2000, $12,607,755.00.

PI in "Supplemental Proposal for the Digital Signal Processing Laboratory," sponsored by Texas Instruments, August 2000, $22,425.00.

PI in "Proposal for a Communication and Signal Processing Laboratory," sponsored by the DOD, 18 months starting August 2000, $235,266.37.

CO-PI in "Tropical Center for Earth and Space Studies", sponsored by NASA, 5 years starting July 2000, $4 Million.

PI in "Communication and Digital Signal Processing Project Development and Implementation: CELP voice coding and error correction coding for discrete multitone modulation," sponsored by the Industrial Affiliates Program, 1 year starting July, 1999, $2853.76.

PI in "Proposal for a Digital Signal Processing Laboratory," sponsored by Intel Corporation, June 1999, $67,500.00.

CO-PI in "Unsupervised Classification System for Hyperspectral Data Analysis," sponsored by DEPSCOR,Grant no. DAAG55-98-1-0016, 3 years starting August 1997, $328,180.

CO-PI in "Tropical Center for Earth and Space Studies", sponsored by NASA, 5 years starting July 1995, $5.5Million.

CO-PI in "Development of a Computer Engineering Research Environment at UPR-Mayagüez", sponsored by the National Science Foundation, 5 years starting July 1994, $1.5Million.

Publications:

Shawn Hunt, Osmarh Martinez, "Study on the use of complexity measures for estimation of correct classification percentage in hyperspectral imagery," In Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XIII, Proceedings of SPIE Vol., pp., April 2010.

Luis Quintero, Christian Matthaus, Shawn Hunt, and Max Diem, "Denoising of single scan Raman spectroscopy signals," Proc. SPIE 7568, 756817 (2010)

Luis Quintero, Milos Miljkovic, Shawn Hunt, Christian Matthäus, and Max Diem, **"**Impulsive noise reduction in Raman spectroscopy images," Proc. SPIE **7568**, 75681I (2010)

C, Benitez, and S. Hunt, "Adaptive Dithering of One Dimensional Signals," ICASSP 2008 March 31-April 4, pp. 3757 – 3760, 2008

C. Rivera-Borrero, S. Rosario, S. Hunt, C. Zayas, A. Mundorf, and S. Cardona, "Ground Truth Data Collection for Unmixing Algorithm Evaluation," In Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XIII, Proceedings of SPIE Vol. 6966, pp., March 2008.

S. Rosario-Torres, M. Vélez-Reyes, L.O. Jiménez-Rodríguez, and S. Hunt, "The MATLAB Hyperspectral Image Analysis Toolbox." Accepted for publication in R. Rajesh, editor, Introduction to Advanced Scientific Softwares and Toolboxes, International Association of Engineers Press, 2007.

C. Rivera, S. Hunt, „Comparative Study of State of the Art Algorithms for Hyperspectral Image Analysis,‟ In Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XIII, Proceedings of SPIE Vol. 6565, pp. 656517-1-656517-9, April 2007.

C. Benitez-Quiroz, and S. Hunt, „Determining the Need for Dither when Re-Quantizing a One-dimensional Signal,‟ 121st AES Convention, San Francisco, October 2006.

Vélez-Reyes, M., Goodman, J. A., Castrodad-Carrau, A., Jiménez-Rodriguez, L. O., Hunt, S. D., Armstrong, R., "Benthic habitat mapping using hyperspectral remote sensing" in *Remote Sensing of the Ocean, Sea Ice, and Large Water Regions 2006*, Proceedings of SPIE Vol. 6360.

Torres-Rosario, J.A.; Rondineu, S.; Rodriguez-Solis, R.A.; Hunt, S.; Popovic, Z., “Adaptive discrete lens antenna array for direction of arrival detection,” in Antennas and Propagation Society International Symposium, 2005 IEEE Volume 4A, 3-8, Page(s):122 - 125 vol. 4A, July 2005.

Shawn Hunt, and Leila S. Rodríguez, “Fast Piecewise Linear Predictors for Lossless Compression of Hyperspectral Imagery,” Geoscience and Remote Sensing Symposium, 2004. IGARSS '04. Proceedings. 2004 IEEE International,Volume 1, 2004.

Shawn Hunt and Jaime Laracuente, “Determining noise in Hyperspectral Imagery for the application of Oversampling to Supervised Classification,” Proceedings of the SPIE, April 2004.

Shawn Hunt and Heidy Sierra, “Spectral Oversampling in Hyperspectral Imagery,” Proceedings of the SPIE, vol.5093, pp.643-650, April 2003.

Shawn Hunt and Diego Rivera, “Pattern Recognition in Hyperspectral Imagery using Feedback,” Proceedings of the SPIE's 9th international Symposium on Remote Sensing, 23 - 27 September 2002,Crete, Greece.

Shawn D. Hunt, “Subsurface Sensing using Hyperspectral Imagery”. *Proc. Signal and Imaging Sciences Workshop*, Center for Advanced Signal and Imaging Sciences, Lawrence-Livermore National Laboratory, Nov 18-20, 2001.

Shawn D. Hunt and Miguel Vélez-Reyes, “Band Selection for Lossless Image Compression,” Proceedings of the SPIE, vol. 4381, pp.76-83 , April 2001.

S.D. Hunt, "Nonlinear Predictors for Lossless Compression of AVHRR Imagery," Proceeding of the SPIE, vol.3717, pp. 198-203, April 1999.

Ricardo Figueroa, and Shawn Hunt, "Subpixel Analysis of AVHRR Images," Proceedings of the University Research Centres Technical Conference Proceedings, February 1998.

A. Lopez, A. Torres, and S.D. Hunt, "JPEG Post Processing Image Enhancement," IEEE International Conference on Neural Networks, Houston, TX, June 9-12, 1997.

S.D. Hunt, A. Lopez, and A. Torres "Nonlinear Post Processing Image Enhancement," NASA University Research Centers Technical Advances in Education, Aeronautics, Space, Autonomy, Earth and Environment, NASA ACE Center Series, Vol. 1, pp.349-354, February, 1997.

S.D. Hunt, "A Nonlinear Adaptive Predictor for Speech Compression," IEEE International Conference on Neural Networks, vol.4, pp. 1998-2002, June 1996.

S.D. Hunt, "Project r: Sample Rate Converter," *Recording Magazine*, July 1996.

S. D. Hunt, and J.R Deller Jr. , "Selective Training of Feedforward Artificial Neural Networks Using Matrix Perturbation Theory," *Neural Networks*, vol.8 no.6 pp.931-943, 1995.

W. Marntinez, J. Borges, N. Rodriguez, Shawn Hunt, "A natural language processor with neural networks," IEEE International Conference on Systems, Man and Cybernetics, vol. 4, pp. 3156-3161., October 1995.

S.D. Hunt and B. Ray, " Neural Network Based control of a PWM Buck DC/DC converter", Symposium on Intelligent Systems in Communications and Power, February 1994.

J.R Deller Jr. , and S. D. Hunt, "Faster, higher quality training of feedforward neural networks by selective updating," 1994 IEEE International Symposium on Circuits and Systems, Vol 2, pp. 435-438, June 1994.

S. D. Hunt, and John R. Deller Jr., "Training of Feedforward Artificial Neural Networks Using Selective Updating," Proceedings of the 36th Midwest Symposium on Circuits and Systems, Vol. 2, pp. 1189-1192, Aug. 1993.

John R. Deller, and Shawn Hunt, "A Simple 'Linearized' Learning Algorithm which Outperforms Back-Propagation," IEEE Conference on Neural Networks, vol. III, pp.133-138, 1992. Neural Networks, 1992.

Shawn Hunt, A. Roseiro, and Marvin Siegel, "Signal processing for a non-invasive microwave heart rate estimator ," Engineering in Medicine and Biology Society, 1988. Proceedings of the Annual International Conference of the IEEE, 4-7 Nov. 1988 Page(s):158 vol.1.

Patents:

United States Patent 7,876,247
Hunt, et al. January 25, 2011
Signal Dependent Dither

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EDUCATION

- Ph.D., Iowa State University, Ames, IA, 1996 - Dissertation: "Risk-based operating limits for dynamic security constrained electric power systems."
- MSEE, University of Michigan, Ann Arbor, MI, 1990
- BSEE, Magna Cum Laude, University of Puerto Rico, Mayagüez, PR, 1988

POST DOCTORAL TRAINING

(9/08 - 6/09) Researcher at the Plataforma Solar de Almería (PSA) in Tabernas, Spain. The PSA is the premiere European research and development laboratory for solar thermal concentration systems.

ACADEMIC WORK EXPERIENCE

- (7/05 – present) Professor, (6/00 – 6/05) Associate Professor and (1/97 – 6/00) Assistant Professor of Electrical Engineering at the University of Puerto Rico, Mayagüez (UPRM).

  Courses most often taught in the last years: INEL 6025 Advanced Energy Conversion, INEL 6027 Electric Power Systems Dynamics and Control, INEL 6995 Special Topics in Electrical Engineering: Reactive Power, INEL 6995 Special Topics in Electrical Engineering: Power System Distribution, INEL 4103 Electric Systems Analysis III, INEL 4407 Electrical Systems Design I, INEL 4415 Electric Power Systems Analysis, INEL 4048 Engineering Practice, INEL 4998 Undergraduate Research, INEL 5495 Design Projects in Electric Power Systems: Distribution System Design of Eolic Generation Park, INEL 5995 Special Problems: Environmental and Infrastructure Impact of Eolic Generation.

- President (8/06 – 06/07) and (08/09 – present) Member, Electrical and Computer Engineering Department Personnel Committee

- (8/06 – 5/07) President, ADHOC Committee to Evaluate Proposals for a New UPRM Class Schedule

- (8/05 – 8/06) Elected Academic Senator UPRM. Coordinator of the ADHOC Committee to Design Instruments to Evaluate the Chancellors' Performance, Coordinator of the ADHOC Committee to Evaluate Proposed Academic Work Schedules for the Mayagüez Campus, Member of the Courses Committee.

- (2/00 – 8/00) Assistant Dean of Academic Affairs UPRM. Supervisor of the Registrar Office and the Admissions Office, coordinator of the registration process for the whole Campus, author of the Academic Calendar proposal, coordinator of the Students Academic Progress Committee, supervisor of the Courses Central Archive keeper and coordinator of the Campus Early Admission Program.

- (10/00 – 01/02) and (8/99 – 2/00) Associate Director for Academic Affairs – Electrical and Computer Engineering Department (ECE), UPRM. Graduate Programs Director, updating the faculty recruitment plan, coordinator of the curriculum revision and accreditation processes, evaluate the creation of new academic programs, coordinator and supervisor of registration, co-author of proposals to bring external funding, in charge of promoting and facilitating scientific research in ECE.

ACADEMIC INTERESTS AT GRADUATE LEVEL:

- ✓ Renewable/alternate energy sources such as; eolic and solar thermal and their integration to the grid
- ✓ Electric power system dynamics and operation

EXAMPLES OF FUNDED RESEARCH and EDUCATION PROJECTS

Achievable Renewable Energy Targets For Puerto Rico's Renewable Energy Portfolio Standard (2007) A $327,197 project sponsored by the Puerto Rico Energy Affairs Administration, to produce an estimate, based in realistic boundaries and limitations, of renewable energy available in Puerto Rico for electricity production. Energy resources studied: biomass - including waste-to-energy, micro hydro, ocean - waves, tides, currents and ocean thermal, solar - photovoltaic and solar thermal, wind – utility as well as small wind, and fuel cells.

Colegio San Ignacio - Ejemplo de Sostenibilidad (2007) A $73,332 project to match the energy needs of Colegio San Ignacio with its available renewable energy sources. Demonstration projects with a strong educational component were designed, installed and operated on the Scholl Campus with the participation of the School Faculty and students. The philosophy behind the program was one of sustainable development.

Programa Panamericano de Capacitación en Ingeniería de Potencia Eléctrica (2006) A $97,370 educational project to deliver a Web-broadcast master program in electric power engineering to engineers in the Dominican Republic. Courses in this program responded to the reality and necessities of the Dominican Republic electric power industry and aims for sustainable development.

Caguas Sustainable Energy Showcase, Phase I (2006) A $90,055 project sponsored by the Municipality of Caguas, Puerto Rico to assess the current electric energy consumption profile, by sector; residential, commercial, industrial and governmental, of Caguas and to propose achievable goals (percentages of demand), by sector, to be satisfied using renewable energy sources.

Failure Probabilities for Risk-Based Maintenance and Parameter Estimation of Synchronous Machines (2003) A $99,444 project sponsored by the National Science Foundation (NSF) to estimate parameters and failure probabilities for synchronous generators.

Intelligent Power Routers for Distributed Coordination in Electric Energy Processing Networks (2002) A $499,849 project sponsored by the National Science Foundation (NSF) and the Office for Naval Research (ONR) to develop a model for the next generation power network using a distributed concept based on scalable coordination by an *Intelligent Power Router* (IPR).

EXAMPLES OF FUNDED TECHNOLOGY TRANSFER PROJECTS

Wind Resource Assessment in Caguas (2010) A technology transfer project, derived from **Caguas Sustainable Energy Showcase, Phase I** (see below).

Inspección de Instalación de Calentadores de Agua Solares y Generación Fotovoltaica Suplementaria para la Urbanización Villa Turabo en Caguas (2010) A technology transfer project, derived from **Caguas Sustainable Energy Showcase, Phase I**.

Sustainable Energy Projects for Bayamón's Sustainability Master Plan (2009) A technology transfer project. Duties included: assist Bayamón´s staff to define the scope of renewable energy projects. Pre-design a Photovoltaic Parking Roof for the Sports Complex Onofre Carballeira Umpierre, write RFP sent to companies, evaluate design submitted by companies, design performance criteria for the construction, test, and delivery phases of the project and evaluate the performance of the company/companies during the construction, test, and delivery phases of the project.

Ahorro Energético vía Calentadores de Agua Solares y Generación Fotovoltaica Suplementaria para la Urbanización Villa Turabo en Caguas (2007) A $37,800 technology transfer project, derived from **Caguas Sustainable Energy Showcase, Phase I** to produce an estimated 25% energy savings in residences at Villa Turabo via solar thermal water heaters and supplemental photovoltaic generation.

INTERNATIONAL CONFERENCES AND WORKSHOPS COORDINATION

1. (06/06 – 06/10) Member of the Probabilistic Methods Applied to Power Systems International Society (PMAPS IS) PMAPS IS, incorporated in Canada, is the governing body of the PMAPS Conferences. (06/06 - 05/08) General Chair of PMAPS 2008 Conference and responsible of organizing PMAPS 2008. (05/08 - 06/10) Board member and responsible to administer the venue selection for PMAPS 2012.

2. (06/06 – 05/08) General Chair of the 10th International Conference on Probabilistic Methods Applied to Power Systems (PMAPS 2008) Rincón, Puerto Rico, May 25-29, 2008. PMAPS Conferences provide a regular forum for engineers and scientists worldwide to interact around the common theme of power engineering decision problems under uncertainty.

3. (01/06 – 05/06) Chair of the Sustainable Energy Workshop "**De Acuerdo con la Energía Sostenible y Ahora ¿Cómo llegar allí?**" at the University of Puerto Rico Mayagüez, May 22 and 23, 2007.

OTHER RECENT PROFESSIONAL EXPERIENCE

EXPERT WITNESS – Over 18 cases in federal and state court.

ELECTRIC POWER GRID MANAGEMENT EVALUATION – Engineering evaluation of power system transmission and distribution limitations, associated to a claim of increased operational costs, for Cunningham Lindsey International, Inc.

RENEWABLE ENERGY – Consultant for private companies and the Government of Puerto Rico (wind data analysis, sitting, preliminary wind turbines selection, interconnection issues and preliminary power purchase agreement negotiations).

PEER REVIEWED PUBLICATIONS (over 40 publications) Most recent examples:

1. Agustín A. Irizarry-Rivera, Manuel Rodríguez-Martínez, Bienvenido Vélez, Miguel Vélez-Reyes, Alberto R. Ramirez-Orquin, Efraín O'Neill-Carrillo and José R. Cedeño, "Chapter 3 Intelligent Power Routers: Distributed Coordination for Electric Energy Processing Networks", In J. Momoh, L. Mili (Editors) *Operation and Control of Electric Energy Processing Networks*, John Wiley and Sons/IEEE Press, 2010.

2. José A. Colucci Ríos, Efraín O'Neill-Carrillo and Agustín A. Irizarry-Rivera. "Renewable Energy in the Caribbean: A Case Study from Puerto Rico", In E. Laboy, F. Schaffner, A. Abdelhadi (Editors) *Environmental Management, Sustainable Development and Human Health*, Taylor and Francis Press, pp 291, 2009.

3. Efraín O'Neill-Carrillo, Agustín A. Irizarry-Rivera and José A. Colucci Ríos, "Struggling for Sustainability in a Fossil Fuel Dependent Society," Journal on Electrical Engineering, vol. 2, no. 4, April-June, pp. 44-56, 2009.

4. Efraín O'Neill-Carrillo, Agustín A. Irizarry-Rivera, José A. Colucci-Rios, William Frey, Cecilio Ortiz-García and Marla Pérez-Lugo, "Advancing a Sustainable Energy Ethic Through Stakeholder Engagement," Proceedings of the IEEE Energy 2030 Conference, November 2008, Atlanta, Georgia.

5. José A. Colucci Ríos, Agustín A. Irizarry-Rivera and Efraín O'Neill-Carrillo, "Sustainable Energy for Puerto Rico", Proceedings of the 2007 Energy Sustainability Conference, June 27-30, 2007, Hilton Long Beach, California, USA.

6. Agustín A. Irizarry-Rivera, Manuel Rodríguez-Martínez, Bienvenido Vélez, Miguel Vélez-Reyes, Alberto R. Ramirez-Orquin, Efraín O'Neill-Carrillo and José R. Cedeño, "Intelligent Power Routers: A Distributed Coordination Approach for Electric Energy Processing Networks", International Journal of Critical Infrastructures, Vol. 3 No 1/2 pp. 20-57, 2007.

7. Efraín O'Neill-Carrillo and Agustín A. Irizarry-Rivera, "Socially-Relevant Capstone Design Projects in Power Engineering," Proceedings of the IEEE/PES Power Systems Conference and Exposition, October 2006, Atlanta, GA.

8. Efraín O'Neill-Carrillo, Agustín A. Irizarry-Rivera, Jorge A. Cruz-Emeric, "Curricular Revisions in Electrical Engineering at UPRM," Proceedings of the Thirty-fifth Annual Frontiers in Education Conference, Indianapolis, Indiana, October 2005.

9. Carlos A. Ramos-Robles and Agustín A. Irizarry-Rivera, "Economical Effects of the Weibull Parameter Estimation on Wind Energy Projects", Proceedings of the Thirty-seventh Annual North American Power Symposium, Ames, Iowa, October 23-25, 2005.

10. Jennifer Jiménez-González and Agustín A. Irizarry-Rivera, "Generation Displacement, Power Losses and Emissions Reduction due to Solar Thermal Water Heaters", Proceedings of the Thirty-seventh Annual North American Power Symposium, Ames, Iowa, October 23-25, 2005.

11. Carlos A. Ramos-Robles and Agustín A. Irizarry-Rivera, "Development of Eolic Generation Under Economic Uncertainty", Proceedings of the Eighth Probabilistic Methods Applied to Power Systems (PMAPS) International Conference, Ames, Iowa, September 13-16, 2004.

12. Carlos M. Torres-Ortolaza and Agustín A. Irizarry-Rivera, "Failure Modes and Failure Probability of Intelligent Power Routers", Proceedings of the Eighth Probabilistic Methods Applied to Power Systems (PMAPS) International Conference, Ames, Iowa, September 13-16, 2004.

GRADUATE THESES SUPERVISED (15 completed, 4 in progress) Most recent examples:

1. Felipe Hernández. "Dish/Stirling Solar Thermal Generation Impact on a Distribution Electric Power System in the Dominican Republic", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, In progress.

2. Héctor Pérez. "Economic and Technical Feasibility of Off-Shore Wind Generation in Puerto Rico", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, In progress.

3. Ariel Mercado. "Ocean Waves into Electricity Using Oscillating Water Column and its Effect on the Electric Network", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, In progress.

4. Franchesca Aponte. "Ocean Wave Energy into Electricity Using Offshore Wave Energy Devices in the North Coast of Puerto Rico", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2009.

5. Magaby Quintero. "Ocean Wave Energy into Electricity Using Shoreline Devices in Puerto Rico", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2009.

6. Miguel Rios. “Small Wind / Photovoltaic Hybrid Renewable Energy System Optimization”, MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2008.

7. Linda Monge. “Effect of Distributed Energy Storage Systems in Voltage Stability of an Island Power System”, MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2006.

8. Jennifer Jiménez. “Benefits of Electric Generation Displacement Using Solar Thermal Water Heating”, MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2005.

9. Carlos Ramos. “Determination of Favorable Conditions for the Development of a Wind Power Farm in Puerto Rico”, MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2005.

10. Carlos Torres. “Failure Probability of Intelligent Power Routers”, MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2005.

HONORS AND OTHER PROFESSIONAL ACTIVITIES:

- “2010 Distinguished UPRM Alumni” from the University of Puerto Rico Mayagüez Alumni Association.

- “Ingeniero Electricista Distinguido 2005” (Distinguished Electrical Engineer 2005) from the Electrical Engineering Institute of the Puerto Rico Professional Engineers Society - In recognition of services rendered to the profession and outstanding professional achievements in the field of electrical engineering.

- “2004 Professional Progress in Engineering Award” from Iowa State University - In recognition of outstanding professional progress and personal development in a field of engineering specialization as evidenced by significant contributions to the theory and practice of engineering, distinguished service rendered to the profession, appropriate community service, and/or achievement in a leadership position.

- Recipient “2003-2004 Electrical and Computer Engineering Outstanding Faculty Award” from the School of Engineering, Mayagüez, Puerto Rico

- Recipient ``Iowa State University Research Excellence Award'' for Ph.D. dissertation

- Registered Professional Electrical Engineer in Puerto Rico (6/91) and Member of the “Colegio de Ingenieros y Agrimensores de Puerto Rico”

- Magna Cum Laude – BSEE, University of Puerto Rico, 1988

SERVICES RENDERED TO THE PROFESSION

- Member of the AD HOC Committee for Renewable Energy and Climate of the Puerto Rico Engineers and Surveyors Association (CIAPR, from the Spanish “Colegio de Ingenieros y Agrimensores de Puerto Rico”).

- Member of the AD HOC Committee to Evaluate the Technical Administration of the Puerto Rico Electric System by the Puerto Rico Electric Power Authority during the Tropical Storm (TS) Jeanne of September 15, 2004 - The official state inquiry by the CIAPR into what caused a general electric blackout in the Island of Puerto Rico during Tropical Storm Jeanne. It is part of the CIAPR public responsibility to conduct such inquiries when technical matters are in dispute. Responsibilities included: analysis of technical evidence, as submitted by PREPA, of the power system state and behavior as TS Jeanne crossed over Puerto Rico, the formulation of a hypothesis to explain such behavior, and to judge the decisions made on the administration of the power system during the storm.

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ACADEMICS	Dr. Jimenez current teaching and research interests are centered on the area of design, optimization, and rapid prototyping of digital and mixed-signal circuits, hardware structures for scalable, reconfigurable systems, and embedded systems. His research experience includes the fields of power estimation, optimization, and automatic layout techniques for VLSI circuits. He also has extensive teaching experience in electronics, digital systems design, circuit analysis, and embedded systems. Dr. Jiménez is the founder and coordinator of the Integrated Circuits Design Laboratory (ICDL), the Rapid Systems Prototyping Lab (RASP), and the Electronic Testing & Characterization Laboratory (ETC). He also coordinates the Microprocessor Development Systems Laboratory (MDS).
EDUCATION	**Michigan State University (MSU)** East Lansing, Michigan Ph.D. in Electrical Engineering Aug. 1999 Area of Specialization: CAD Techniques for Automatic Layout Design Research: Development of a Power Minimizing Physical Design Methodology for Digital VLSI Circuits. Research Advisor: Dr. Michael Shanblatt
	University of Puerto Rico at Mayagüez (UPRM) Mayagüez, Puerto Rico Master of Sciences in Electrical Engineering Dec. 1991 Areas of Specialization: Digital Communication Systems and Microprocessors Research: Development and Modeling of a Communications Protocol for a Centralized Packet-radio Network Research Advisor: Dr. Ramón Vasquez
	Universidad Autónoma de Santo Domingo (UASD) Santo Domingo, Dominican Republic B.Sc. in Electromechanical Engineering Nov. 1986 Majors: Power Distribution Systems and Digital Electronics
WORK EXPERIENCE	**University of Puerto Rico at Mayagüez** *Professor: (July 2007 to present)* Electrical and Computer Engineering Department, Mayagüez, Puerto Rico *Associate Professor*: (July 2002 to June 2007) Electrical and Computer Engineering Department, Mayagüez, Puerto Rico *Assistant Professor*: July 1999 to June 2002 Electrical and Computer Engineering Department, Mayagüez, Puerto Rico
	Texas Instruments Inc. *Visiting Professor*: Summer 2008 MSP430 Applications Group - HPA, Dallas, Texas Development of didactic materials for teaching embedded systems using MSP430. **APEC University** *Invited Professor*: Summer 2003 Engineering and Technology School, Santo Domingo, Dominican Republic Taught graduate-level course in Digital Microelectronics and IC Design
	Texas Instruments Inc. *Visiting Professor*: Summer 2000 Wireless CAPCOM Division, Dallas, Texas Collaborator in a design team developing a variable multi-output band-gap voltage reference IC. Provided recommendations for reducing the number of different voltage levels necessary to satisfy design requirements. *Visiting Professor*: Summer 1999 Power Management Products Division, Dallas,Texas Design optimization of mixed-signal power management chip. Recommended design improvements to solve erratic transient behavior when the chip switched among the multiple power supplies it managed.

	Michigan State University *Lecturer:* Summer 1996 Electrical Engineering Department, East Lansing, Michigan Circuit Analysis (EE-200), Michigan State University, East Lansing, MI Taught the basic electric circuits course in the Electrical Engineering Department *Teaching Assistant:* Aug. 1994 - to May 1999 Electrical Engineering Department, East Lansing, Michigan Microprocessors and Computer Interfacing Laboratory, Guided undergraduate students in the usage of development tools and programming/interfacing of the 68HC11 and 68000 microprocessors.
	University of Puerto Rico at Mayagüez *Instructor*: Aug. 1991 - May 1994 Electrical and Computer Engineering Department, Mayagüez, Puerto Rico Taught senior students techniques for designing embedded microprocessor systems. Organized the Interfacing course (INEL-4217) structure and laboratory into a format that is still successfully used today. *Teaching Assistant:* Jan. 1989 - Jun. 1991 Microprocessor Systems Development Laboratory, Electrical and Computer Engineering Department, Mayagüez, Puerto Rico Trained students and developed tutorials in the usage of an HP64000 development system.
	Corporación Dominicana de Electricidad Government Power Utilities Company, Santo Domingo, Dominican Republic *Operations' Division System Analyst* Jan. 1985 - Dec. 1988 Coordinated Division's Computer Section. Developed software applications for load dispatch center.
	Productos Electrónicos S.A. Private Consulting Company, Santo Domingo, Dominican Republic *Technical Support Engineer* Mar. 1984-Jun. 1988 Assembled, troubleshot, and maintained microprocessor based machinery control boards. Designed electrical distribution systems for industrial, commercial, and residential buildings.
COURSES TAUGHT	Fundamentals of Electronics (INEL-4076) Electrical Systems Analysis II (INEL-4102) Microprocessors I (INEL-4206) Digital Electronics (INEL-4207) Microprocessor Interfacing (INEL-4217/ICOM-5217) Integrated Circuits Engineering (INEL-4218) Engineering Practice (INEL-4048) Undergraduate Research (INEL-4998/ICOM-4998) Special Topics – Undergraduate Level (INEL-5995/ICOM-5995) ME/MS Thesis (INEL-6045/INEL-6046) Advanced IC Design Techniques (INEL-6079) VLSI Systems Design (INEL-6080) Special Topics -Graduate level- (INEL-6995) Doctoral Dissertation (CIIC-9995) Special Topics in CISE (CIIC-8997)
SKILLS	FPGA Design and VHDL programming. Advanced EDA tools (Cadence, Synopsys, Mentor Graphics, XILINX tools). Programming experience in C/C++, assembly (MSP430, 68000, 80x86, 8051, 68HC11, 6805, PIC, Z-80), and Fortran. Familiar with UNIX, Windows/DOS, and Mac OS. Knowledge in computer communication protocols, network simulation and analysis software (OpNet), and digital circuit design/analysis packages. Capable of managing groups and conducting independent research. Electronics hobbyist, photography, tennis, enjoys learning new computer programs. Fluent in English and Spanish.
HONORS AND MEMBERSHIPS	General Co-chair: The 49th Midwest Symposium on Circuits and Systems, San Juan, PR Aug. 6 – 9, 2006 Member of Panel in Reviews for the National Science Foundation in Several Occasions (Since 2003) Member Steering Committee for the "Midwest Symposium on Circuits and Systems" (Spring 2001 – to present) Recipient of a National Science Foundation Fellowship for Minorities and Women (1994-1998)

	Recipient of a GTE Corporation Fellowship (Spring 1996) Member of Tau Beta Pi: The National Engineering Honor Society, Alpha Chapter PR (since 1991) Member of The Institute of Electrical and Electronic Engineers (IEEE) (1989-to present) Member of The National Society of Professional Engineers (NSPE) Michigan Chapter (1995-2000) Member of the American Society for Engineering Education (ASEE) (1999 - to present)
REFEREED PUBLICATIONS	[1]. C. Bula and M. Jiménez, "DAC Topologies for GSM ΣΔ Modulators", In Proc. of 2010 Andean Conference and Industry Forum (ANDESCON 2010), Bogota, Colombia, Sept. 2010
	[2]. V. Montaño and **M. Jiménez**, "Design and Implementation of a Scalable Floating-point FFT IP Core for Xilinx FPGAs", In Proc. of the 53th IEEE International Midwest Symposium on Circuits and Systems (MWSCAS 2010), Seattle, WA , Aug. 2010
	[3]. O. Acevedo-Patino, A. Cruz-Ayoroa, and **M. Jiménez**, "Static Simulation: A Method for Power and Energy Estimation in Embedded Microprocessors", In Proc. of the 53th IEEE International Midwest Symposium on Circuits and Systems (MWSCAS 2010), Seattle, WA , Aug. 2010
	[4]. J. Moreno, O. Gonzalez, R. Vega, R. Palomera, and **M. Jimenez**, "Emulating an Agilent 4142 SMU on 2600 Keithley Unit" In Proc. Of 2010 Latin-American Workshop on Testing (LATW2010), Punta del Este, Uruguay, March 2010
	[5]. C. Bula and **M. Jimenez**, "Practical Consideration in the Design of FD SC-CMFB Networks for OTAs", In Proceedings of 2010 Latin-American Symposium on Circuits and Systems, LASCAS 2010, Iguaçu Falls, Brazil, Feb. 2010
	[6]. R. Arce-Nazario, **M. Jiménez**, D. Rodriguez, "Mapping of Discrete Cosine Transforms onto Distributed Hardware Architectures," Journal of Signal Processing Systems, Volume 53, No. 3, December, 2008.
	[7]. R. Arce, **M. Jiménez**, and D. Rodriguez, "Architectural Model and Resource Estimation for Distributed Hardware Implementation of Discrete Signal Transforms", In Proceedings of the 2008 International Conference on ReConFigurable Computing and FPGAs, Cancun, Mexico, Dec. 2008
	[8]. R. Palomera, **M. Jimenez**, and G.O. Ducoudray; "Is Design Overemphasized in Engineering Education?", In Proceedings of the International Conference on Engineering Education, Budapest, Hungary, Aug. 2008
	[9]. G. Suarez, **M. Jimenez**, and F. Fernandez, "Behavioral Modeling Methods for Switched-Capacitor SD Modulators", IEEE Transactions on Circuits and Systems I, Vol. 54, No. 6, pp. 1236-1244, Jun. 2007
	[10]. R. Arce, **M. Jiménez**, and D. Rodriguez, "Algorithmic-level Exploration of Discrete Signal Transforms for Partitioning to Distributed Hardware Architectures" IET – Computers and Digital Techniques. Vol. 1 No. 5, pp. 557-564, Sep. 2007.
	[11]. **M. Jiménez**, N. Santiago, J. F. Vega, C. Rubert, G. Bonilla, I. Torres, C. Maldonado, J. Malavé, and R. Rosario, "Integrating Fundamental and Advanced Concepts in a Rounded Capstone Design Experience in Computer Engineering" In Proceedings of the 2007 Frontiers in Education Conference (FIE 2007), Milwakee, WI, Oct. 10-13, 2007
	[12]. R. Arce, **M. Jiménez**, and D. Rodriguez, "DMAGIC: A High-level Partitioning Methodology for Discrete Signal Transforms onto Distributed Hardware Architectures", In Proc. of the 11th Annual Workshop on High Performance Embedded Computing (HPEC 2007), MIT Lincoln Labs, Boston, MA. Sep. 2007
	[13]. R. Arce, **M. Jiménez**, and D. Rodriguez, "Partitioning Exploration for Automated Mapping of Discrete Cosine Transforms onto Distributed Hardware Architectures", In Proc. of the 50th IEEE International Midwest Symposium on Circuits and Systems (MWSCAS 2007), Montreal, Canada, Aug. 5-9, 2007
	[14]. **M. Jiménez**, C. Pomales, A. Nieves, N. Santiago, J. F. Vega, and V. López, "An Analysis of Behavioral Patterns in Generation-Y Engineering Students and their Implications in the Teaching-learning Process" In Proceedings of the 2007 ASEE Annual Conference and Exposition, Honolulu, HI, June 24-27, 2007
	[15]. G. Suarez, and **M. Jiménez**, "Considerations for Accurate Behavioral Modeling of High-Speed SC ΣΔ Modulators", In Proceedings of The 2006 IEEE Custom Integrated Circuits Conference (CICC 2006), San Jose, CA, Sep. 2006
	[16]. R. Arce, **M. Jiménez**, and D. Rodriguez, "High-level Partitioning of Discrete Signal Transforms for Multi-FPGA Architectures", In Proceedings of the 16th International Conference on Field Programmable Logic and Applications (FPL 2006), Madrid, Spain, Aug. 2006

	[17]. R. Arce, **M. Jiménez**, and D. Rodriguez, "Functionally-aware Partitioning of Discrete Signal Transforms for Distributed Hardware Architectures", In Proceedings of the 49th International IEEE Midwest Symposium on Circuits and Systems (MWSCAS 2006), San Juan, PR Aug. 2006
	[18]. G. Suarez and **M. Jiménez**, "Behavioral Modeling of Switched Capacitor Integrators with Application to ΣΔ Modulators", In Proceedings of the 49th International IEEE Midwest Symposium on Circuits and Systems (MWSCAS 2006), San Juan, PR Aug. 2006
	[19]. **M. Jiménez**, R. Palomera, M. Toledo, D. Rodriguez, A. Ramirez, and L. Bautista, "Signal Processing for High School Students: Learning from a Reach-out Experience", In Proceedings of the International Conference on Engineering Education (ICEE 2006), San Juan, PR, July 2006
	[20]. R. Arce, **M. Jiménez**, and D. Rodriguez, "Effects of High-level Discrete Signal Transform Formulations on Partitioning for Multi-FPGA Architectures", Poster at Field-Programmable Custom Computing Machines Conference FCCM 2006, Napa Valley, CA, Apr. 2006
	[21]. G. Suarez and **M. Jiménez**, "Behavioral Modeling of Sigma-Delta Modulators Using VHDL-AMS", In Proceedings of the 48th IEEE International Midwest Symposium on Circuits and Systems (MWSCAS 2005), IEEE Circuits and Systems Society, Cincinnati, OH, August. 2005
	[22]. A. Rivera and **M. Jiménez**, "Analytical Models for Estimating Parasitic Components in Power Electronics PCBs", In Proceedings of the 48th IEEE International Midwest Symposium on Circuits and Systems (MWSCAS 2005), IEEE Circuits and Systems Society, Cincinnati, OH, August. 2005
	[23]. R. Arce and **M. Jiménez**, "An Assessment of High-level Partitioning Techniques for Implementing Discrete Signal Transforms on Distributed Hardware Architectures", In Proceedings of the 48th IEEE International Midwest Symposium on Circuits and Systems (MWSCAS 2005), IEEE Circuits and Systems Society, Cincinnati, OH, August. 2005
	[24]. **M. Jiménez** and N. Santiago, "The Supporting Role of CAD/CAM Tools in Undergraduate Research Education in Electrical and Computer Engineering", In Proc. of the 6th Annual International Conference in Information Technology in Higher Education and Training (ITHET 2005), Juan Dolio, Dominican Republic, July 2005
	[25]. P. Alicea, C. Ortiz, R. Perez, R. Palomera, and **M. Jiménez**, "Design of and Adjustable, Low-voltage, Low-dropout Regulator", In Proceedings of the International Caracas Conference on Devices, Circuits and Systems (ICCDCS 2004), Punta Cana, Dominican Republic, Nov. 2004
	[26]. **M. Jiménez** and M. Nuñez, "Implementing IrDA on the MSP430: A Project Development Under the Undergraduate Research/Co-op Education Model", In Proceedings of Frontiers In Education, FIE-2004, Savannah, GA, Oct. 2004
	[27]. M. Toledo, J. Arvey, Y. Jia, **M. Jiménez**, and R. Palomera, "Undergraduate Research Experiences in Wireless, Powerless Sensor Technology", In Proceedings of the International Conference on Engineering Education (ICEE 2004), Gainesville, FL, October 2004
	[28]. R. Palomera, M. Toledo, and **M. Jiménez**, "Industry Sponsored Undergraduate Research at UPRM", In Proceedings of the International Conference on Engineering Education (ICEE 2004), Gainesville, FL, October 2004
	[29]. I. Couvertier, **M. Jiménez**, and R. Palomera, "Integrating Concepts and Practice in Teaching Embedded Systems Design", In Proceedings of the International Conference on Engineering Education (ICEE 2004), Gainesville, FL, October 2004
	[30]. A. Rivera, E. Bravo, **M. Jiménez**, and R. Palomera, "Design Review and Innovations in Low-voltage Differential Signaling Drivers", In Proceedings of the 47th IEEE Midwest Symposium on Circuits and Systems (MWSCAS 2004), IEEE Circuits and Systems Society, Hiroshima, Japan, July. 2004
	[31]. I. Ortiz, and **M. Jiménez**, "Scalable Pipeline Insertion in Floating-point Division and Square Root Units", In Proceedings of the 47th IEEE Midwest Symposium on Circuits and Systems (MWSCAS 2004), IEEE Circuits and Systems Society, Hiroshima, Japan, July. 2004
	[32]. M. Toledo, **M. Jiménez**, and R. Palomera, "Industry Sponsored Practical Undergraduate Learning: Two Case Studies from the University of Puerto Rico", In. Proceedings of the International Conference on Engineering Education, and Reasearch, VSB-TUO, Ostrava, ISSN 1562-3580, June 2004

[33]. M. Toledo, J. Henao, Y. Jia, **M. Jiménez**, and R. Palomera, “Teaching Wireless Sensor Technology to Undergraduate Students Through Research Projects”, In. Proceedings of the International Conference on Engineering Education, and Reasearch, VSB-TUO, Ostrava, ISSN 1562-3580, June 2004

[34]. R. Arce and **M. Jiménez**, “Integer-Pair Representation for Multi-output Logic”, In Proceedings of the 46th IEEE Midwest Symposium on Circuits and Systems (MWSCAS 2003), IEEE Circuits and Systems Society, Cairo, Egypt, Dec. 2003

[35]. J. García, R. Palomera, and **M. Jiménez**, “Modeling Composite Transistors Based on Four-terminal Floating Nullors”, In Proceedings of the 46th IEEE Midwest Symposium on Circuits and Systems (MWSCAS 2003), IEEE Circuits and Systems Society, Cairo, Egypt, Dec. 2003

[36]. F. Fernandez and **M. Jiménez**, “Behavioral Modeling of Switched Capacitor Integrators Based on Symbolic Admittance Matrix”, In Proceedings of the “Seminario Annual de Automática, Electrónica Industrial e Instrumentación (SAEEI 2003)”, Vigo, Spain, September 2003

[37]. I. Ortíz and **M. Jiménez**, “Scalable Pipeline Insertion in Floating-point Units”, In Proceedings of IASTED Conference on Circuits, Signals, and Systems, IASTED/CSS-2003, Cancun, Mexico, May 2003

[38]. **M. Jiménez**, R. Palomera, and M. Toledo, “Undergraduate Research and Co-op Education: A Winning Combination”, In Proceedings of Frontiers In Education, FIE-2002, Boston, MA, Nov. 2002

[39]. J. Navarro, J. Borges, and **M. Jiménez**, “Electronic Academic Counseling System”, Frontiers In Education, FIE-2002, Boston, MA, Nov. 2002

[40]. F. Fernandez and **M. Jiménez**, “Behavioral Modeling of Dynamic Capacitive Loads on Sigma-Delta Modulators” In Proceedings of the “Seminario Anual de Automática Electrónica Industrial e Instrumentación (SAAEI 2002)”, Alcalá de Henares, Spain, Sep. 2002.

[41]. M. Aguirre, C. Heredia, H. Torres, R. Palomera, and **M. Jiménez**, “Design of a CMOS 1.8V Low-voltage Differential Signaling Receiver” In Proceedings of the 45th IEEE Midwest Symposium on Circuits and Systems (MWSCAS 2002), IEEE Circuits and Systems Society, Tulsa, OK, Aug. 2002.

[42]. **M. Jiménez** and M. Shanblatt, “Integrating a Low-Power Objective into the Placement of Macro Block-based Layouts” In Proceedings of the 44th IEEE Midwest Symposium on Circuits and Systems (MWSCAS 2001), IEEE Circuits and Systems Society, Dayton, OH, Aug. 2001.

[43]. **M. Jiménez**, D. Rodriguez and N. Santiago, “Scalable Floating Point FPGA Cores for Digital Signal Processing”, In Proceedings of the “Seminario Anual de Automática Electrónica Industrial e Instrumentación (SAAEI 2001)”, Matanzas, Cuba, September 2001.

[44]. **M. Jiménez** with M. Shanblatt, “A Low-power Approach to the Placement of Macro Block-based VLSI Layouts”, In Proceedings of the “Seminario Anual de Automática Electrónica Industrial e Instrumentación (SAAEI 2001)”, Matanzas, Cuba, September 2001.

[45]. **M. Jimenéz**, and M. Shanblatt, "Median Biased Steiner Tree Heuristics in the Rectilinear Plane for Low-power Physical Layout", In Proceedings of The 41st. Midwest Symposium on Circuits and Systems (MWSCAS 1998), IEEE Circuits and Systems Society, South Bend, IN, Aug. 1998.

[46]. A. Diaz, **M. Jiménez**, E. Strangas and M. Shanblatt, "Integer Pair Representation of Binary Terms and Equations", In Proceedings of The 41st. Midwest Symposium on Circuits and Systems (MWSCAS'98), IEEE Circuits and Systems Society, South Bend, IN, Aug. 1998.

[47]. **M. Jiménez**, N. Santiago, and D. Rover, "Development of an FPGA-Based Scalable Floating Point Multiplier", In Proceedings of The Fifth Canadian Workshop on Field-Programmable Devices Workshop (FPD'98), pp. 145-150, Montreal, Canada, Jun. 1998.

[48]. **M. Jiménez**, C. L. Wey, and M. Shanblatt, "Mapping Multiplication Algorithms into a Family of LUT-based FPGAs", Poster at the 1998 ACM/SIGDA Sixth International Symposium on Field Programmable Gate Arrays (FPGA'98), Monterrey CA, Feb. 1998.

[49]. N. D. Ramirez, **M. A. Jiménez**, and J. Allison, "Optimization of Electrical Energy Distribution for a Deficient System" Journal of the Operational Research Society, Great Britain, Vol. 44, No. 8, pp. 761-772, Aug. 1993.

[50]. **M. Jimenez-Cedeño** and R. Vasquez, "A Simulation Model for a Centralized Multihop Packet Radio Network" In Proceedings of The 36th. Midwest Symposium on Circuits and Systems (MWSCAS’93), Vol. 2, pp. 1132-1135, May 1993.

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Education:

-Ph.D. Electrical Engineering, Purdue University, May 2001
-B.S. Electrical Engineering, University of Puerto Rico at Mayagüez, May 1997

Professional Experience:

7/04-present	Associate Professor, Department of Electrical and Computer Engineering, University of Puerto Rico at Mayagüez, Mayagüez, PR
1/10-6/10	Acting Associate Dean of Research and Graduate Studies, College of Engineering, University of Puerto Rico at Mayagüez
7/08-present	Adjunct Associate Professor, Weldon School of Biomedical Engineering, Purdue University, W. Lafayette, IN
2/05-present	Co-Founder and Scientific Advisor, SonarMed, Inc., IN, USA
7/01-6/04	Assistant Professor, Department of Electrical and Computer Engineering, University of Puerto Rico at Mayagüez, Mayagüez, PR
1/98-5/01	Research Assistant, Biomedical Acoustics Laboratory, School of Electrical and Computer Engineering, Purdue University, West Lafayette, IN
Spring 2000	Teaching Assistant, biomedical instrumentation course, School of Electrical and Computer Engineering, Purdue University, West Lafayette, IN

Research Interests:

Biomedical acoustics, medical instrumentation, biosensors, cardiovascular devices.

Research Funding:

- *In vivo Assessment of Localized Magnetic Fluid Hyperthermia for Ovarian Cancer Treatment*. Funded by the Puerto Rico Comprehensive Cancer Center NIH-U54 program; $140,000. 1/10/10-30/9/10 (Co-PI).
- *RISE: Enhancing Biomedical Sciences and Biomedical Engineering in Science and Technology*. Funded by NIH-MBRS Program; $5,081,000. 1/8/10-31/9/14 (Co-PI).

BioSEI: Acoustic Monitoring System for Indwelling Liquid-Filled Catheters
Funded by UPR-Mayagüez; $80,000. 1/01/09-6/30/10 (PI)
- *CREST: Nanotechnology Center for Biomedical and Energy-Driven Systems and Applications* Funded by NSF; $5,000,000. 9/01/08-8/31/13 (Senior Personnel)
- *Acoustical Guidance of Liquid-Filled Catheters.* Funded by NIH-SCORE Program; $111,361. 5/01/03-4/30/07 (PI)
- *Non-Invasive Stress Level Assessment Using a Hydrogel-Based Biosensor*. Funded by Tropical Center for Earth and Space Studies (TCESS-NASA); $60,000, 10/02-10/03. (Co-PI)
- *Biomedical Research and Education Experiences (BReEd) at UPRM*. Funded by NSF; $99,653, 9/03-8/04. (Co-PI)
- *Development of Technologies for the Manufacture of Cardiac Pacing and Defibrillation Leads: Phase I*. Funded by Medtronic, Inc. $45,863. 8/03-12/03. (PI)
- *Development of Technologies for the Manufacture of Cardiac Pacing and Defibrillation Leads: Phase II*. Funded by Medtronic, Inc. $65,363, 1/04-9/04. (PI)

Journal Articles:

Juan, E.J., Mansfield, J.P., Wodicka, G.R., *Miniature Acoustic Guidance System for Endotracheal Tubes*, IEEE Transactions on Biomedical Engineering, vol.49, pp. 584-596, 2002.

Conference Articles:

Juan E.J., Visbal-Onufrak M., *"Closed-Loop Temperature Control of Cobalt Ferrite Ferrofluids Using Continuous Modes Controllers",* American Institute of Physics Conference Proceedings, In Press.

Kyle A.M., Albors G., Wodicka G.R., Juan E.J., *Sound Propagation in Liquid-Filled Arterial Segments: Measurements and Model Predictions*, Proceedings of the 29th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, Lyon, France, August 2007.

Albors G., Kyle A.M., Wodicka G.R., Juan E.J., *Computer Simulation Tool for Predicting Sound Propagation in Air-Filled Tubes with Acoustic Impedance Discontinuities*, Proceedings of the 29th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, Lyon, France, August 2007.

Goenaga M., Juan E.J., *Modeling Impermeable Membranes as Acoustic Filters for Biomedical Applications*, Proceedings of the 28th Annual International Conference of the IEEE Engineering in Medicine and Biology Society IEEE. New York City, NY, 2006.

Figueroa H., Juan E.J., *Estimation of Tube Wall Compliance Using Pulse-Echo Acoustic Reflectometry*, Proceedings of the 28th Annual International Conference of the IEEE Engineering in Medicine and Biology Society IEEE. New York City, NY, 2006.

Ugarte D., Santana J., Velázquez L., Juan E.J., *Acoustical Characterization of Impermeable Membranes: Hearing Aid Applications*, Proceedings of the 25th Annual International Conference of the IEEE Engineering in Medicine and Biology Society IEEE. Cancún, Mexico, 2003.

Juan E.J., Mansfield J.P., Wodicka G.R., *In-line Acoustic System to Position and Monitor Infant-sized Endotracheal Tubes*, Proceedings of the 22nd Annual International Conference of the IEEE Engineering in Medicine and Biology Society IEEE. Part vol.4, 2000, pp.2571-4 vol.4. Piscataway, NJ, USA.

Conference Presentations:

Juan E.J., Visbal-Onufrak M., *"Closed-Loop Temperature Control of Cobalt Ferrite Ferrofluids Using Continuous Modes Controllers",* 8th International Conference on the Scientific and Clinical Applications of Magnetic Carriers, Rostock, Germany, May 2010.

Visbal-Onufrak M., Herrera A., Rinaldi C., Juan E.J., *"A Parametric Study of Specific Absorption Rates in Magnetic Nanoparticles for Magnetic Fluid Hyperthermia"*, 8th International Conference on the Scientific and Clinical Applications of Magnetic Carriers, Rostock, Germany, May 2010.

Tafur J., Visbal M., Barrera C., Herrera A., Rinaldi C., Juan E.J., *"Viscosity Measurements of Cobalt Ferrite Ferrofluids by Means of Complex Magnetic Susceptibility"*, Joint Intermag-MMM Conference, Washington DC, January 2010.

A.M. Kyle, G.R. Wodicka, S.L. Ordonez, E.J. Juan, J.S. Bolton, *"Wave Propagation In Lliquid-Filled Tubes: Measurements and Model Predictions"*, J. of Acoustical Society of America, vol. 199(5) Part 2, May 2006, p. 3410. (Awarded as Best Student Paper in Engineering Acoustics)

Magazine Articles:

Juan, E.J., *Electrical Stimulation of Excitable Tissue*, Dimensión, Revista del Colegio de Ingenieros y Agrimensores de Puerto Rico, vol.2, pp. 29-32, 2007.

Juan, E.J., *Biomedical Engineering: an Overview*, Dimensión, Revista del Colegio de Ingenieros y Agrimensores de Puerto Rico, vol.4, pp. 25-27, 2005.

Patents:

Juan, E.J., Mansfield, J.P., Wodicka, G.R., *Miniature Acoustical Guidance and Monitoring System for Tube or Catheter Placement*, U.S. patent 6,705,319.

Selected Technical Presentations:

Acoustic Monitoring of Liquid-Filled Tubes and Catheters, Naval Undersea Warfare Center, Newport, RI, March 2010.

Acoustical Guidance of Indwelling Tubes and Catheters , University of Texas at Austin, Austin, TX, May 2008.

Medical Device Accidents: Causes and Case Studies, Medical Device Puerto Rico Exhibition and Conference, San Juan, PR, February 2006.

Electrical Shock and Trauma: Cause, Mechanisms of Injury and Case Studies, Colegio de Ingenieros y Agrimensores de Puerto Rico, Mayagüez Chapter, Mayagüez, PR, November 2005.

Acoustical Guidance of Intravascular Catheters: Theory and Application of an Acoustical Transmission Line Model, Annual Symposium of Chemical Engineering and Biotechnology, Mayagüez, PR, October 2004.

Biomedical Engineering at UPRM, CIAPR - Industry University Symposium on Electrical Engineering, San Juan, PR, November 2003.

Biomedical Engineering: An Overview, presentation to engineering students of the University of Puerto Rico- Mayagüez, Mayagüez, PR, October 17, 2002.

Novel Acoustic Methods for the Development of Intelligent Catheters, 2002 Forum for Innovation, San Juan, PR, May 23, 2002.

Honors and Awards:

Third Place Winner, EnterPrize Business Plan Competition, 2009.
First Place Winner, Business Idea Competition, Puerto Rico Techno-Economic Corridor, Mayagüez, PR; May 2009.
Geddes-Laufman-Greatbach Outstanding Graduate Student Award, Department of Biomedical Engineering, Purdue University, 1999
SLOAN Fellowship, 1997-1998
GEM Fellowship, 1997-1998

Professional Memberships:

Institute of Electrical and Electronics Engineers (IEEE) – Senior Member
IEEE-Engineering in Medicine and Biology Society – Senior Member

Professional Service:

Reviewer, IEEE Transactions on Biomedical Engineering
Academic Program Reviewer, Puerto Rico's Council on Higher Education

Institutional Service:

Academic Programs Developed:
Responsible for the development of a bioengineering graduate program at the University of Puerto Rico - Mayagüez

Committees:
President, College of Engineering Graduate Committee 3/08-1/10

Courses Taught:
INEL 4505 Introduction to Control Systems
INEL 5205 Instrumentation
INEL 5506 Process Control and Instrumentation Engineering

INEL 4102 Circuits Analysis II
INEL 5208 Principles of Biomedical Instrumentation

Courses Developed:
INEL 5208 Principles of Biomedical Instrumentation
INEL 6097 Biomedical Acoustics

Students:
Supervised research projects of 20 undergraduate students.
Supervised research projects of 8 graduate students.

Electrical and Computer Engineering Service:

Coordinator, Control Systems Area Committee 2002-2007
Member, Departmental Planning Committee 2002-2007
Member, Graduate Committee 2001-present

Dr. KEJIE LU

Education

- Ph.D. Electrical Engineering (major in Telecommunications), The University of Texas at Dallas, Dallas, Texas, USA, 2003
- M.S. Communications and Electronic Systems, Beijing University of Posts and Telecommunications, Beijing, China, 1997
- B.S. Telecommunications Engineering, Beijing University of Posts and Telecommunications, Beijing, China, 1994

Experience

- Assistant Professor, Department of Electrical and Computer Engineering, University of Puerto Rico at Mayagüez, Jul. 2005 ~
    - Tenure since Jul. 2010
- Postdoctoral Research Associate, University of Florida, 2004-2005
- Research Assistant, The University of Texas at Dallas, 2001-2003
- Senior Software Engineer, Beijing Research Institute, Huawei Technologies, Beijing, China, 1998-2000
- Software Engineer, Gaohong Telecommunications, Beijing, China, 1997-1998
- Research Assistant, China Academy of Telecommunications Technology (CATT), Beijing, China, 1995-1997

Research Interests

- Computer and communications networks: architecture and protocol design, performance evaluation, network security, network coding
- Wireless communications: space-time coding, channel capacity, cooperative communication

Publications

Selected Book Chapter Publications

1. Miguel A. Erazo,Yi Qian,Kejie Lu, and Domingo Rodriguez, "Enabling Periodic Monitoring Applications in Wireless Sensor Networks: Design and Analysis of an Efficient MAC Protocol," to appear, Handbook on Sensor Networks, Edited by Yang Xiao, Hui Chen, and Frank H. Li, World Scientific Publishing Co., 2009.
2. Bo Rong, Yi Qian, and Kejie Lu, "SIP and VoIP over Wireless Mesh Networks," *to appear*, *VoIP Handbook: Applications, Technologies, Reliability, and Security, Edited by Syed Ahson and Mohammad Ilyas, CRC Press*, 2008.

Selected Journal Publications

1. Jianping Wang, Chunming Qiao, Yan Li, and Kejie Lu, "On Guaranteed VoD Services in Next Generation Optical Access Networks," IEEE Journal on Selected Areas in Communications, Vol. 28, No. 6, pp. 875-888, Aug. 2010.

2. Bo Rong, Yi Qian, Kejie Lu, Rose Qingyang Hu, and Kadoch Michel, "Multipath Routing over Wireless Mesh Networks for Multiple Description Video Transmission," to appear, IEEE Journal on Selected Areas in Communications, Apr. 2010.
3. Bo Rong, Yi Qian, Kejie Lu, Rose Qingyang Hu, and Michel Kadoch, "Mobile Agent Based Handoff in Wireless Mesh Networks: Architecture and Call Admission Control," IEEE Transactions on Vehicular Technology, Vol. 58, No. 8, pp. 4565-4575, Oct. 2009.
4. Kejie Lu, Shengli Fu, Yi Qian, and Hsiao-Hwa Chen, "On Capacity of Random Wireless Networks with Physical-Layer Network Coding," IEEE Journal on Selected Areas in Communications, Vol. 27, No. 5, pp. 763-772, Jun. 2009.
5. Kejie Lu, Jianfeng Wang, Dapeng Wu, and Yuguang Fang, "Performance of A Burst-Frame-Based CSMA/CA Protocol: Analysis and Enhancement," ACM Wireless Networks, Vol. 15, No. 1, pp. 87-98, Jan. 2009.
6. Bo Rong, Hsiao-Hwa Chen, Yi Qian, Kejie Lu, R. Q. Hu, and S. Guizani, "A Pyramidal Security Model for Large-Scale Group-Oriented Computing in Mobile Ad Hoc Networks: the Key Management Study," IEEE Transactions on Vehicular Technology, Vol. 58, No. 1, pp. 398-408, Jan. 2009.
7. Bo Rong, Yi Qian, Kejie Lu, Hsiao-Hwa Chen and Mohsen Guizani, "Call admission control optimization in WiMAX networks," IEEE Transactions on Vehicular Technology, Vol. 57, No. 4, pp. 2509-2522, Jul 2008. *Ranked #1 (most accessed) in all papers published in IEEE Transactions on Vehicular Technology (August 2008). (Ranked #69 among all IEEE papers, in August 2008)*
8. Bo Rong, Yi Qian, Kejie Lu, and Rose Q. Hu, "Enhanced QoS Multicast Routing in Wireless Mesh Networks," IEEE Transactions on Wireless Communications, Vol. 7, No. 6, pp. 2119-2220, Jun. 2008.
9. Xiaodong Huang, Qingya She, Tao Zhang, Kejie Lu, and Jason P. Jue, "Modeling and Performance Analysis of Small Group Multicast with Deflection Routing in Optical Burst Switched Networks," IEEE Journal on Selected Areas in Communications - Supplement on Optical Communications and Networking (JSAC-OCN), Vol. 26, No. 3, pp. 74-86, Apr. 2008.
10. Kejie Lu, Yi Qian, Mohsen Guizani, and Hsiao-Hwa Chen, "A Framework for a Distributed Key Management Scheme in Heterogeneous Wireless Sensor Networks," IEEE Transactions on Wireless Communications, Vol. 7, No. 2, pp. 639-647, Feb. 2008.
11. Jieyan Fan, Dapeng Wu, Kejie Lu, and Antonio Nucci, "An Efficient Data Structure for Network Anomaly Detection," Security and Communication Networks, Vol. 1, No. 2, pp. 107-124, Feb. 2008.
12. Yi Qian, Kejie Lu, Bo Rong, and David Tipper, "A Design of Optimal Key Management Scheme for Secure and Survivable Wireless Sensor Networks," Security and Communication Networks, Vol. 1, No. 1, pp. 75-82, Jan. 2008.
13. Jian Liu, Gaoxi Xiao, Kejie Lu and Imrich Chlamtac, "An Evaluation of Distributed Parallel Reservations in Wavelength-Routed Networks," IEEE Journal on Selected Areas in Communications - Supplement on Optical Communications and Networking (JSAC-OCN), Vol. 25, No. 9, pp. 27-39, Dec. 2007.
14. Kejie Lu, Dapeng Wu, Jieyan Fan, S. Todorovic, and A. Nucci, "Robust and Efficient Detection of DDoS Attacks for Large-Scale Internet," Computer Networks, Vol. 51, No. 18, pp. 5036-5056, Dec. 2007.
15. Kejie Lu, Yi Qian, Domingo Rodriguez, Wilson Rivera, Manual Rodriguez, "A cross-layer design framework for wireless sensor networks with environmental monitoring applications," Journal of Communications Software and Systems, Vol. 3, No. 3, pp. 207-214, Sept. 2007.
16. Bo Rong, Yi Qian, and Kejie Lu, "Integrated Downlink Resource Management for Multiservice WiMAX Networks," IEEE Transactions on Mobile Computing, Vol. 6, No. 6,

pp. 621-632, Jun. 2007. *Ranked #6 (most accessed) in all papers published in IEEE Transactions on Mobile Computing (July 2007).*

17. Kejie Lu, Dapeng Wu, Yi Qian, Yuguang Fang, and Robert C. Qiu, "Performance of An Aggregation-Based MAC Protocol for High-Data-Rate Ultra-Wideband Ad Hoc Networks," IEEE Transactions on Vehicular Technology, Vol. 56, No. 1, pp. 312-321, Jan. 2007.
18. Yu Zheng, Kejie Lu, Dapeng Wu, and Yuguang Fang, "Performance Analysis of IEEE 802.11 DCF in Imperfect Channels," IEEE Transactions on Vehicular Technology, Vol. 55, No. 5, pp. 1648-1656, Sept. 2006.
19. Tao Zhang, Kejie Lu, and Jason P. Jue, "Shared Buffering in Optical Packet-Switched Networks," IEEE Journal on Selected Areas in Communications - Supplement on Optical Communications and Networking (JSAC-OCN), Vol. 24, No. 4, pp. 118-127, Apr. 2006.
20. Wei Liu, Yanchao Zhang, Kejie Lu, and Yuguang Fang, "Energy conservation through resource-aware movement in heterogeneous mobile ad hoc networks," Journal of Combinatorial Optimization, Special Issue on Network Applications, Vol. 11, No. 1, pp. 7-20, Jan. 2006.

Selected Magazine Publications

1. Shengli Fu, Kejie Lu, Tao Zhang, Yi Qian, and Haisao-Hwa Chen, "Cooperative wireless networks based on physical layer network coding," accepted, IEEE Wireless Communications, 2010.
2. Kejie Lu, Yi Qian, Hsiao-Hwa Chen, and Shengli Fu, "WiMAX Networks: From Access To Service Platform," *IEEE Network*, Vol. 22, No. 3, pp. 38-45, May 2008. *Ranked #1 (most accessed) among all papers published in IEEE Network Magazine (August 2008). (Ranked #32 among all IEEE papers, in September 2008)*
3. Yi Qian, Kejie Lu, and David Tipper, "A design for secure and survivable wireless sensor networks," *IEEE Wireless Communications Magazine*, Vol. 14, No. 5, pp. 30-37, Oct. 2007.
4. Kejie Lu, Yi Qian, and Hsiao-Hwa Chen, "A Secure and Service-Oriented Network Control Framework for WiMAX Networks," *IEEE Communications Magazine*, Vol. 45, No. 5, pp. 124-130, May 2007. *Ranked #1 (most accessed) among all papers published in IEEE Communications Magazine (July 2007). (Ranked #23 among all IEEE papers, in July 2007)*

Selected Conference Publications

1. Gonzalo Vaca-Castano, Domingo Rodriguez, Julio Castillo, Kejie Lu, Alejandro Rios, and Fernando Bird, "A Framework for Bioacoustical Species Classification in a Versatile Service-Oriented Wireless Mesh Network," in Proc. 2010 European Signal Processing Conference (EUSIPCO-2010), Aalborg, Denmark, Aug. 2010.
2. Xiangmao Chang, Jin Wang, Jianping Wang, Victor Lee, Kejie Lu and Yixian Yang, "On Achieving Maximum Secure Throughput Using Network Coding Against Wiretap Attack," in Proc. IEEE ICDCS 2010, Genoa, Italy, Jun. 2010.
3. Kejie Lu, Wang Liu, Jianping Wang, Tao Zhang, Shengli Fu, "Achieving the Capacity Bounds of Multicast in Large-Scale Wireless Networks," in Proc. IEEE ISIT 2010, Austin, Texas, Jun. 2010.
4. Hui Guo, Yi Qian, Kejie Lu, and Nader Moayeri, "Backbone Routing over Multihop Wireless Networks: Increased Network Coding Opportunity," in Proc. IEEE ICC 2010, Capetown, South Arica, May 2010.

5. Tao Zhang, Kejie Lu, Ayat Jafari, Shengli Fu, and Yi Qian, "On the Capacity Bounds of Large-Scale Wireless Network with Physical-Layer Network Coding Under the Generalized Physical Model," in Proc. IEEE ICC 2010 - Workshop on Cooperative and Cognitive Mobile Networks, Capetown, South Africa, May 2010.
6. Jianping Wang, Chunming Qiao, Yan Li, and Kejie Lu, "Minimizing the Worst-Case Playback Delay in VoD Services over Passive Optical Networks," to appear, in Proc. IEEE INFOCOM 2010, San Diego, CA, Mar. 2010.
7. Jin Wang, Jianping Wang, Kejie Lu, Bin Xiao, and Naijie Gu, "Optimal Linear Network Coding Design for Secure Unicast with Multiple Streams," to appear, in Proc. IEEE INFOCOM 2010, San Diego, CA, Mar. 2010.
8. Kejie Lu, Shengli Fu, Yi Qian, and Hsiao-Hwa Chen, "SER Performance Analysis for Physical Layer Network Coding over AWGN Channel," in Proc. IEEE Globecom 2009, Honolulu, Hawaii, USA, Dec. 2009.
9. Dong Wang, Shengli Fu, and Kejie Lu, "Channel Coding Design to Support Asynchronous Physical Layer Network Coding," in Proc. IEEE Globecom 2009, Honolulu, Hawaii, USA, Dec. 2009.
10. Hui Guo, Yi Qian, Kejie Lu, and Nader Moayeri, "The Benefits of Network Coding over a Wireless Backbone," in Proc. IEEE Globecom 2009, Honolulu, Hawaii, USA, Dec. 2009.
11. Hui Guo, Yi Qian, Kejie Lu, and Nader Moayeri, "Backbone Construction for Heterogeneous Wireless Ad Hoc Networks," in Proc. IEEE ICC 2009, Dresden, Germany, Jun. 2009.
12. Kejie Lu, Shengli Fu, Yi Qian, and Tao Zhang, "On The Security Performance of Physical-Layer Network Coding," in Proc. IEEE ICC 2009, Dresden, Germany, Jun. 2009.
13. Kejie Lu, Tao Zhang, Yi Qian, and Shengli Fu, "A Novel Topology Control Scheme for Future Wireless Mesh Networks," in Proc. IEEE Globecom 2008, New Orleans, Nov. 2008.
14. Yi Qian, Kejie Lu, and Nader Moayeri, "A Secure VANET MAC Protocol for DSRC Applications," in Proc. IEEE Globecom 2008, New Orleans, Nov. 2008.
15. Hector M. Lugo-Cordero, Kejie Lu, Domingo Rodriguez, Sastri Kota, "A Novel Service-Oriented Routing Algorithm for Wireless Mesh Network," in Proc. IEEE MILCOM 2008, San Diego, CA, Nov. 2008.
16. Kejie Lu, Tao Zhang, Yi Qian, and Shengli Fu, "Performance of a Novel Topology Control Scheme for Future Wireless Mesh Networks," in Proc. IEEE MILCOM 2008, San Diego, CA, Nov. 2008.
17. Ming Li, Hua Zhu, Shiwen Mao, Kejie Lu, Min Chen, "Robot Swarm Communication Networks: Architectures, Protocols, and Applications," in Proc. Chinacom 2008, Hangzhou, China, Aug. 2008.
18. Kejie Lu, Shengli Fu, and Yi Qian, "Capacity of Random Wireless Networks: Impact of Physical-Layer Network Coding," in Proc. IEEE ICC 2008, Beijing, China, May 2008.
19. Bo Rong, Yi Qian, Kejie Lu, and M. Kadoch, "Call Admission Control for Mobile Agent Based Hando?," in Proc. IEEE ICC 2008, Beijing, China, May 2008.
20. Hua Zhu, Kejie Lu, and Ming Li, "Distributed Topology Control in Multi-Channel Multi-Radio Mesh Networks," in Proc. IEEE ICC 2008, Beijing, China, May 2008.
21. Kejie Lu, Shengli Fu, Tao Zhang, and Yi Qian, "On the Design of Future Wireless Ad Hoc Networks," in Proc. of IEEE Globecom 2007, Washington DC, USA, Nov. 2007.
22. Shengli Fu, Kejie Lu, Yi Qian, and Murali Varanasi, "Cooperative Network Coding for Wireless Ad-Hoc Networks," in Proc. of IEEE Globecom 2007, Washington DC, USA, Nov. 2007.

23. Kejie Lu, Shengli Fu, Yi Qian, and Hsiao-Hwa Chen, "Increasing the Throughput of Wireless LANs Via Cooperative Retransmission," in Proc. of IEEE Globecom 2007, Washington DC, USA, Nov. 2007.
24. Yi Qian, Kejie Lu, Bo Rong, and Hua Zhu, "Optimal Key Management for Secure and Survivable Heterogeneous Wireless Sensor," in Proc. of IEEE Globecom 2007, Washington DC, USA, Nov. 2007.
25. Kejie Lu, Yi Qian, Domingo Rodriguez, Wilson Rivera, Manual Rodriguez, "Wireless Sensor Networks for Environmental Monitoring Applications: A Design Framework," in Proc. of IEEE Globecom 2007, Washington DC, USA, Nov. 2007.
26. Kejie Lu, Shengli Fu, Yi Qian, and Sastri Kota, "A Novel Architecture for Future Wireless Mesh Networks," in Proc. IEEE Milcom 2007, Orlando, FL, USA, Oct. 2007.
27. Tao Zhang, Kejie Lu, Gaoxi Xiao, and S.-Q. Zheng, "Design Principles and Formulation for Optical SMART Networks," in Proc. IEEE Milcom 2007, Orlando, FL, USA, Oct. 2007.
28. Omar Villavicencio, Kejie Lu, Hua Zhu, and Sastri Kota, "Performance of IEEE 802.11n in Multi-Channel Multi-Radio Wireless Ad Hoc Network," in Proc. IEEE Milcom 2007, Orlando, FL, USA, Oct. 2007.
29. Miguel A. Erazo, Yi Qian, Kejie Lu, and Domingo Rodriguez, "Analysis and Design of A MAC Protocol for Wireless Sensor Networks with Periodic Monitoring Applications," in Proc. IEEE Milcom 2007, Orlando, FL, USA, Oct. 2007.
30. Yi Qian, Kejie Lu, Bo Rong, Hector Lugo, and David Tipper, "An Optimal Key Management Scheme for Wireless Sensor Networks," in Proc. IEEE Milcom 2007, Orlando, FL, USA, Oct. 2007.
31. Hua Zhu and Kejie Lu, "Resilient Opportunistic Forwarding: Issues and Challenges," in Proc. IEEE Milcom 2007, Orlando, FL, USA, Oct. 2007.
32. Kejie Lu, Tao Zhang, and Ayat Jafari, "An Anycast Routing Scheme for Supporting Emerging Grid Computing Applications in OBS Networks," in Proc. of IEEE ICC'2007, Glasgow, UK, Jun. 2007.
33. Bo Rong, Yi Qian, and Kejie Lu, "Downlink Call Admission Control in Multiservice WiMAX Networks," in Proc. of IEEE ICC 2007, Glasgow, UK, Jun. 2007.
34. Kejie Lu, Tao Zhang, Shengli Fu, Yi Qian, Ashwin Gumaste, and S.-Q. Zheng, "A Design Principle for Future High-Speed Networks," in Proc. of High-Speed Networks Workshop 2007 (with IEEE INFOCOM 2007), Anchorage, AK, USA, May 2007.
35. Yi Qian, Kejie Lu, and David Tipper, "Towards Survivable and Secure Wireless Sensor Networks," in Proc. of IEEE IPCCC 2007 (WIA'07), New Orleans, LA, USA, Apr. 2007.
36. Jieyan Fan, Dapeng Wu, Kejie Lu, and Antonio Nucci, "Design of Bloom Filter Array for Network Anomaly Detection," in Proc. of IEEE Globecom 2006, San Francisco, CA, USA, Nov. 2006.

External Research Grants

- NSF-EPSCOR Start-Up Grant: $200,000, August 2005 - May 2007, PI: Project on "A Novel Medium Access Framework for Emerging Wireless Mesh Networks: Protocol Design, Theoretical Analysis, and Prototype Development".
- NSF CCLI Grant: $149,999, June 2008 – May 2011, PI, project title: “Improving the Curriculum of Electrical and Computer Engineering through Projects on Wireless Networks”.
- NSF MRI Grant: $589,970, September 2009 – August 2012, PI, project title: “MRI: Development of a Versatile Service-Oriented Wireless Mesh Network for Disaster Relief and Environmental Monitoring in Puerto Rico”.

Dr. Vidya Manian
Assistant Professor

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E-mail: manian@ece.uprm.edu

Research and Teaching Interests:
Image processing, hyperspectral image analysis, computational modeling for classification of high dimensional images. Variational algorithms and manifold graph geometry for solving problems in image processing, biomedical image processing, computational algorithm analysis and hardware implementations of algorithms.

Education:

Ph.D. Computing, Information Science and Engineering, University of Puerto Rico, Mayagüez, 2004.
M.S. Electrical Engineering, University of Puerto Rico, Mayagüez, May 1995.
B.E. Electrical and Electronics Engineering, A. C. College of Eng. and Tech., Karaikudi, India, June 1990.

Experience:

Department of Electrical and Computer Engineering,
University of Puerto Rico Mayagüez Campus, Mayagüez, P.R.
Assistant Professor Aug 2006 - present
Post doctoral Associate, CenSSIS Jan 2005-July 2006
Lane Department of Computer Science and Electrical Engineering,
West Virginia University, Morgantown, WV.
Visiting Scholar Jan 2004-Dec 2004

NSF Precise & Space Information Laboratory, UPRM. 1/2001-12/2003, Research assistant and NASA investigator in summer

Department of Electrical and Computer Engineering, UPRM, 7/99-12/2000, Instructor

Laboratory for Applied Remote Sensing and Image Processing, UPRM, 8/95 -6/99, Remote Sensing and Image Processing Specialist

Department of Electrical and Computer Engineering, UPRM, 8/93-5/95,
Research Assistant

W.S. Industries (I) Ltd., Chennai, India, 7/90-2/92, Engineer.

Teaching and research in Electrical Engineering. Currently involved in research in computational models for high dimensional images and teaching courses in Image Processing, Pattern Recognition and remote sensing.

Journal Publications:

S. Huaman Vega and V. Manian, “Object segmentation in hyperspectral images using active contours and graph cuts,” accepted for **Intl Journal of Remote Sensing**, 2010.

S. Velasco-Forero and V. Manian, “Improving hyperspectral image classification using spatial preprocessing,” **IEEE Trans. Geoscience and Remote Sensing Letters**, Vol. 6, No. 2, pp 297-301, April 2009.

V. Manian and M. Velez-Reyes, “Support vector classification of land cover and benthic habitat from hyperspectral images”, **Intl. Journal of high speed electronics and systems**, Vol. 18, No. 2, pp. 337-348, June 2008.

V. Manian and L. O Jimenez, “Land cover and benthic habitat classification using texture features from multispectral and hyperspectral images”, **Journal of Electronic Imaging**, SPIE, Vol. 16, No. 2, 2007.

V. Manian and A. Ross, “Face detection using statistical and multi-resolution texture features”, **Multimedia Cyberspace Journal, Special Issue on Pattern Recognition and Bioinformatics**, Vol. 3, No. 3, pp. 1-9, 2005.

V. Manian and R. Vasquez, “Approaches to color and texture based image classification”, **Journal of Optical Engineering**, SPIE, Vol. 41, No. 7, pp. 1480-1490, July 2002.

V. Manian, R. Vasquez, and P. Katiyar, “Texture classification using logical operators”, **IEEE Trans. on Image Processing**, Vol. 9, No: 10, pp. 1693-1703, Oct. 2000.

V. Manian and R. Vasquez, “Scaled and rotated texture classification using a class of basis functions”, **Journal of Pattern Recognition**, Vol. 31, No. 12, pp. 1937-1948, 1998.

Publications in Conference Proceedings:
Fanny SPIE
Nestor CAHSI
Susi CAHSI

S. Huaman Vega and V. Manian, “Object segmentation in hyperspectral images using active contours and graph cuts,” 2010 Intl. Symposium on Spectral Sensing Research (ISSR), June 2010, Springfield, Missouri.

F. Nina-Paravecino and V. Manian, “Spherical harmonics as a shape descriptor for hyperspectral image classification,” **Proc. SPIE Intl. Conf. Defense, Security and Sensing**, Vol. 7695, Orlando, 2010.

N. Diaz and V. Manian, “Hyperspectral texture synthesis by multiresolution pyramid decomposition,” **Proceedings SPIE Intl. Conf. defense, security and sensing**, Vol. 7334, Orlando, April 2009.

S. Velasco and V. Manian, “Accelerating hyperspectral manifold learning using graphical processing units, “ Proceedings **SPIE Intl. Conf. defense, security and sensing**, Vol. 7334, Orlando, April 2009.

S. Velasco and V. Manian, “Improving hyperspectral image classification based on graphs using spatial preprocessing,” Proceedings **IEEE Intl. Conf. IGARSS**, Boston, July 2008.

A. Alarcon and V. Manian, “A variational method for target detection in hyperspectral images,” **Proceedings SPIE Intl. Conf. Defense & Security**, Vol. 6967, Orlando, April 2008.

S. Cruz and V. Manian, “Hyperspectral image classification using spectral histograms and semi-supervised learning,” **Proceedings SPIE Intl. Conf. Defense & Security**, Vol. 6966, Orlando, April 2008.

V. Manian, L. O. Jimenez and M. Velez-Reyes, “A comparison of statistical and multiresolution texture features for improving hyperspectral image classification.” **Proceedings SPIE Intl Conf. Remote Sensing**, SPIE, Belgium, Sept. 2005.

V. Manian and M. Velez-Reyes, “A boosted learning algorithm for texture classification and object detection”, **Proceedings SPIE Conf. Defense & Security,** SPIE, Vol. 5817, Orlando, April 2005.

V. Manian and R. Vasquez, “Application of nonlinear texture dynamics for image classification.” **Proceedings SPIE Conf. Defense and Security**, SPIE, Orlando, FL, April 2004.

V. Manian and R. Vasquez, “Texture discrimination based on neural dynamics of visual perception.” **Proceedings IEEE Joint Intl. conf. Neural Networks**, Proceedings IEEE, Vol. 1, pp. 113-118, Portland, Oregon, July 2003.

V. Manian and R. Vasquez , “Texture based cloud detection in MODIS images, **Proceedings SPIE Remote Sensing conference**, Crete, Greece, Sept. 23-28, 2002.

V. Manian and R. Vasquez, A genetic algorithm for texture description and classification, **Proceedings SPIE Intl. Conf. AeroSense’02**, Orlando, FL, April 2002.

V. Manian, A. Vega and R. Vasquez, Comparison of feature selection algorithms for texture image classification, **Proceedings SPIE International Conference AeroSense’01**, Orlando, FL, April 2001.

V. Manian, Roger Hernandez and R. Vasquez, Classifier performance for SAR image classification, **Proceedings IEEE conference IGARSS’00**, Hawaii, July 2000.

V. Manian, Michael Diaz and R. Vasquez, Wavelet features for color image classification, **Proceedings ASPRS** 2000, Washington D.C., May 2000.

V. Manian, Marcel Castro and R. Vasquez “Texture based algorithm for color image classification, **Proceedings SPIE International Conference AeroSense’2000**, Orlando, April 2000.

V. Manian and R. Vásquez, Image classification using semivariogram method, **Proceedings World Multiconference on Systemics, Cybernetics and Informatics**, Vol. 6, Orlando, FL, August, 1999.

V. Manian and R. Vasquez, “Multiresolution edge detection algorithm applied to SAR images,” **Proceedings IEEE Intl. Conference IGARSS'99**, Hamburg, July 1999.

V. Manian and R. Vásquez, On remote sensing image classification and segmentation using a toolbox, **Proceedings 4th Intl. Airborne remote sensing conference ERIM**, Ottawa, Canada, June 1999.

V. Manian, M. Ruiz and R. Vasquez, “The use of a robust toolbox for texture classification and segmentation, **Proceedings of SPIE AeroSense’99**, Orlando, FL, April’1999**.**

V. Manian and R. Vasquez, “On the use of transform features for SAR image classification, **Proceedings IEEE Intl. Conference IGARSS’98**, Seattle, July 1998.

V. Manian and R. Vasquez, "Texture discrimination in noise using wavelets**,"** **Proceedings SPIE Intl. Conference on AeroSense'98,** Orlando, FL, April 1998**.**

V. Manian and R. Vásquez, Comparison of traditional and wavelet methods for invariant texture classification, **Proceedings of COPIMERA'97**, Santiago, Chile, Oct'97.

V. Manian and R. Vasquez, "A framework for SAR image classification: comparison of co-occurrence and a Gabor based method," **Proceedings IEEE IGARSS**, Singapore, Aug. 1997.

V. Manian and R. Vásquez, On scaled and rotated texture segmentation using a class of basis functions, **Proceedings SPIE conf. on AeroSense**, Orlando, April 1997.

V. Manian and R. Vásquez, Feature analysis for scaled and rotated texture segmentation, **Proceedings 21st Int. Conf. on Computers and Industrial Engineering**, San Juan, PR, March 1997.

V. Manian and R. Vásquez, A framework for the recognition of scaled, translated and rotated objects using the short time Fourier transform, **Proceedings IEEE conf. SMC**, Beijing, China, Oct.1996.

V. Manian and R. Vásquez, On the implementation of wavelet transforms in multicomputer networks, **Proceedings of ICSPAT'96**, Boston, Oct. 1996.

V. Manian and R. Vasquez, "A framework for object recognition in images using the short time Fourier transform," **Proceedings of SPIE's optical science, instrumentation and engineering**, Denver, August 1996 **.**

V. Manian and R. Vásquez, Efficient algorithms for Gabor transforms in multicomputer networks, **Proceedings SPIE's 1996 AeroSense conference**, Orlando, April 1996.

V. Manian and R. Vásquez, A computational framework for analyzing textured image classification, **Proceedings 1995 IEEE SMC**, Vancouver, Canada, Oct. 1995.

V. Manian and R. Vásquez, Analysis of transputer processor networks for image processing, **Proceedings SPIE's 1995 AeroSense conference**, Orlando, April 1995.

Book Chapter Contribution:

CenSSIS Spectral Sensing Book

Presentations:

V. Manian and M. Velez-Reyes, "Support vector classification of alnd cover and benthic habitat from hyperspectral images," **International Symposium on Spectral Sensing Research**, Bar Harbor, Maine, May 2006.

V. Manian and A. Ross, "A texture based approach to face detection," *presented at* **Biometric Consortium**, Washington, Sept. 2004.

Research Grants:

Co-PI in **Hyperspectral Imaging for Biodiversity Assessment of Coastal and Terrestrial Ecosystems,** NASA EPSCoR, $750,000, September 2009 to August 2012.

Collaborator in **National Center for Island, Maritime& Extreme Environment Security,** Hawaii University, 2009-2011.

PI in **Advanced processing and pattern recognition techniques for hyperspectral images**, National Geospatial Agency, $139,998, September 2008 to August 2010.

PI in **Advanced skin diagnostics and assessment**, Lockheed Martin, $100,000, April 2008 to December 2008.

Co-PI in **Improving algorithms for target detection in hyperspectral infrared imagery**, (PI Miguel Velez-Reyes) Department of Defense, $485,057, November 2005 to November 2008.

Co-PI in A **geometric approach for the analysis of hyperspectral imagery**, (PI Miguel Velez-Reyes), National Geospatial Agency, $140,000, August 2006 to July 2008.

Collaborator in **Center for Subsurface Sensing and Imaging Systems** (CenSSIS), (Co-PI Miguel Velez-Reyes) A consortium between Northeastern University (lead institution), Boston University, Renselear Polytechnic, and the University of Puerto Rico Mayaguez Campus, NSF Engineering Research Centers Program, UPRM component $3.75M, September 2000- August 2010.

Collaborator in **NOAA - Co-operative Remote Sensing Science and Technology Center** (CREST), A consortium with CUNY and other universities UPRM PI - Dr. Ramon Vasquez, 2006-2010.

PI in **Statistical modeling and classification of skin components using multispectral reflectance confocal microscopic and hypersepctral images**, UPRM MBRS-SCORE seed money grant, $7000, 2005.

PI in **Hyperspectral texture modeling by multiple pairwise pixel interactions**, UPRM R&D seed money grant, $5000, 2007.

Graduate Theses Supervised:

Sol Marie-Cruz, **Classification of Hyperspectral Images using Spectral Difference Histogram**, M.S. Electrical Engineering. Completed in July 2008.

Andres Alarcon, **A Variational Method for Target Detection in Hyperspectral Images**, M.S. Electrical Engineering Thesis. Completed in July 2009.

Nestor Diaz, **Hyperspectral texture synthesis and inpainting methods**, M.S. Electrical Engineering Thesis. Completed in July 2010.

Susi Huaman, **Graph cuts method for segmentation of hyperspectral images**, M.S. Computer Engineering Thesis. Completed in July 2010.

Fanny Nina, **Computational methods for hyperspectral image classification,** M.S. Computer Engineering Thesis. In Progress.

Lizdabel Morales Tirado

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University of Puerto Rico at Mayagüez
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Professional Development:

Ph.D., Virginia Polytechnic Institute and State University, Blacksburg, Virginia.
Degree Date: January 2010.
Dissertation Title: "*An Approach to Using Cognition in Wireless Networks*".
M.S.E.E., Northwestern University, Evanston, Illinois. December 1998.
B.S.E.E., University of Puerto Rico, Mayagüez, Puerto Rico. June 1996.

Appointments:

Department of Electrical and Computer Engineering,
University of Puerto Rico, Mayagüez, Puerto Rico,
Assistant Professor, January 2010 to present.
Teaching: *Undergraduate Research* and *Introduction to Electrical Engineering.*

Department of Electrical and Computer Engineering,
University of Puerto Rico, Mayagüez, Puerto Rico,
Instructor, August 2009 to December 2009
Taught: *Electrical Systems Analysis I* and *Introduction to Electrical Engineering*.

Department of Electrical and Computer Engineering,
Virginia Polytechnic Institute and State University,
Graduate Research Assistant, August 2005-June 2007.

Communications Networking Services,
Virginia Polytechnic Institute and State University,
Graduate Research Assistant, August 2004-June 2005

Department of Mathematics and Applied Sciences
Interamerican University, San Germán, Puerto Rico,
Instructor, January 2003-June 2003.

Lucent Technologies, Whippany, New Jersey,
Systems Engineer, August 1999–March 2001.

Motorola, Inc., Schaumburg, Illinois,
Systems Engineer, August 1996-June 1999.

Research Related Publications:

1. An He, Kyung Kyoon Bae, Timothy R. Newman, Joseph Gaeddert, Kyouwoong Kim, Rekha Menon, Lizdabel Morales, Youping Zhao, Jeffrey H. Reed, and William H. Tranter, "*A Survey of Artificial Intelligence for Cognitive Radios*", accepted to IEEE Transactions on Vehicular Technology, April 2010.

2. L. Morales, J. E. Surís and J. H. Reed, "*A Hybrid Cognitive Engine for Improving Coverage in 3G Wireless Networks*", IEEE ICC Joint Workshop on Cognitive Wireless Networks and Systems, June 2009.

3. L. Morales and J. E. Surís, "*Cognitive Radio: A New Trend in Wireless Communications*", Colegio de Ingenieros y Agrimensores de Puerto Rico, Revista Dimensión, to be published in 2010.

4. An He, Timothy R. Newman, Jeffrey H. Reed, Lizdabel Morales, Kyung K. Bae, Chan H. Park, "*Development of a Case-Based Reasoning Cognitive Engine for IEEE 802.22 WRAN Applications*,"

accepted to ACM MC2R Special Issue on Cognitive Radio Technologies and Systems, to be published in 2010.

5. An He, Joseph Gaeddert, Timothy Newman, Lizdabel Morales, Jeffrey H. Reed, Kyung K. Bae, Chang-Hyung Park, "*Development of a Case-Based Reasoning Cognitive Engine for IEEE 802.22 WRAN Applications*," ACM Mobile Communications and Computing Review, April 2009.

Other Related Publications

1. Y. Zhao, L. Morales, J. Gaeddert, K. K. Bae, J. S. Um; J. H. Reed, "*Applying Radio Environment Maps to Cognitive Wireless Regional Area Networks,*" IEEE Dynamic Spectrum Access Networks (DySpan), April 2007.

2. Y. Zhao, J. Gaeddert, L. Morales, K. K. Bae, J. S. Um, and J. H. Reed, "*Development of Radio Environment Map Enabled Case- and Knowledge-Based Learning Algorithms for IEEE 802.22 WRAN Cognitive Engines,*" International Conference on Cognitive Radio Oriented Wireless Networks and Communications (CrownCom), August 2007.

Research Related Intellectual Property:

1. A Case and Knowledge Based Learning (REM-CKL) Method for Cognitive Radios, VTIP:07-062.
2. A Generic Cognitive Engine Design Based on REM, VTIP:07-060.

Synergistic Activities:

IEEE ICC 2011 Wireless Network Symposium Technical Program Committee Member.
Reviewer for IEEE Communications Letters, IEEE International Midwest Symposium on Circuits and Systems (MWSCAS 2010) and IEEE GlobeComm Technical Conferences 2009, 2010. Undergraduate student mentor and CAHSI Affinity Research Group Model participant. Lead mentor in a Collaborative Research Experience for Undergraduates (CREU) for the Coalition to Diversity Computing in "Body Area Network for bio-telemetric applications" 8/2010-6/2011.
Puerto Rico CubeSat Project Faculty Advisor 10/2010 until present.

Awards:

Gesta Hispana Medal, Virginia Polytechnic Institute and State University, 2010.
GSA Travel Fellowship, Virginia Polytechnic Institute and State University, 2009.
Pratt Fellowship, Virginia Polytechnic Institute and State University, 2004-2007.
Virginia Space Grant Fellowship, Virginia Space Grant Consortium, 2005-2007.
GEM Fellowship, Northwestern University, Evanston, Illinois, 1997-1999.

Graduate Advisors:

Ph.D. - Dr. Jeffrey H. Reed, Virginia Polytechnic Institute and State University.
M.S.E.E. - Dr. Chung-Chieh Lee, Northwestern University.

ORTIZ-RIVERA, EDUARDO I.

US Citizen

Born: Aibonito, Puerto Rico, United States of America

Academic rank: Assistant Professor

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University of Puerto Rico at Mayagüez
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(i) Degrees with fields, institution, and date:

Ph.D.	Electrical Engineering, Ph.D. Advisor: Ph.D. Dissertation:	Michigan State University (MSU), Dr. Fang Z. Peng, IEEE Fellow "Modeling and Analysis of Solar Distributed Generation"	05/2006
M.S.	Electrical Engineering, Academic Advisor: Research Advisor:	Michigan State University, Dr. Percy A. Pierre, National Academy of Engineering Fellow Dr. R.L. Tummala, MSU Distinguished Professor	05/2002
B.S.	Electrical Engineering Specialization:	University of Puerto Rico, Mayagüez Campus Power Systems and Control Systems	05/2000

(ii) Faculty service at UPRM:

- Date of original appointment: August 2006
- Dates of advancement in rank:
  - Assistant Professor: 2006 to present
  - Total years of service: 4 years and 6 months

(iii) Areas of professional expertise:

Photovoltaic Systems, Decision & Risks for Power Markets, Renewable Energy, Algorithms for Maximum Power Control, Resonators, Nonlinear Control, Power Electronics, Electric Drives, Engineering Education

Professional Certifications:

1. *Installing Photovoltaic Systems Certification by Florida Solar Energy Center 2009 (DBPR CE No. 0000859, ECLB No. 0008242)*
2. *North American Board of Certified Energy Practitioners* (*NABCEP*) (No. E121109-18, *NAPCEB Certified 2010)*
3. *Licensed Engineer In Training (EIT) in Puerto Rico, USA, since 2000*

(iv) Appointments—academic or industrial:

08/2006 to present	Assistant Professor, University of Puerto Rico-Mayagüez, PR
09/2010 to present	Undergraduate Research LS-AMP Faculty Mentor, UPRM-College of Engineering,
Summers 2007-10	Faculty Guest Researcher, Argonne National Laboratory, Argonne, IL
2010	DHS Faculty Researcher, University of Southern California, DHS Center of Excellence USC-CREATE, Los Angeles, CA
Summer 2006	Research Assist., Volgograd State Technical University, Volgograd, Russia
08/2002 – 05/2006	Research Assistant, Michigan State University, East Lansing, MI
05/2004 - 07/2004	Research Assistant, Chinese Academy of Sciences Institute of Automation (CASIA), Beijing, China
08/2001 - 04/2002	Teaching Assistant, Electrical and Computer Engineering, MSU, East Lansing
Summers 2001-02	Research Assistant, Fermi National Accelerator Laboratory, Batavia, IL
08/2000 - 04/2001	Teaching Assistant, Electrical and Computer Engineering, MSU, East Lansing
05/2000 - 07/2000	Project Manager Assistant, Transmission Lines Division, Lord Electric Company, Rio Piedras, PR
08/1999 – 04/2000	Research Assistant, Tren Urbano, ATI, San Juan, PR

(v) Journal publications (undergraduate student as co-author*):

1- **Ortiz-Rivera, Eduardo I**.; Cosme, Antonio*; Alvarez, Jaime*; "Compact Fluorescent Lamps, an Anticipatory Mind to Mercury" IEEE Potentials-Magazine Jan./February 2011 Vol.30 No.1

2- Balaguer, Irvin; **Ortiz-Rivera, Eduardo I**.; "Survey of Distributed Generation Islanding Detection Methods" IEEE Latin America Transactions, October 2010 vol. 8 No. 5

3- Fang Zheng Peng; Joseph, A.; Jin Wang; Miaosen Shen; Lihua Chen; Zhiguo Pan; **Ortiz-Rivera, E.**; Yi Huang; "Z-source inverter for motor drives" IEEE Transactions on Power Electronics, Volume 20, Issue 4, July 2005 Page(s):857 – 863

4- **Ortiz-Rivera, Eduardo I**. "Analytical Model for a Photovoltaic Module using the Electrical Characteristics provided by the Manufacturer Data Sheet" IEEE Transactions on Power Electronics. (Accepted)

5- **Ortiz-Rivera, Eduardo I**. "A Novel Method to Estimate the Maximum Power for a Photovoltaic Inverter System." IEEE Transactions on Power Electronics (Accepted)

(vi) Conference publications (undergraduate student as co-author*):

6- Otero, Ruben, Santiago, Juan; Cruz, Joel; Lopez, Victor; **Ortiz-Rivera, Eduardo I**.; "Three Phase Induction Motor Drive Using Flyback Converter and PWM Inverter Fed from a Single Photovoltaic Panel" 2011 Power and Energy Society General Meeting, Detroit, MI

7- Santiago, Juan; Gonzalez, Pedro; Garcia, Sergio; **Ortiz-Rivera, Eduardo I**.; "Design of an Observer and Speed Controller for a DC Motor Fed by Fuel Cells and DC to DC Converters" 2011 Power and Energy Society General Meeting, Detroit, MI

8- Ortiz, Eliud; Maldonado, Ricardo; O'neill, Harry, **Ortiz-Rivera, Eduardo I**.; "Proposed System Model and Simulation for Three Phase Induction Motor Operation with Single PV Panel" 2011 Power and Energy Society General Meeting, Detroit, MI

9- Garcia, Sergio*; Pabon, Jose*; Diaz, Yancy*; **Ortiz-Rivera, Eduardo I**.; "An Integrated Undergraduate Research Experience in Control, Power Electronics, and Design using a Micromouse" 2010 Frontiers in Education Conference, Washington, DC (**Nomination for 2010 IEEE FIE Young Faculty Award**)

10- Mendez, Edgardo; Serrano Guillermo; **Ortiz-Rivera, Eduardo I**.; "A Monolithic Integrated Solar Energy Harvesting System", 2010 IEEE Photovoltaic Specialists Conf., Hawaii, June 2010 (**IEEE Student Award: Best Photovoltaic Terrestrial Application!)**

11- Díaz-Mercado, Yancy*; García-Vergara, Sergio*; Pabón-De León, José*; **Ortíz-Rivera, Eduardo I.**; "Maximum Power Control Based on Matching D.C. Motor Dynamics and Fuel Cell Dynamic Behavior" Proc. 2010 CPES Annual Conf., D2.9, Blacksburg, VA, April 11-13, 2010

12- Cabrera, Rafmag; Merced, Emmanuelle J.; Suarez, Ramon; Santiago, Jorge; **Ortiz-Rivera, Eduardo I.** "Self-sustainable Voltage Regulator for Photovoltaic Systems using Optimal Control Algorithm" Proceedings 2010 CPES Annual Conf., D2.10, Blacksburg, VA, April 11-13, 2010

13- Soltero, Daniel E. *; Francisco, Luis S.; **Ortiz-Rivera, Eduardo I.**; "Optimal Control for Buck Converter with PV Module" Proceedings 2010 CPES Annual Conference, D2.10, Blacksburg, VA, April 11-13, 2010

14- Jimenez-Brea, Emil A.; **Ortiz-Rivera, Eduardo I**.; Salazar, Andres; "Simple Photovoltaic Solar Cell Dynamic Sliding Mode Controlled Maximum Power Point Tracker for Battery Charging Applications" 23rd IEEE Applied Power Electronics Conference and Exposition, Palms Springs, CA, February 21-25, 2010 (**IEEE Award: Best Presentation on Renewable Energy!)**

15- **Ortiz-Rivera, Eduardo I**. Salazar, Andres; Gonzalez, Jesús; "A Mathematical Model for Online Electrical Characterization of Thermoelectric Generators Using the P-I Curves at Different Temperatures" 23rd IEEE Applied Power Electronics Conference and Exposition, Palms Springs, CA, February 21-25, 2010

16- Jimenez-Brea, Emil A.; Salazar, Andres; **Ortiz-Rivera, Eduardo I.**; Gonzalez, Jesús; "A Maximum Power Point Tracker Implementation for Photovoltaic Cells Using Dynamic Optimal Voltage Tracking" 23rd IEEE Applied Power Electronics Conference and Exp., Palms Springs, CA, February 21-25, 2010

17- Gonzalez, Jesús; **Ortiz-Rivera, Eduardo I**.; Salazar, Andres; Jimenez-Brea, Emil A.; "Analyzing the Optimal Matching of DC Motors to Photovoltaic Modules via DC-DC Converters" 23rd IEEE Applied Power Electronics Conference and Exp., Palms Springs, CA, February 21-25, 2010

18- **Ortiz-Rivera, Eduardo I.**; Salazar, Andres C.; Velez, José*; "An Enriched Undergraduate Research Experience based on the Simulation, Experiments, and Theory of Fuel Cells" 2009 Frontiers in Education Conference, San Antonio, TX , October 18-21, 2009

19- **Ortiz-Rivera, Eduardo I.**; Castro, Marcel; "Integration of Hands on Laboratory Experience of Power Electronics and Renewable Energy Applications: Work in Progress" 2009 Frontiers in Education Conference, San Antonio, TX, October 18-21, 2009

20- **Ortiz-Rivera, Eduardo I.**; Gonzalez, Jesús; Salazar, Andres C.; "Bringing Renewable Energy to the Electrical Engineering Undergraduate Education & Research at UPRM" 2009 Frontiers in Education Conference, San Antonio, TX, October 18-21, 2009

21- **Ortiz-Rivera, Eduardo I.**; Feliciano, Luisa; "Performance Evaluation and Simulation of a Solar Thermal Power Plant" 2009 IEEE Energy Conversion Congress and Exposition (Former IEEE PESC Conf.) San Jose, CA, USA, Sept. 20-24, 2009 **(IEEE IAS Myron Sucker Award!)**

22- Diaz, Andrés J.; Saltares, Roger; Rodríguez, Christian; Nuñez, Roberto; **Ortiz-Rivera, Eduardo I.**; Gonzalez, Jesús; "Induction Motor Equivalent Circuit for Dynamic Simulation" IEEE International Machines and Drives Conference, Miami, FL, May 3-6, 2009

23- E. E. Jimenez-Toribio, A. A. Labour-Castro, F. Muniz-Rodriguez, H. R. Perez-Hernandez, and **E. I. Ortiz-Rivera**; "Sensorless Control of SEPIC and Cuk Converters for DC Motors using Solar Panels" IEEE International Machines and Drives Conference, May 3-6, 2009

24- Gonzalez-Llorente, Jesús; **Ortiz-Rivera, Eduardo I**.; Diaz, Andrés J.; "A Maximum Power Point Tracker using Positive Feedforward Control based on the DC Motor Dynamics and PVM Mathematical Model" IEEE International Machines and Drives Conference, May 3-6, 2009

25- Balaguer, Irvin J.; Kim, Heung-Geun; Peng, Fang Z.; **Ortiz, Eduardo I.**; "Survey of Photovoltaic Power Systems Islanding Detection Methods" 34th Annual Conference of the IEEE Industrial Electronics Society, November 10-13, 2008

26- **Ortiz-Rivera, Eduardo I.**; Diaz, Andrés J.; "An Approximation of a PVM Model using Integer Polynomials" 34th Annual Conf. of the IEEE Industrial Electronics Soc, November 10-13, 2008

27- Jimenez-Brea, Emil A.; **Ortiz-Rivera, Eduardo I.**; Gil-Arias, Omar; "A Dynamic Maximum Power Point Tracker using Sliding Mode Control" 11th IEEE Control and Modeling for Power Electronics (COMPEL), Zurich, Switzerland, Aug 18-20, 2008

28- Gil-Arias, Omar; **Ortiz-Rivera, Eduardo I**.; "A General Purpose Tool for Simulating the Behavior of PV Solar Cells, Modules and Arrays" 11th IEEE Control and Modeling for Power Electronics (COMPEL), Zurich, Switzerland, August 18-20, 2008

29- **Ortiz-Rivera, Eduardo I.**; Pan, Zach; Wang, Jin; "A Mathematical Model to Describe the Electrical Characteristics for a Fuel Cell" IEEE 39th Power Electronics Specialists Conference, Rhodes, Greece, June 15-19 2008

30- Jimenez-Brea, Emil A.; **Ortiz-Rivera, Eduardo I.**; "Sliding Mode Control for PV Power Systems" Proceedings CPES General Meeting 2008, Blacksburg, Virginia, April 6-9, 2008

31- **Ortiz-Rivera, Eduardo I**.; "Maximum Power Point Tracking using the Optimal Duty Ratio for DC-DC Converters and Load Matching in Photovoltaic Applications" 22nd IEEE Applied Power Electronics Conference and Exposition, Austin, Texas, February 24-28, 2008

32- **Ortiz-Rivera, Eduardo I.**; Rodriguez, Luis*; "The Z-Source Converter as an Introduction to Power Electronics and Undergraduate Research" Proceedings 2007 Frontiers in Education Conference, Milwaukee, WI, October, 10-13, 2007

33- **Ortiz-Rivera, Eduardo I.**; Reyes-Hernandez, Angel L.*; Febo, Rey A.*; "Understanding the History of Fuel Cells" Proceedings 2007 IEEE Conference on the History of Electric Power, New Brunswick, New Jersey, August 3-5, 2007

34- **Ortiz-Rivera, Eduardo I.**; "A MPPT Method Based on the Approximation of a PVM Model using Fractional Polynomials" 38th IEEE Power Electronics Spec. Conf., Orlando FL, June 18-22, 2007.

35- Arias, Omar G.; **Ortiz-Rivera, Eduardo I.**; "Emulation of the Behavior of a Photovoltaic Module in SABER" Proc. CPES General Meeting 2007, Blacksburg, Virginia, April 15, 2007

36- Rodriguez, Luis*; Lugo, Salvador*; **Ortiz-Rivera, Eduardo I.**; "Undergraduate Research: Introduction to Power Electronics Using The T-Filter and Z-Source Converter" Proceedings CPES General Meeting 2007, Blacksburg, Virginia, April 15, 2007

37- **Ortiz-Rivera, Eduardo I.;** Peng, Fang Z.; "Algorithms to Estimate the Temperature and Effective Irradiance Level over a Photovoltaic Module using the Fixed Point Theorem.", 37th IEEE Power Electronics Specialists Conf., Jeju, Korea, June 18-22, 2006.

38- **Ortiz Rivera, E.I.**; Peng, F.Z.; "Linear Reoriented Coordinates Method", 2006 IEEE International Conf. on Electro/information Technology, 7-10 May 2006 Page(s):459 – 464

39- **Ortiz-Rivera, Eduardo I**., "A Novel Method of Area Optimization for a System Modeled with Transcendental Functions." AIAA 3rd International Energy Conversion Engineering Conference, San Francisco, California, August 15-18, 2005

40- **Ortiz-Rivera, Eduardo I**.; Peng, Fang Z.; "A Dynamic Photovoltaic System Using the Z-Source Converter.", AIAA 3rd International Energy Conversion Engineering Conference, San Francisco, California, August 15-18, 2005

41- **Ortiz-Rivera, E.I.**; Peng, F.Z.; "Analytical Model for a Photovoltaic Module using the Electrical Characteristics provided by the Manufacturer Data Sheet" PESC '05. IEEE 36th Power Electronics Specialists Conference, 2005. 16-16 June 2005 Page(s):2087 – 2091

42- **Ortiz-Rivera, Eduardo I.** and Fang Z. Peng "A Novel Method to Estimate the Maximum Power for a Photovoltaic Inverter System." The 35th IEEE Power Electronics Specialists Conference (PESC), Aachen, Germany, June 20-25, 2004

43- **Ortiz-Rivera, E.I.**; "Study of power quality: problems in commercial buildings in Puerto Rico" Proceedings of the 2004 IEEE International Conference on Electric Utility Deregulation, Restructuring and Power Technologies, 2004. (DRPT 2004). Volume 1, 5-8 April 2004 Page(s):301 - 305 Vol.1

(vii) Theses and Graduate Students Supervised (Master in Science Electrical Engineering) (http://grad.uprm.edu/oeg/TesisDisertacionesDigitales/IngenieriaElectricaComputadoras/)

1- Feliciano-Cruz, Luisa I. Performance Evaluation and Simulation of a Compound Parabolic Concentrator (CPC) Trough Solar Thermal Power Plant in Puerto Rico Under Solar Transient Conditions, Masters Thesis. Electrical and Computer Engineering Department, University of Puerto Rico, Mayaguez, February, 2010.

2- Jimenez-Brea, Emil A. Control of Alternative Energy Hybrid System for Residential and Low Power Applications, Masters Thesis. Electrical and Computer Engineering Department, University of Puerto Rico, Mayaguez, November, 2009.

3- González-Llorente, Jesús D. Analysis of Optimal Matching Between a Dc Motor and Photovoltaic Modules Via Dc-Dc Power Converters, Masters Thesis. Electrical and Computer Engineering Department, University of Puerto Rico, Mayaguez, September, 2009.

4- Gil-Arias, Omar. Modeling and Simulation of Photovoltaic Devices, Masters Thesis. Electrical and Computer Engineering Department, University of Puerto Rico, Mayaguez, November, 2008.

(viii) Graduate Student Committee Member
(Thesis can be found at http://grad.uprm.edu/oeg/TesisDisertacionesDigitales/)

1- Cruz-García, Cristina; A Study of Equation-Free Methods for Simulation of Power Electronics Systems, Masters Project. Electrical and Computer Engineering Department, University of Puerto Rico, Mayaguez, December, 2010. Advisor: Dr. Miguel Velez-Reyes

2- Vargas-Colón, Ariel O.; Automation of a Fluid Bed Dryer utilizing Multi-Variate Near Infrared Spectra and Model Predictive Control, Masters Thesis. Chemical Engineering Department, University of Puerto Rico, Mayaguez, March, 2010. Advisor: Dr. Carlos Velázquez

3- Dávila-Velázquez, Jorge A.; Development of a simulation model for the design of renewable energy systems applied to aqueducts in communities at Puerto Rico, Masters Thesis. Civil Engineering Department, University of Puerto Rico, Mayaguez, November, 2008. Advisor: Dr. Francisco Maldonado

4- Rodriguez-Otero, Miguel; Power Quality Issues and Feasibility Study in a DC Residential Renewable Energy System, Masters Thesis. Electrical and Computer Engineering Department, University of Puerto Rico, Mayaguez, October, 2008. Advisor: Dr. Efraín O'neill

5- Torres-Hernández, María E. Hierarchical Control of Hybrid Power Systems, Masters Thesis. Electrical and Computer Engineering Department, University of Puerto Rico, Mayaguez, October, 2007. Advisor: Dr. Miguel Velez-Reyes

(ix) Current Graduate Students – Major and Theses Advisor

1- Salazar, Andres. Thesis Topic: Nonlinear Control of Fuel Cell Power Systems using Power Electronics, Degree Program: MSEE; Start Date: January 2009; Completion Date: May 2011

2- *Vargas, Nestor. Thesis Topic: A Robust Photovoltaic Power Supply for CubeSat Applications, Degree Program: MSEE; Start Date: January 2010; Completion Date: December 2011

3- *Reyes, Frankie. Thesis Topic: Hybrid Distributed Power Technologies for a High Resilient Building, Degree Program: MSEE; Start Date: January 2010; Completion Date: December 2011

4- *Ortiz, Eliud. Thesis Topic: Optimal Integrated Circuits for Thermal Energy Harvesting Systems, Degree Program: MSEE; Start Date: August 2010; Completion Date: May 201

5- *Bousoño, Orlando. Thesis Topic: Three Phase Photovoltaic Inverter for Power Factor Correction, Degree Program: MSEE; Start Date: August 2010; Completion Date: May 2012

6- Hernandez Josiah. Thesis Topic: A Residential Single Phase Inverter Based on the Z-Source Topology, Degree Program: MSEE; Start Date: January 2011; Completion Date: December 2012

**Previous undergraduate member of my research team $M_{inds}{}^{2}$CREATE.*

Efraín O'Neill-Carrillo, PhD, PE

ACADEMIC EXPERIENCE

Professor, Electrical and Computer Engineering Department, 7/04-Present
University of Puerto Rico-Mayagüez (UPRM)
Visiting Researcher, Advanced Research Institute, Virginia Tech (Arlington), Summer 2010.
Co-Director, Center for Resources in General Education, UPRM, since 2008.
Director of the Institute for Tropical Energy, Environment and Society, UPRM, 2007-2010.
Coordinator for Social, Ethical and Global Issues, College of Engineering, UPRM, 2006-2010.
Visiting Researcher: Centre for Economic Renewable Power Delivery, U. of Glasgow, Scotland, 6/2004.
Associate Professor, Electrical and Computer Engineering Department, 7/02-6/04
Assistant Professor, Electrical and Computer Engineering Department, 7/99-6/02
Graduate students supervised in last 5 years: 10

PROFESSIONAL EXPERIENCE

Visiting Researcher: Puerto Rico Electric Power Authority, Summer 2002.
Electrical Engineer: TOR Engineering, Phoenix, Arizona, 1/98-7/98.
Electrical Engineering Intern. CPI del Caribe, Dorado, PR, 1/93-7/93.

EDUCATION

Ph.D., Electrical Engineering, May 1999, Arizona State University, Tempe, Arizona, Dissertation: "Nonlinear Modeling and Analysis of Highly Varying Loads", Adv. G.T. Heydt
Master of Science in Electrical Engineering, December 1995, Purdue University, Indiana
Bachelor of Science in Electrical Engineering, Magna Cum Laude, June 1994, UPR-Mayagüez

RESEARCH PROJECTS

*Joint Principal Investigator (PI): "*Center for Resources in General Education: Towards Student Success in General and STEM Education at UPRM," U.S. Department of Education, 10/2008 – 9/2013.
PI: "Power Quality Research and Education: A New Power Engineer for Today's Energy Challenges," National Science Foundation ECS CAREER Program Grant, May 2002-April 2008.
Co-PI: "Graduate Education in Research Ethics for Scientists and Engineers," NSF REC/EESE Grant, January 2007-December 2008.
Joint PI: "Pan-American Capacitating Program in Power Engineering," Joint project between UPRM and the APEC University (Santo Domingo, DR), January 2007-May 2011.
Co-PI: Achievable Renewable Energy Targets for Puerto Rico's Renewable Energy Portfolio Standard," Puerto Rico's Energy Affairs Administration, Oct. 2007- Nov. 2008
Co-PI: "San Ignacio: Example of Sustainability," San Ignacio Private School, June 2007-May 2008.
Co-PI: "Caguas Sustainable Energy Showcase," Caguas City Government Grant, 9/2006-2/2007.
PI: "Acquisition of Instrumentation for the Electric Energy Processing Systems Laboratory," National Science Foundation ECS Grant for Major Research Instrumentation (MRI), 1/2002 – 12/2004.
PI: "Integrating Laboratory Practices and Undergraduate Research to the Power Engineering Curriculum at UPRM," National Science Foundation DUE Grant for Course, Curriculum and Laboratory Improvement (CCLI), May 2001-June 2003.
Joint PI: "Failure Probabilities for Risk-Based Maintenance and Parameter Estimation of Synchronous Generators," NSF EEC Grant - I/UCRC PSERC, August 2003 – July 2005.
Co-PI: "Intelligent Power Routers for Distributed Coordination in Electric Energy Processing Networks," NSF/ONR ECS EPNES Grant, January 2003 – December 2005.

SELECTED PUBLICATIONS

A.A. Irizarry-Rivera, M. Rodríguez-Martínez, B. Vélez, M. Vélez-Reyes, A.R. Ramírez-Orquín, E. O'Neill-Carrillo, and J.R. Cedeño, "Intelligent Power Routers: Distributed Coordination for Electric

Energy Processing Networks." Chapter in L. Mili and J. Momoh. Eds., *Electric Power Networks Efficiency and Security,* John Wiley, 2010.

M. Castro-Sitiriche, E. O'Neill-Carrillo, C. Papadopoulos, C. Pomales-García, A. Santiago-Román and J. Seguel "Leveraging Accreditation Efforts to Foster Innovation in Engineering Education," *Proceedings of the 40th ASEE/IEEE Frontiers in Education Conference*, October 27 - 30, 2010, Arlington, VA.

E. O'Neill-Carrillo, C. Ortiz-García, M. Pérez, I. Baigés, S. Minos, "Experiences with Stakeholder Engagement in Transitioning to an Increased Use of Renewable Energy Systems," *Proceedings of the IEEE International Symposium on Sustainable Systems and Technology*, Washington, DC, May 2010.

R. Martínez-Cid, E. O'Neill-Carrillo, "Sustainable Microgrids for Isolated Systems," *Proceedings of the IEEE/PES Transmission and Distribution Conference*, New Orleans, LA, April 2010.

A. A. Irizarry Rivera, J. A. Colucci-Ríos, E. O'Neill-Carrillo *Achievable Renewable Energy Targets For Puerto Rico's Renewable Energy Portfolio Standard,* Puerto Rico State Energy Office, 2009, 300 pages.

J. Colucci -Ríos, E. O'Neill-Carrillo, A. Irizarry Rivera, "Renewable Energy in the Caribbean: A Case Study from Puerto Rico," Chapter in *Environmental Management, Sustainable Development and Human Health*, CRC Press, 2009.

E. O'Neill-Carrillo, D. Collins, J. López Garriga, R. Macchiavelli, J. A. Cruz, "Center for Resources in General Education (CIVIS): Towards Student Success in General and STEM Education," *Proceedings of the 39th ASEE/IEEE Frontiers in Education Conference*, October 18 - 21, 2009, San Antonio, TX.

L. O. Jiménez, E. O'Neill-Carrillo, M. Rodríguez, "An Introductory Learning Module on Ethics and Academic Integrity for Freshman Engineering Students," *Proceedings of the 39th ASEE/IEEE Frontiers in Education Conference*, October 18 - 21, 2009, San Antonio, TX.

H. P. Ladner-García, E. O'Neill-Carrillo, "The Potential of Photovoltaic Generation in Puerto Rico," *General Meeting of the IEEE Power Engineering Society*, July 2009, Calgary, Canada.

E. O'Neill-Carrillo, A.A. Irizarry-Rivera, C. Pomales, "Integrative Graduate Program in Sustainable Electric Energy Systems," *General Meeting of the IEEE Power Engineering Society*, July 2009, Calgary, Canada.

E. O'Neill-Carrillo, A. Irizarry-Rivera, J. Colucci-Rios, "Struggling for Sustainability in a Fossil Fuel Dependent Society," *Journal on Electrical Engineering*, vol. 2, no. 4, April-June 2009, pp. 44-56.

L. Collazo, E. O'Neill-Carrillo, "Comparison of Windowed Fourier Transform and Dynamic Phasors for Power Quality Analysis," *Proceedings of the IEEE/PES Power Systems Conference and Exposition*, March 2009, Seattle, WA.

E. O'Neill-Carrillo, M. Pérez-Lugo, C. Ortiz-García, A. A. Irizarry-Rivera, J.A. Colucci-Ríos, "Sustainable Energy: Balancing the Economic, Environmental and Social Dimensions of Energy," *Proceedings of Energy 2030: IEEE Conference on Global Sustainable Energy Infrastructure*, November 2008, Atlanta, GA.

E. O'Neill-Carrillo, W. Frey, C. Ortiz-García, A. A. Irizarry-Rivera, M. Pérez-Lugo, J.A. Colucci-Rios, "Advancing a Sustainable Energy Ethics Through Stakeholder Engagement," *Proceedings of Energy 2030: IEEE Conference on Global Sustainable Energy Infrastructure*, November 2008, Atlanta, GA.

M. Rodríguez-Otero, E. O'Neill-Carrillo, "Efficient Home Appliances for a Future DC Residence," *Proceedings of Energy 2030: IEEE Conference on Global Sustainable Energy Infrastructure*, November 2008, Atlanta, GA.

E. O'Neill-Carrillo, W. Frey, L. Jiménez, M. Rodríguez, D. Negrón, "Social, Ethical and Global Issues in Engineering," *Proceedings of the 38th Frontiers in Education Conference (FIE 2008)*, October 2008, Saratoga Springs, NY.

W. Frey, E. O'Neill-Carrillo, "Teaching Engineering Ethics to Professional Engineers in Puerto Rico," *Proceedings of the 38th Frontiers in Education Conference (FIE 2008)*, October 2008, Saratoga Springs, NY.

E. O'Neill-Carrillo, J.J. Ferrer, W. Frey, E. Jaramillo, L. Jiménez, "Development and Assessment of an Introductory Research Ethics Module," *Proceedings of the 38th Frontiers in Education Conference (FIE 2008)*, October 2008, Saratoga Springs, NY.

W. Frey, E. O'Neill-Carrillo, "Engineering Ethics in Puerto Rico: Issues and Narratives," *Journal for Science and Engineering Ethics*, vol. 14, no. 3, 2008, pp. 417-431.

E. O'Neill-Carrillo, "Power Quality Research and Education: A New Power Engineer for Today's Energy Challenges," Invited Panel Paper, *General Meeting of the IEEE Power Engineering Society*, July 2008, Pittsburgh, PA.

H. Ladner, E. O'Neill-Carrillo, "Demonstrative PV Systems for an Isolated System," *Proceedings of the 10th IASTED International Conference on Power and Energy Systems*, April 2008, Baltimore, MD.

E. O'Neill-Carrillo, M. Pérez-Lugo, C. Ortiz-García, A. Irizarry-Rivera, J. Colucci-Ríos, "Sustainability, Energy Policy and Ethics in Puerto Rico," *Proceedings of Energy and Responsibility: A Conference on Ethics and the Environment*, April 10-12, 2008, Knoxville, Tennessee.

E. O'Neill-Carrillo, L. Seijo, E.D. Hirleman, F. Maldonado, E. Marti, A. Rivera, "Mentoring Interdisciplinary Service Learning Projects," *Proceedings of the 37th Frontiers in Education Conference (FIE 2007)*, October 2007, Milwaukee, MN.

J. Colucci, A. Irizarry, E. O'Neill-Carrillo "Sustainable Energy in Puerto Rico," *ASME Sustainability '07 Conference*, June 2007, Long Beach, CA.

A. A. Irizarry-Rivera, M. Rodríguez-Martínez, B. Vélez, M. Vélez-Reyes, A. Ramirez-Orquin, E. O'Neill-Carrillo and J. Cedeño "Intelligent Power Routers: A Distributed Coordination Approach for Electric Energy Processing Networks," *International Journal of Critical Infrastructures*, Special Issue, Vol. 3 No 1/2 pp. 20-57, 2007.

E. O'Neill-Carrillo, A. Irizarry-Rivera, "Socially-Relevant Capstone Design Projects in Power Engineering," *Proceedings of the IEEE/PES Power Systems Conference and Exposition*, October 2006, Atlanta, GA.

L.O. Jiménez, E. O'Neill-Carrillo, W. Frey, R. Rodríguez-Solis, A. Irizarry-Rivera, S. Hunt, "A Learning Module of Social and Ethical Implications for ECE Capstone Design Courses," *Proceedings of the 36th Frontiers in Education Conference (FIE 2006)*, October 2006, San Diego, CA.

E. O'Neill-Carrillo, E. Marrero, A. Irizarry-Rivera, "Integrated Laboratory Experiences in Power Engineering Courses," *Proceedings of the International Conference on Engineering Education*, July 2006, San Juan, PR.

L.O. Jiménez, E. O'Neill-Carrillo, E. Marrero, "Creating Ethical Awareness in Electrical and Computer Engineering Senior Students: A Learning Module on Ethics," *Proceedings of the 35th Frontiers in Education Conference (FIE 2005)*, October 2005, Indianapolis, IN.

E. O'Neill-Carrillo, A. Irizarry-Rivera, J. Cruz-Emeric, "Curricular Revisions in Electrical Engineering at UPRM," *Proceedings of the 35th Frontiers in Education Conference (FIE 2005)*, October 2005, Indianapolis, IN.

M. Rodríguez-Fernández, E. O'Neill-Carrillo, A. Baretty, O. López, "Puerto Rico Electric Power Authority Power Quality Monitoring and Benchmarking Project," *Proceedings of the Power Quality Exhibition and Conference*, October 2005, Baltimore, MD.

G. A. Rivera-Rodríguez, E. O'Neill-Carrillo, "Economic Assessment of Distributed Generation Using Life Cycle Costs and Environmental Externalities," *Proceedings of the 37th North American Power Symposium,* Ames, IA, October 2005.

H. R. Zamot, E. O'Neill-Carrillo A. Irizarry-Rivera, "Analysis of Wind Projects Considering Public Perception and Environmental Impact," *Proceedings of the 37th North American Power Symposium,* Ames, IA, October 2005.

D. Rodríguez-Sanabria, E. O'Neill-Carrillo, "Power Quality Indices in the Hartley Domain," Proceedings of the 7th *IASTED International Conference on Power and Energy Systems*, November 29-December 1, 2004, Tampa, FL.

A. Santiago, A. Aquino, J. Cedeno, E. O'Neill-Carrillo, "Optimal Location of Distributed Generation in Distribution Feeders," *Proceedings of the 2004 Power Systems Conference: Distributed Generation and Advanced Metering,* March 2004, Clemson, SC.

M. Concepción-Robles, E. O'Neill-Carrillo, "Simulation and Power Quality Analysis of Grid-Tied Inverters," *Proceedings of the 35th North American Power Symposium,* Rolla, MO, October 2003.

R.E. Pérez-Guerrero, E. O'Neill-Carrillo, D. Rodríguez-Sanabria, "A Phasor Dynamic Approach for Inrush Current Analysis," *Proceedings of the 35th North American Power Symposium,* Rolla, MO, October 2003.

D. Rodríguez-Sanabria, E. O'Neill-Carrillo, "Modeling Harmonic Impact and Mitigation Tools in Distribution Systems using ATP," *Proceedings of the 35th North American Power Symposium,* Rolla, MO, October 2003.

J. L. Huaman-Qquellon, E. O'Neill-Carrillo, " Analysis and Mitigation of Non Ideal Supply Effects in an Induction Motor Using Curve Fitting Algorithm," *Proceedings of the 35th North American Power Symposium,* Rolla, MO, October 2003.

E. O'Neill-Carrillo, M. Vélez-Reyes, A. Irizarry-Rivera, E. Marrero, "The Power of Undergraduate Research," *Power and Energy Magazine*, vol. 1, no. 4, July/August 2003, pp. 29-36.

D. Rodríguez, E. O'Neill-Carrillo, "Education Modules for Distributed Generation in Power Systems," *Proceedings of the 2003 Power Systems Conference: Distributed Generation and Advanced Metering,* March 2003, Clemson, SC.

E. O'Neill-Carrillo, J. Ramos, T. Martínez-Navedo, M. Vélez-Reyes, E. Marrero "Undergraduate Research and New Laboratory Practices in Power Engineering," *Proceedings of the 32nd ASEE/IEEE Frontiers in Education Conference*, November 2002, Boston, MA., Session T1D, pp. 1-6.

E. O'Neill-Carrillo, J. Arroyo-Figueroa, J. Rosado, J. Santiago, "The Atmospheric Phenomena Laboratory: Connecting Electrical and Computer Engineering through Undergraduate Research," *Proceedings of the 32nd ASEE/IEEE Frontiers in Education Conference*, Boston, MA, November 2002.

D. Rodríguez, E. O'Neill-Carrillo, M. Concepción, J. García-Pérez, "Impact of Distributed Generation in Electric Power Systems," *Proceedings of the 34th North American Power Symposium,* Tempe, AZ, October 2002.

A. Méndez-Goyco, V. Oliveras-Martínez, E. O'Neill-Carrillo, J. García-Pérez, D. Rodríguez, "PV Systems in Electric Power Grids," *Proceedings of the 34th North American Power Symposium,* Tempe, AZ, October 2002.

J. García-Pérez, M. Mendoza-Sánchez, E. Olmeda, C. Ramos-Robles, E. O'Neill-Carrillo, "Monitoring, Modeling and Solving Power Quality Events," *Proceedings of the 34th North American Power Symposium,* Tempe, AZ, October 2002.

E. O'Neill-Carrillo, T. Martínez, A. Méndez-Goyco, V. Oliveras, "Simulation Tools for Power Electronics Applications in Power Systems," *Proceedings of the 8th IEEE Workshop on Computers in Power Electronics*, Mayagüez, PR, June 2002.

E. O'Neill-Carrillo, J. Aguiar, "Power Quality Research: An Alternative For Power Engineering Education," *Proceedings of the 5th IASTED International Conference on Power and Energy Systems*, November 19-22, 2001, Tampa, FL, pp. 47-51.

E. O'Neill-Carrillo, A. Irizarry-Rivera, M. Vélez-Reyes, "Curriculum Improvements in Power Engineering," *Proceedings of the 31st ASEE/IEEE Frontiers in Education Conference*, Reno, NV, October 10-13, 2001, Session T4A, pp. 15-20.

T. Martínez-Navedo, J. García-Pérez, B. Rodríguez-Medina, E. O'Neill-Carrillo, "Power Electronics Systems for Distribution Reliability and Quality," *Proceedings of the 33th North American Power Symposium*, October 15-16, 2001, College Station, TX, pp. 256-263.

E. O'Neill-Carrillo, B. Banfai, G.T. Heydt, J. Si, "EMTP Implementation of Nonlinear Load Models," *Journal of Electric Power Components and Systems*, vol. 29, no. 9, September 2001, pp. 809-819.

PROFESSIONAL SERVICE

Founding Member of the Puerto Rico Electric Energy Round Table, Multi-sector Group on the Future of Puerto Rico's Electric System, 2008-present. Coordinator (2008-2010).
PV Project Reviewer, *2010 Solar Energy Technologies Program Peer Review*, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy, May 24-27, 2010 Washington, DC.
Member of the Round Table of Scientists on the Effects of Climate Change in Puerto Rico, May 2007.
Editor-in-Chief/President of the Board, *Dimension*, Professional Magazine of the CIAPR (PR Society of Professional Engineers and Land Surveyors), 2006-2007.
Chair of the IEEE Western PR Joint Chapter of the Education Society/SSIT, 2006-2008.
Organizer of the IEEE Western PR Joint Chapter of the Education Society/Society for Social Implications of Technology (SSIT), 2006.
IEEE EAC Program Evaluator (ABET), since 2006.
Creator and President of the Organizing Committee of the *First Experts' Summit – Electric Energy in Puerto Rico: Past, Present and Alternatives for the Future*, CIAPR, San Juan, PR, November 2005.
Engineering Representative to the UPRM Institutional Review Board (IRB), 2006-2007.
Adjunct Professor, Center for Professional Ethics, UPRM, since 2005.
Member of the Committee to Evaluate the Technical Administration of the Puerto Rico Electric System by the Puerto Rico Electric Power Authority during the Tropical Storm (TS) Jeanne. The official inquiry by the CIAPR about what caused a general electric blackout in the Island of Puerto Rico during the TS of September 15, 2004. Responsibilities included: analysis of technical evidence, as submitted by PREPA, of the power system state and behavior as TS Jeanne crossed over Puerto Rico, the formulation of an hypothesis to explain such behavior, and to judge the decisions made on the administration of the power system during the storm. September 2004 – April 2005.
Chair of the IEEE Western PR Power Engineering Society Chapter, 2004-2009.
Organizer of the IEEE Western PR Power Engineering Society Chapter, 2004.
President of the Industry-Academe Committee of the PR Institute of Electrical Engineers, 2004-Present.
Organizing Committee, *First Puerto Rico Manufacturing Symposium*, Mayaguez, 2004.
Creator and President of the Executive Committee of the *First Industry-University Symposium on Electrical Engineering* (IUSEE 2003), November 2003.
Creator and General Chair, *NSF Caribbean Colloquium on Power Quality*, June 24-27, 2003, Dorado, PR.
Associate Editor of the *IASTED International Journal of Power and Energy Systems,* 2001-2007
Reviewer for the *IEEE Transactions on Education* and *IEEE Proceedings.*
Reviewer of NSF proposals in Education and Engineering.
Organizer, leader and presenter of continuing education conferences, short course and seminars for the IEEE, PES and the Colegio de Ingenieros y Agrimensores de Puerto Rico (CIAPR - PR Society of Professional Engineers and Land Surveyors). Since 2002, the continuing education activities organized by Dr. O'Neill have reached over 2,000 practicing engineers in Puerto Rico.

AWARDS

2009 Outstanding Electrical Engineering Project (Joint Award to UPRM Team for PV Lab in Casa Pueblo, Adjuntas), PR Society of Professional Engineers and Land Surveyors.
2005 Walter Fee Outstanding Young Engineer Award, IEEE Power Engineering Society
Senior Member, IEEE, May 2005.
2004-2005 Outstanding Professor of Electrical and Computer Engineering Award, UPRM
Early Promotion to Full Professor for Exceptional Merit, UPRM, November 2004
2003 Electrical Engineer of the Year, PR Society of Professional Engineers and Land Surveyors
2001-2002 Outstanding Professor of Electrical and Computer Engineering Award, UPRM

Dr. Hamed Parsiani,

Professor

Electrical & Computer Engineering

University of Puerto Rico at Mayaguez (UPRM)

EDUCATION:

1979 PhD, Electrical Engineering, Texas A&M University

1973 MEE, Electrical Engineering, Texas A&M University

1971 BS, Electrical Engineering, Oregon State University

1970 BS, Mathematics, Oregon State University

EMPLOYMENT:

Jan to Oct 2010: Acting director of Electrical & Computer Engineering

1993- present: Professor of Electrical & Computer Engineering, UPRM

1988- 1993: Associate professor of Electrical & Computer Engineering, UPRM

1986- 1988: Assistant professor of Electrical & Computer Engineering, UPRM

PROFESSIONAL EXPERIENCE:

- **Director of UPRM NOAA-CREST in charge of progress in projects covering remote sensing in troposphere, hydroclimate, and coastal remote sensing, 2005 to present.**
- **Director Lidar laboratory for atmospheric research, 2008 to present**
- **Coordinator for the design, purchase, assembly, and testing of the first Lidar system in the Caribbean region, 2007-2008**
- **Supervised 5 MS students over the past 5 years.**

RESEARCH INTERSTS:

Development of Lidar system for advanced atmospheric research

- **Aerosol Characterization using sunphotometer/AERONET and Lidar over PR**
- **Cloud characterization using Lidar and satellites**
- **Soil Type and Moisture Determination using Radar**
- **Vegetation Health Index determination using Radar**
- **Image Processing and classification**

PROFESSIONAL AFFILIATIONS & HONORS:

Institute of Electrical and Electronics Engineers, (Member). Permanent member of the Eta Kappa Nu Honor Society, granted by Texas A&M University.

GRANTS:

Current Funding

Tropospheric aerosol characterizations and air quality, UPRM- PI of "Center of Remote Sensing & Technology", NOAA-CREST research grant for $2,500,000, per year for 2006-2011.

Pending Grants

A GOES-R-Based Algorithm for Estimating Solar Insolation and its Application to a Hydrologic Water and

Energy Balance over Puerto Rico, $450K. NOAA GOES-R Risk Reduction Program.

Other Research grants:

PI of "Subsurface Aquifer Delineation using Ground Penetrating Radar", NSF-3DGeo Company, $105,000.00 grant, 2008-2009.

PI of"soil moisture algorithm development using Radar", GSSI Inc. grant 2006-2007, $36,000.00

UPRM-Deputy-PI and Research Director of "Center of Remote Sensing & Technology", CREST-NOAA research grant for $2,500,000.00 per year for 2001-2006.

Co-PI of "Tropical Center for Earth and Space Studies", NASA-URC II, Goddard Flight Center, NASA grant for $4,999,513.00, with UPR matching fund for $2,450,000.00, 2000-2005.

Research collaborator, PaSCOR-NASA grant, for $3,163,167.00, with UPR matching fund for $ 299,918.00, 1999-2004.

PUBLICATIONS:

1. **Javier Mendez, Hamed Parsiani, "*Implementation of a Lidar System and its Usage in Characterization of Aerosols in the Atmospheric column*", Proceedings of 8th International conference on Instrumentation, Measurements, Circuits and Systems, May 20-22, 2009**
2. **Javier Mendez, Hamed Parsian, Emmanuel Sanchez, "*Remote Sensing of Atmospheric Particles Using LIDAR, Calipso Satellite, & AERONET: Algorithm Development*" ,WSEAS TRANSACTIONS ON SYSTEMS, Issue 1, Volume 8, January 2009**
3. **Hamed Parsiani, Javier Mendez, "*UPRM Lidar Assembly and application to Aerosol Characterization*", 12th WSEAS International Conference on Systems, Heraklion, Greece, July 22-24, 2008.**
4. **Hamed Parsiani, Andres Bonilla, "*Effectiveness of Aerosol Size Distribution Determination Using Sun-Photometer with supervised training*", 2008 WSEAS Transactions on Systems.**
5. **Ana Picon, Hamed Parsiani, Ramon Vasquez, "*Integrating Cross-Comparison Methodologies For The Retrieval of Cloud Top Heights Over The Caribbean*", WSEAS Transactions on Signal Processing, Issue 2, Vol. 2, Feb. 2006.**
6. **Andres Bonilla, Hamed Parsiani, "Aerosol Optical Depth Spatial Variation as Sensed By a Sunphotometer and Compared to a Fixed AERONET Station", SIP 2008 Proceedings, Aug. 18-23, 2008, Hawaii .**
7. **Hamed Parsiani, Andres Bonilla, "Aerosol size Distribution Using Sun-Photometer and Artificial Neural Network", WSEAS 2008 Proceedings, July 22-24, 2008, Greece.**
8. **Ana Picon, Ramon Vasquez, Hamed Parsiani, "*Cross Comparison of MODIS and MISR Cloud Top Height Retrieval Over The Caribbean*", WSEAS 2005 Proceedings, Nov. 2005, Italy.**
9. **Hamed Parsiani, Enrico Mattei, "*Soil Moisture Determination Based on Radar Response and Artificial Neural Networks*", WSEAS Transactions on Signal Processing, Issue 2, Vol. 1, Nov. 2005.**
10. **Hamed Parsiani, Enrico Mattei "*Open Field Soil Moisture Measurements with Radar*", WSEAS 2005 Proceedings, Nov. 2005, Italy.**

11. Hamed Parsiani, Enrico Mattei, Allen Lizarraga, Mairim Ramos, "*Soil Moisture Determination based on MCFD/NN-GUI Algorithm using Wideband Radar Images of Land*", Proceedings of IASTED SIP 2005, Aug. 15-17, 2005, Hawaii.

12. Hamed Parsiani, Maritza Torres, Pedro Rodriguez, "*Material Characteristics in Fourier Domain (MCFD) formulation, a signature to determine soil type, moisture, and vegetation health, based on multilayer ground penetrating radar reflection*", Proceedings of IASTED SIP 2004, Aug. 23-25, 2004, Hawaii.

13. Hamed Parsiani, Maritza Torres, "*High-resolution vegetation index as measured by radar and its validation with spectrometer*", Proceedings of SPIE 2004, Gran Canaria, Spain, Sept. 13-16, 2004.

14. **González, J. E., J. C. Luvall, D. Rickman, D. E. Comarazamy, A. J. Picón, E. W. Harmsen, Hamed Parsiani, N. Ramírez, R. Vázquez, R. Williams, R. B. Waide, and C. A. Tepley, 2005: *Urban heat islands developing in coastal tropical cities. EOS Transactions, AGU*, 86, 42, pp. 397 & 403.**

15. Hamed Parsiani, Pedro Rodriguez, "Subsurface Material Type Determination from Ground Penetrating Radar Signatures", Proceedings of SPIE 2004, Gran Canaria, Spain, Sept. 13-16, 2004.

16. Hamed Parsiani, Leonid Tolstoy, "Application of Fourier Descriptors and Fuzzy Logic to Classification of Radar Subsurface Images", proceedings of SPIE 2003, Barcelona, Spain, Sept. 8-12, 2003.

17. **Eric Harmsen, Hamed Parsiani, "Evaluation of Several Dielectric Mixing Models for Estimating Soil Moisture Content", Proceedings of ASAE'2003 Conference, Las Vegas, Nevada, July 26-30, 2003.**

18. Maritza Torres, Hamed Parsiani, " Non-linearity of Soil Dielectric as a Function of Radar Frequency and Soil Moisture Content", CRC'2004 Proceedings, April 2, 2004, Mayaguez, P.R.

19. Pedro Rodriguez, Hamed Parsiani, "Moisture Determination Based on Ground Penetrating Radar Measurements," CRC'2004 Proceedings, April 2, 2004, Mayaguez, P.R.

20. Maritza Torres, Hamed Parsiani, "Improved Subsurface Radiation Pattern Determination of 1.5 GHz SIR-20 Bow-Tie Antenna", NOAA-CREST/NASA Symposium 2003, Talahassee, Fl, March 30-April 3, 2003.

21. Victor Marrero, Hamed Parsiani, "Subsurface Unsupervised Cluster Determination", NOAA-CREST/NASA Symposium 2003, Talahassee, Fl, March 30-April 3, 2003.

22. Daniel Rodriguez, Richard Diaz, Hamed Parsiani, Eric Harmsen, "Validation of an Inverse Procedure for Estimating Soil Moisture Content using GPR", NOAA-CREST/NASA Symposium 2003, Talahassee, Fl, March 30-April 3, 2003.

23. Hamed Parsiani, Leonid Tolstoy , " Neural Network classification of the subsurface reflected waves and media velocity determination", NOAA-CREST/NASA-EPSCoR Joint Symposium for Climate Studies 2003, University of Puerto Rico - Mayaguez Campus, January 10-11, 2003.

24. Eric Harmsen, Hamed Parsiani, "Inverse Procedure for Estimating Vertically Distributed Soil Hydraulic Parameters Using GPR", NOAA-CREST/NASA-EPSCoR Joint Symposium for Climate Studies 2003, University of Puerto Rico - Mayaguez Campus, January 10-11, 2003.

25. Leonid Tolstoy , Hamed Parsiani, "Comparison of Neural Network Classification Methods Applied to Subsurface Radar Images Based on Single Echo and Hyperbolic Signature", CRC'2003 Proceedings,

Mayaguez, P.R

26. Leonid Tolstoy, Hamed Parsiani, Jorge Ortiz , "Application of Fourier Descriptors and Neural Network to Classification of Radar Subsurface Images", SPIE Int. Conf. 2002 Proceedings, Sept. 23-27, 2002, Crete, Greece.

27. Leonid Tolstoy, Hamed Parsiani, "Application of Fourier Descriptors and Neural Network to Shape Recognition", CRC' 2002 Proceedings, Mayaguez, Puerto Rico, 2002.

28. Héctor Ortiz, Hamed Parsiani, "Simplified JPEG Compression of Radar Sub-Surface Images and the Application of Threshold Filtering." Proceedings of CRC' 2002, Mayaguez, PR, 2002.

29. S. Cruz-Pol, Velez-Reyes, M., Hunt, S., Parsiani, H., Colom-Ustaris, J., Jimenez, L.O., and Vasquez, R., "The Laboratory for Applied Remote Sensing and Image Processing at University of Puerto Rico at Mayaguez", IEEE Geoscience and Remote Sensing Newsletter, January 2002.

30. Elí García, Ruth Rieckehoff, Hamed Parsiani, "*Restoration of a Degraded Image*." In Proceedings CRC 2002, Mayaguez, PR, 2002.

31. Hamed Parsiani & Rolando Gonzalez, "*Iterated Block Matching Fractals with Parent & Child*," Proceedings of` , SIP'2000, Nov. 19-23, 2000, Las Vegas, Nevada.

32. Jose del Toro Duran, Hamed Parsiani, "*Analysis of Fractals and Wavelets leading to an improved image compression method*", CRC'2000 Proceedings, May 6, 2000, Mayaguez, P.R.

33. Rolando Gonzalez, Hamed Parsiani, "*Modular Approach to IBMF Compression Software*", CRC'2000 Proceedings, May 6, 2000, Mayaguez, P.R.

34. Santos Lopez, Hamed Parsiani, "Non-linear Least Square method applied to Iterated Block Matching Fractals (IBMF) for image compression", CRC'2000 Proceedings, May 6, 2000, Mayaguez, P.R.

35. Norman Lopez, Hamed Parsiani, "*Predictive Lossless Image Compression (PLIC)based on pixels Correlation coefficients and a tight region of support*," URC-TC'2000, conference proceedings, April 8, 2000, Nashville TN.

36. Norman Lopez, Hamed Parsiani, "*Predictive Lossless Image Compression (PLIC) Algorithm and its Coding Analysis,*" CRC'2000 Proceedings, May 6, 2000, Mayaguez, P.R.

37. Hamed Parsiani, Andres Fuentes,*"Fast Near lossless Iterated Block Matching Fractals Image Compression", Signal and Image Processing , SIP'98, Oct. 28-31, 98, Las Vegas, Nevada.*

38. Hamed Parsiani, Paul Roman , "Near lossless Iterated Block Matching Fractals Image Compression", Proceedings of URC-TC'98 Conference, Huntsville, Alabama, Feb. 22-25, 1998.

39. Hamed Parsiani, William Navas, "Advances in Weighted Finite Automata & Matching Pursuits in Image Compression", Proceedings of Midwest Symposium. on Circuits and Systems, MWSCAS' Aug. 9-12, 98.

40. Hamed Parsiani, "Analysis of Iterated Function System Fractals for Image Compression", Proceedings of the 21st International Conference on Computers & Industrial Engineering (ICC&IE- 97), San Juan, P.R.

41. Hamed Parsiani, "Analysis of Iterated Block Matching Fractals for Image Compression", Proceedings of the 21st International Conference on Computers & Industrial Engineering (ICC&IE- 97), San Juan,

P.R.

42. Hamed Parsiani, William Navas, "Recent Progress in Fractal Compression" , Proceedings of First ADMI Conference on Computing at Minority Institutions, ADMI'97.
43. Hamed Parsinai, William Navas, "Weighted Finite Automata Fractal Compression" , Proceedings of the 8th International Conference on Signal Processing Applications & Technology ICSPAT'97.
44. Hamed Parsiani, Ricardo Garcia, "State of the Art Iterated Block Matching Fractals in Image compression" , Proceedings of Midwest Symposium on Circuits and Systems, MWSCAS'97.
45. Hamed Parsiani, Ricardo Garcia, "Iterated Block Matching Encoder/Decoder for Image Compression", Proceedings of Computing Research Conference, CRC'97.
46. Oscar Misla, Hamed Parsiani, "Fuzzy Logic in Image Compression", Proceedings of 31 ACS Junior Tchnical Meeting, 3/9/96.
47. Oscar Misla, Hamed Parsiani, "Codebook Design Limitations of Fuzzy C-Means. Algorithm", Proceedings of Computing Research Conference, CRC'96, April 19, 1996.
48. Oscar Misla, Hamed Parsiani, "Crisp and Fuzzy C-Means Algorithm Analysis", Proceedings of First ADMI Conference on Computing at Minority Institutions, ADMI'96, July 23-28, 1996.
49. Hamed Parsiani, Oscar Misla, "Fuzzy Class Learning Vector Quantizer in Image Compression", Proceedings of Midwest Symposium on Circuits and Systems, MWSCAS'96, Iowa State University, August 18-21, 1996.
50. Hamed Parsiani, Oscar Misla, "Computationally Efficient Fuzzy Class Learning Vector Quantizer in Image Compression", Proceedings of the 7th International Conference on Signal Processing Applications & Technology ICSPAT'96, Boston Massachusetts, USA, October 7-10, 1996.
51. Hamed Parsiani, "Color Image and Video Compression Modules for Signal Processing Worksystem (SPW) System Simulation Software". Proceedings of 24th COPIMERA congress, Oct. 3-8, 1993, in San Juan, P.R.
52. Hamed Parsiani, "Isolated Noise Detection and Reduction in Color Images". Proceedings of "36th Midwest Symposium on Circuits and Systems" (Aug. 16-18, 1993), Detroit, Michigan.
53. Hamed Parsiani, "Coding and Decoding of the Differential Motion Vector Using One Single VLC Table", Bell Communications Research, Technical , TM-ARH-019703, 11 pages, Aug. 7, 1991, Morristown, N.J.
54. Hamed Parsiani," Still Image Transmission Methods", Bell Communications Research, Technical , TM-TSY- 013427 , 28 pages, Jan. 16, 1989, Red Bank N.J.
55. H. Parsiani, "A mathematical technique for modeling multiplexed channel transmission error performance, and its applications to embedded channel error statistical parameters determination", Bell Communications Research Tech. , TM-TSY-011088, 23 pages, Jan 4, 1988, Red Bank, NJ.
56. Hamed Parsiani and P.S. Noe, "Satellite Selection for Sequential Receivers", Proceedings Navigation Satellite Users Conference, Institute of Navigation, 6 pages, Dec. 1979.
57. Hamed Parsiani, et al, " A Navigation Algorithm for Single Channel Low- Cost GPS Receiver", Texas A&M University, 8 pages, 1979.

Rafael A. Rodríguez Solís

Profile

Dr. Rafael A. Rodríguez Solís received a BSEE and a BSCpE from the University of Puerto Rico at Mayagüez in 1990, a M.S. degree in electrical engineering from University of Florida in 1993 and a Ph.D. in electrical engineering from the Pennsylvania State University in 1997. He is currently a Professor of Electrical and Computer Engineering at the University of Puerto Rico, Mayagüez. At UPRM he is the Director of the UPRM Radiation Laboratory and the UPRM Education Thrust Leader of the NSF Center for Subsurface Sensing and Imaging Systems (CenSSIS). He received a NSF CAREER award in 2001 to work in the characterization of wideband slot-like antennas. He has worked in the development of tunable antennas with electroceramic materials with the NASA Tropical Center for Earth and Space Studies (TCESS) at UPRM and is currently working in the development of VO_2 based reconfigurable antennas with AFRL. In addition, he is working in the development of low cost electronically scanned antenna alternatives for the NSF Center for Adaptive Sensing of the Atmosphere (CASA), and in the development of a measurement system for a laboratory-scale Soil-Bed for detection of contaminants in soil for the DoE. Dr. Rodríguez Solís was named Outstanding Professor in Electrical Engineering by the UPRM Engineering Faculty in 2001 and is a member of the IEEE Antennas and Propagation, Microwave Theory and Techniques, and Geoscience and Remote Sensing Societies. His research interests include wideband microwave and millimeter-wave antennas, reconfigurable, tunable and multiband antennas, and wideband and tunable microwave circuits.

Education

The Pennsylvania State University, University Park, PA - Ph.D., Electrical Engineering, 12/97
Dissertation: "Analysis and Design of a Microwave 3-D Frequency Independent Phased Array Using Folded Slots." Designed, analyzed, built and tested antenna array prototypes from 2 to 12 GHz.

University of Florida, Gainesville, FL - M.S., Electrical Engineering, 12/93
Thesis: "Improved Modeling of R.F. and Microwave BJTs and Circuit Simulation." Evaluated and improved new physics-based model for microwave bipolar transistors. Compared results with existing empirical model and measured data to demonstrate agreement.

University of Puerto Rico, Mayagüez, PR - B.S., Electrical Engineering, 06/90
Magna Cum Laude. Specialization in Communications and Electronics.

University of Puerto Rico, Mayagüez, PR - B.S., Computer Engineering, 06/90
Magna Cum Laude. Specialization in Hardware Systems.

Experience

Professor, University of Puerto Rico, Mayagüez, PR 01/98 to present
Research interests: Broadband microwave antennas and circuits, microwave/millimeter-wave antennas, numerical methods in electromagnetics.

NSF CAREER 2001 award: "Wideband Slot-Like Antennas and Enhancement of Applied Electromagnetics Education at UPRM"

PI and Co-PI in 3 NSF MRI projects.

UPRM CenSSIS Education Thrust Leader

Researcher in CenSSIS

Researcher in UPRM NASA Tropical Center for Earth and Space Studies (TCESS)

Researcher in NSF ERC for Collaborative and Adaptive Sensing of the Atmosphere (CASA)

Researcher in PASSER program

Director of UPRM Radiation Laboratory, 2000-present

President ECE Personnel Committee, 2009-present

Coordinator for the ECE Applied Electromagnetics Area, 2000-2010

ECE Graduate Committee, 2001-present

School of Engineering Graduate Committee, 2001-2006

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UPRM Graduate Council, 2006-2009

Faculty advisor to student branch of UPRM IEEE Communications Society

Graduated 16 M.S. students, advising 4 graduate students, member of graduate committee of 22 M.S. students and 2 Ph.D. students, and advised 60 undergraduate students on 32 different undergraduate research projects.

Reviewer for IEEE Transactions on Antennas an Propagation Special Issue on Multifunction Antennas and Antenna Systems, Feb. 2006

Panelist for the NSF-SBIR Program in 2003, 2005 and 2007

Panelist for the NSF Graduate Research Fellowship Program in 2005

Visiting Scientist, BBN Technologies, Cambridge, MA. 06/99 to 08/99
Consulted on antennas and R.F. systems for wireless networks.

Independent Consultant, REMCOM, Inc., University Park, PA. 08/97 to 12/97
Modeled, designed and fabricated microwave circuit and antennas. Validated and tested electromagnetic simulators.

Engr. Technical Associate, BBN Systems and Technologies, Cambridge, MA. 08/96 to 08/97
Evaluated and recommended wireless LAN adapters and developed Linux device drivers.

Summer Intern, BBN Corporation, Cambridge, MA. 05/96 to 08/96
Integrated wireless IP-secure LAN using custom off the shelf components. Demonstrated integrated system to customers and upper management. Developed service offerings using the integrated system.

Summer Staff, MIT Lincoln Laboratory, Lexington, MA. 06/95 to 08/95
Developed computer model of complex phased array antenna system to investigate effects in the radiation pattern of random failures and excitation errors.

Graduate Assistant, University of Florida, Gainesville., FL. 08/91 to 08/93
Conducted laboratory sessions of a Computer Architecture course and a Microprocessors course and worked on the improvement of a physics-based model for microwave BJTs.

Engineer I, Telefónica Larga Distancia, San Juan, Puerto Rico. 05/90 to 08/91
Developed computer model of complex phased array antenna system to investigate effects in the radiation pattern of random failures and excitation errors.

Publications

J. G. Colom, R. Medina, and **R. Rodríguez**, “Design of Tunable Amplifier using Ferroelectric Materials,” Integrated Ferroelectrics, vol. 56, 2003, pp. 1097-1106.

J. G. Colom, **R. A. Rodríguez-Solís**, J. Almodóvar, and M. Castañeda, “Design and Simulation of a Tunable Multilayer Lange Coupler,” Integrated Ferroelectrics, vol. 42, 2002, pp. 313-321.

J.K. Breakall and **R.A. Rodríguez Solís**, “A new design method for low sidelobe level log-periodic dipole antennas,” Applied Computational Electromagnetics Society Journal, Nov. 1996, pp. 9-15.

M.F. Córdoba-Erazo and **R.A. Rodríguez Solís**, “Cavity-Backed Folded-Slot Antenna,” Antennas and Propagation Society International Symposium (APSURSI), 2010 IEEE, June 2010, pp 1-4.

Galvez, M.B.; Colom, J.; Chandrasekar, V.; Junyent, F.; Cruz-Pol, S.; **Rodriguez, R.**; , "Salient features of the radar nodes in the Puerto Rico tropical weather testbed," Geoscience and Remote Sensing Symposium, 2009 IEEE International, IGARSS 2009 , vol.3, no., pp.III-841-III-844, 12-17 July 2009

A. Rivera Albino and **R.A. Rodríguez Solís**, “Design of Tapered Slot Antenna Array for Space Distributed Class-E Power Amplifier”, 2009 IEEE Antennas and Propagation Society International Symposium, June 2009, pp. 1-4.

V. J. Marrero Fontánez, **R. A. Rodríguez Solís**, "Dual-Polarized Antenna Array for X-Band Radar Application," 2007 IEEE Antennas and Propagation Society International Symposium, June 2007, pp. 2144-2147.

V. J. Marrero Fontánez, **R. A. Rodríguez Solís**, "Dual-Polarized Aperture-Coupled Patch Antenna for X-Band Series-Fed Array," 2007 IEEE Antennas and Propagation Society International Symposium, June 2007, pp. 2148-2151.

V. J. Marrero Fontánez, **R. A. Rodríguez-Solís**, "Low Cross-Polarization Antenna Array for CASA Student Test bed Radar," International Geoscience and Remote Sensing Symposium, 23-28 July 2007, pp. 2746 - 2749.

Serrano, M F, Padilla, I Y, **Rodriguez, R**, (2007) "Electromagnetic Detection and Digital Visualization Of Dnapl Contaminants In A Two-dimensional Soilbed", Eos Trans. AGU, 88(23), Jt. Assem. Suppl., Abstract B41B-09.

M. F. Serrano Guzman, I. Y. Padilla, **R. Rodriguez**, C. M. Rappaport, "Bimodal detection of underground detection in two dimensional systems," Proceedings of the SPIE, [6540-54]

M.F. Serrano-Guzmán, I. Padilla, **R Rodriguez**, "Two-dimensional detection of underground contamination and buried objects using cross-well radar," Proceedings of SPIE, vol 6210, Radar Sensor Technology X, 62100R (May. 8, 2006).

Amador-Perez, A.; **Rodríguez-Solís, R.A.**, "Analysis of a CPW Fed Annular Slot Ring Antenna using DOE," 2006 IEEE Antennas and Propagation Society International Symposium, Albuquerque, NM, July 2006, pp. 4301 - 4304.

D. A. Del Río, **R. A. Rodríguez-Solís**, D. S. Filipovic, "Ways to Improve the Radiation Pattern of a LPFSA," 2005 IEEE Antennas and Propagation International Symposium, July 2005, vol. 1B, pp. 410 - 413.

J. A. Torres-Rosario, S. Rondineu, **R. A. Rodríguez-Solís**, S. Hunt, Z. Popovic, "Adaptive Discrete Lens Antenna Array for Direction of Arrival Detection," 2005 IEEE Antennas and Propagation International Symposium, July 2005, vol. 4A, pp. 122 - 125.

C. Jaramillo-Henao, **R. A. Rodríguez-Solís**, D. Rosario-Román, D. González-Barreto, "Analysis of Concentric Slot-Ring Antenna Arrays using DOE and FDA," 2004 IEEE Antennas and Propagation International Symposium, June 2004, vol. 1, pp. 1074 - 1077.

Ileana Carrasquillo-Rivera, **R.A.R. Solís**, José G. Colom-Ustáriz, "Tunable and Dual-Band Rectangular Slot-Ring Antenna," 2004 IEEE Antennas and Propagation International Symposium, June 2004, vol. 4, pp. 4308 - 4311.

J.L. Salazar-Cerreño and **R.A. Rodríguez-Solís**, "Broadband Log-Periodic Normal Mode Helical Antenna," 2003 IEEE Antennas and Propagation International Symposium, June 2003, vol. 1, pp. 249-252.

N.D. López-Rivera and **R.A. Rodríguez-Solís**, "Input Impedance and Resonant Frequency Characterization of Folded Slot Antennas through DOE Techniques," 2003 IEEE Antennas and Propagation International Symposium, June 2003 vol. 2, pp. 545-548.

S. Rodríguez-Acosta, **R.A. Rodríguez-Solís**, and J.G. Colom Ustáriz, "Design and Characterization of a Tunable Aperture Coupled Microstrip Patch Antenna with Ferroelectric Films," 2003 IEEE Antennas and Propagation International Symposium, June 2003 vol. 4, pp. 536-539.

A.M. Castro-Vilaró and **R.A.R. Solís**, "Tunable Folded Slot Antenna with Ferroelectric Material," 2003 IEEE Antennas and Propagation International Symposium, June 2003 vol. 2, pp 549-552.

I. Carrasquillo-Rivera, Z. Popovic, and **R.A.R. Solís**, "Tunable Slot Antenna Using Varactors and Photodiodes," 2003 IEEE Antennas and Propagation International Symposium, June 2003 vol. 4, pp. 532-535.

J. Colom-Ustáriz, **R. Rodríguez-Solís**, S. Vélez, and S. Rodríguez-Acosta, "Frequency Agile Microwave Components using Ferroelectric Materials," Proceedings of the SPIE 9th International Conference on Remote Sensing, vol. 4881, April 2003, pp. 280-286

N.D. López-Rivera and **R.A. Rodríguez-Solís**, "Impedance Matching Technique for Microwave Folded-Slot Antennas," 2002 IEEE Antennas and Propagation International Symposium, June 2002, vol. III, pp. 450-453.

R.A. Rodríguez Solís, Ana M. Medina, and Néstor López, "Microstrip Patch Antenna Encircled by a Trench," IEEE Antennas and Propagation International Symposium, July 2000, pp. 1620-1623.

Jimenez, L.O.; O'Neill-Carrillo, E.; Frey, W.; **Rodriguez-Solis, R**.; Irizarry-Rivera, A.; Hunt, S, "Social and Ethical Implications of Engineering Design: A Learning Module Developed for ECE Capstone Design Courses," 36th Annual Frontiers in Education Conference, Oct. 2006, pp. 1-6.

S. McKnight, G. Tadmor, M. Ruane, **R. Rodríguez-Solís** and G. Saulnier, "Creating "High-Tech Tools & Toys Lab" Learning Environments at Four Universities," 32nd ASEE/IEEE Frontiers in Education Conference, Nov. 2002, p. S3E-7.

J. G. Colom and **R. Rodríguez-Solís**, "Introduction To Electrical Engineering: A New Freshman Course At UPR-Mayagúez," ASEE 2003 ASEE Annual Conference and Exposition Proceedings, June 2003, Nashville, TN.

J.G. Colom Ustáriz, **R.A. Rodríguez Solís**, and R.J. Luebbers, "Undergraduate Research using the Finite Difference Time Domain Method for Electromagnetics," 2001 ASEE Annual Conference and Exposition Proceedings, June 2001, Albuquerque, NM.

J.G. Colom Ustáriz, R.R. Barton, L.A. Carpenter, and **R.A. Rodríguez Solís**, "A Novel Graphical Technique for Selection of a Robust Design Point," 2001 ASEE Annual Conference and Exposition Proceedings, June 2001, Albuquerque, NM.

Presentations

María F. Córdoba, Erazo, **Rafael A. Rodríguez Solís**; "Cavity-backed Folded-Slot Antennas", 2009 Historically Black Colleges and Universities (HBCU)/Other Minority Serving Institutions (OMI's) Collaboration Conference, Ohio Aerospace Institute (OAI), Cleveland, Ohio, July 21st and 22nd 2009

A. Rivera Albino and **R.A. Rodríguez Solís**, "Design of Coplanar Waveguide Fed Tapered Slot Antenna Arrays for High Power Space Distributed Amplifier Applications, 32nd Annual Antenna Applications Symposium, Monticello, Ill, September 2008

R.A. Rodríguez Solís, "Printed Antenna Research at the UPRM Radiation Laboratory," Georgia Tech, Atlanta, GA, 2002.

J.G. Colom Ustáriz, **R.A. Rodríguez Solís**, "Design and Simulation of a Tunable Ferroelectric Lange Coupler," Ferroelectrics Workshop 2001, San Juan P.R.

Grants

Reconfigurable Antennas Using Insulator to Metal Transition Devices
UTC (AFRL) 10-S567-0014-02-C2, $139,007, Co-PI

MRI: Development of a Meteorological Radar Network for Puerto Rico's West Coast
NSF ECS-0821331, $1,731,766, Co-PI

Detection, Fate, Transport and Remediation of Chlorinated solvents in Low-Permeability Porous Media, DOE DE-FG09-07SR22571, $450,000, Co-PI

MRI: Acquisition of Processing and Testing Equipment for the Integration of Materials Science and Engineering Research at the University of Puerto Rico at Mayagüez

NSF ECS-0722534. $454,909, Co-PI

NSF Center for Collaborative and Adaptive Sensing of the Atmosphere (CASA),
NSF EEC 0313747, Senior Personnel

CAREER: Wideband Slot-like Antennas and Enhancement of Applied Electromagnetics Education at UPRM.
NSF ECS-0093650, $584,346, PI

NSF Center for Subsurface Sensing and Imaging System,(CenSSIS)
NSF EEC 9986821, Senior Personnel

Electroceramic Antennas and Devices
NASA Tropical Center for Earth and Space Studies, Senior Personnel

Acquisition of Microwave Instrumentation for the UPRM Radiation Laboratory.
NSF ECS-9977178, $677,104, PI

Partnership for Space Science Education and Research.
NASA, $794,993, Co-PI

Professional Courses

Design of Reflector Antennas
2009 IEEE Antennas and Propagation International Symposium, Charlotte, SC.

Introduction to Networking and Wireless Networks
CASA ERC, Mayagüez, PR, Jan. 2006

Practical Design of Microstrip Arrays and Reflectarrays
2003 IEEE Antennas and Propagation International Symposium, Columbus, OH.

Adaptive Antennas: The Future of Mobile Communications
2002 IEEE Antennas and Propagation International Symposium, San Antonio, TX.

Smart Antennas for Wireless Systems
2000 IEEE Antennas and Propagation International Symposium, Salt Lake City, UT.

Microwave Antenna Measurements.
California State University, Northridge, 1994.

Digital Transmission Systems.
Siemens Telecomunicazioni S.P.A., Santiago, Chile, 1991

Honors

NSF CAREER Award (2001), Outstanding Electrical Engineering Professor (2001), GTE Fellow (1996-1997), Graduate Engineering Education Fellow (1993-1996), National Science Foundation Fellowship and Ford Foundation Fellowship Honorable Mentions (1993), Commonwealth of Puerto Rico Economic Development Administration Fellow (1991-1993), Tau Beta Pi Honor Society.

Professional Organizations

Member of the Microwave Theory and Techniques Society, Geoscience and Remote Sensing Society, the Education Society, and the Antennas and Propagation Society of the Institute of Electrical and Electronic Engineers (IEEE). Member of the IEEE Antennas and Propagation Society Education Committee.

BIOGRAPHICAL SKETCH

Nayda G. Santiago

PROFESSIONAL PREPARATION

Ph.D.	Electrical Engineering	Michigan State University	2003
M.Eng.	Electrical Engineering	Cornell University	1990
B.S.	Electrical Engineering	University of Puerto Rico, Mayaguez Campus	1989

APPOINTMENTS

Jul 2008-Present: Associate Professor, Electrical and Computer Engineering Department, University of Puerto Rico, Mayaguez Campus.
2003-Jun 2008: Assistant Professor, Electrical and Computer Engineering Department, University of Puerto Rico, Mayaguez Campus.
2000-2003: Instructor, Electrical and Computer Engineering Department, University of Puerto Rico, Mayaguez Campus.
1997-2000: Research Assistant, Department of Electrical and Computer Engineering, Michigan State University.
Summer 1996: Summer Intern, Cornell Theory Center, Cornell University
1995-1996: Teaching Assistant, Department of Electrical and Computer Engineering, Michigan State University.
1990-1994: Instructor, Electrical and Computer Engineering Department, University of Puerto Rico, Mayaguez Campus.
1989 - 1990: Research Assistant, School of Electrical and Computer Engineering, Cornell University
1988-1989: Lab Instructor, Electrical and Computer Engineering Department, University of Puerto Rico, Mayaguez Campus.
Summer 1988: Summer Intern, Department of Electrical Engineering, Texas A & M.

PUBLICATIONS

Five relevant publications

1. David Gonzalez, Christian Sanchez, Ricardo Veguilla, Nayda G. Santiago, Samuel Rosario, Miguel Velez-Reyes. Abundace Estimation Algorithms Using NVIDIA CUDATM Technology. Proceedings of SPIE -- Volume 6966, Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XIV, 69661E, Orlando, FL, March 2008.
2. D.A. Ortiz and N.G. Santiago. High-level optimization for low power consumption on microprocessor-based systems. 50th IEEE International Midwest Symposium on Circuits and Systems (MWSCAS'07), pages 1265 –1268, Montreal, Canada, Aug. 2007.
3. Javier Morales, Nayda G. Santiago, and Alejandro Ferandez, An FPGA Implementation of Image Space Reconstruction Algorithm for Hyperspectral Imaging Analysis, Proceedings of the SPIE, Vol. 6565 65651V (2007), Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XIII, pp. V-1 to V-12, March 2007.
4. G. A. Chaparro-Baquero, N. G. Santiago, W. Rivera, J. F. Vega-Riveros, "Measuring Quantitative Dependability Attributes in Digital Publishing using Petri Net Workflow Modeling", The 2nd IEEE International Symposium on Dependable, Autonomic and Secure Computing (DASC'06), Indianapolis, IN, Sept 2006.
5. N.G. Santiago, C.A. Aceros Moreno, D. Rodriguez, "Performance measures for parameter extraction of sensor array point targets using the discrete chirp Fourier transform", Proc. SPIE 6235, 62351L (2006)

Five other significant publications

1. D. Mera and N. Santiago. Low Power Software Techniques for Embedded Systems Running Real Time Operating Systems, . 53rd IEEE International Midwest Symposium on Circuits and Systems (MWSCAS 2010, Seattle, Washington, Aug. 2010.

2. D. A. Ortiz and N. Santiago, "Impact of Source Code Optimizations on Power Consumption of Embedded Systems", 2008 Joint IEEE North-East Workshop on Circuits and Systems and TAISA Conference, NEWCAS-TAISA, 2008, p 133-136.
3. J. Morales, N. Medero, N. Santiago and J. Sosa, "Hardware Implementation of Image Space Reconstruction Algorithm using FPGA", Proceedings of the 49th Midwest Symposium on Circuits and Systems, August 6-9, 2006, San Juan, PR.
4. N. G. Santiago, D. T. Rover, D. Rodriguez, "A Statistical Approach for the Analysis of the Relation between Low-Level Performance Information, the Code and the Environment", Information: An International Journal, Vol.9, No.3, May 2006.
5. D. Rodriguez and N. Santiago, "Integrating Novel Methodologies, Tools, and IT Resources for Graduate Level Courses in High Performance Computing and Advanced Signal Processing Algorithms", Proceedings 6th International Conference on Information Technology Based Higher Education and Training, ITHET 2005, July 7-9, 2005, Dominican Republic.

SYNERGISTIC ACTIVITIES

1. Femprof Grant, CoPI, Assist CS and CEng undergraduate female students to become skillful to go into graduate school and become female professors in computing related areas.
2. Computing Alliance of Hispanic Serving Institutions, CAHSI Alliance between 8 Hispanic Serving Institutions. Role since 2006: Promote undergraduate research and the affinity research group model among HSIs and train undergraduate students on research skills to increase the number of Hispanics in computing related areas.

COLLABORATORS AND OTHER AFFILIATIONS

1. Graduate advisors
   - Dr. Diane Rover, PhD Dissertation
   - Dr. Michael Kelly, MEng Project
2. List of Current Collaborators
   - Ana Nieves, Assistant Professor, Psychology Department, UPRM
   - Anne Gates, Associate Vice President for Research at the University of Texas at El Paso, Director of Computing Alliance of Hispanic Serving Institutions
   - Fernando Vega, Associate Professor, ECE Department, UPRM
   - Kejie Lu, Assistant Professor, ECE Department, UPRM
   - Kensall D. Wise, Professor of EE and CS, Univ of Michigan, Ann Arbor, Director, Center for Wireless Integrated MicroSystems an NSF Engineering Research Center
   - Malek Adjouadi, Associate Professor, Department of ECE, and Director, Center for Advanced Technology and Education (CATE), Florida International University
   - Miguel Velez, Professor, ECE Department, UPRM
   - Moshen Beheshti, Chair, CS Department, California State University Dominguez Hills
   - Nestor Rodriguez, Professor, ECE Department, UPRM
   - Omayra Ducoudray, Assistant Professor, ECE Department, UPRM
   - Richard Alo, Professor, Director of Center for Computational Science and Advanced Distributed Simulation, Department of Computer and Mathematical Sciences, University of Houston-Downtown
   - David Kaeli, Professor, Northeastern University
3. Graduate students currently under supervision
   - Daniel Mera, MSCpE
4. Past Graduate Students
   - Gustavo Chaparro, MSCpE, July 2006, Faculty at Turabo University
   - Javier Morales, MSEE, February 2007, Office Naval Research
   - David Ortiz, MSEE, December 2007, PhD Student University of Texas at Dallas
   - Ricardo Veguilla, MSCpE, December 2007, Softek Co.
   - Daniel Mera, MSCpE, July 2010, Faculty Turabo

2. Additional students
   - 133 BS students supervised in undergraduate research using ARG model

Guillermo J. Serrano

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University of Puerto Rico at Mayagüez
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Education

Ph.D. Electrical Engineering 12/2007
Georgia Institute of Technology
Dissertation: *"Analog circuit design using floating-gate transistors."*

M.S. Electrical Engineering 05/2003
Georgia Institute of Technology
Thesis: *"Design of a current scaling digital-to-analog converter for retinal implant applications."*

B.S. Electrical Engineering 05/2001
University of Puerto Rico at Mayagüez
Area of Specialization: *Electronics*

Experience

Assistant Professor 07/2007 - Present
University of Puerto Rico Mayagüez, PR
Research Interests: *Analog and mixed-signal circuit design, low-power and sub-threshold design, floating gate transistors.*

Co-Op Student 08/2005 – 12/2005
Texas Instruments, Manchester, New Hampshire
Performed design and simulation of analog circuits such as a voltage regulator, a band-gap reference, and a current reference.

Graduate Research Assistant 08/2001 – 08/2007
Georgia Institute of Technology, Atlanta, GA
Performed design, simulation, implementation, and testing of integrated circuits in a 0.5µm CMOS process.

Selected Publications

- E. Mendez, **G. J. Serrano,** and E. Ortiz "Monolithic Integrated Solar Energy Harvesting System," IEEE Photovoltaic Specialist Conference, Jun. 2010.

- H. Roman **and G. J. Serrano,** "A System Architecture for Automated Charge Modification of Analog Memories," IEEE Midwest Symposium of Circuits and Systems, Aug. 2010, pp- 1069-1072.

- V. Srinivasan, **G. J. Serrano,** C. Twigg, and P. Hasler, "A Floating-Gate-Based Programmable CMOS Reference," IEEE Transactions on Circuits and Systems I, vol. 55, no. 11, Dec. 2008, pp- 3448-3456.

- **G. J. Serrano,** and P. Hasler, "A precision Low-TC Wide-Range CMOS Current Reference," IEEE Journal of Solid-State Circuits, vol. 43, no. 2, Feb. 2008, pp- 558-565.

- V. Srinivasan, **G. J. Serrano,** C. Twigg, and P. Hasler, "A Floating-Gate-

Based Programmable CMOS Reference," IEEE Transactions on Circuits and Systems, vol. 55, no. 11, Dec. 2008, pp- 3448-3456.

- V. Srinivasan, **G. J. Serrano,** J. Gray and P. Hasler, "A precision CMOS Amplifier Using Floating-Gates for Offset Cancellation," IEEE Journal of Solid-State Circuits, vol.42, no. 2, Feb. 2007, pp- 280-291.

- A. Bandyopadhyay, **G. J. Serrano** and P. Hasler, "Adaptive Algorithm Using Hot-Electron Injection for Programming Analog Computational Memory Elements Within 0.2% of Accuracy over 3.5 Decades," IEEE Journal of Solid-State Circuits, vol. 41, no. 9, Sept. 2006, pp- 2107-2114.

- Srinivasan, **G. J. Serrano**, C. Twigg and P. Hasler, "A Compact Programmable CMOS Reference with 40uV Accuracy," IEEE Custom Integrated Circuits Conference, Sept. 2006, pp- 611-614.

- Srinivasan, **G. J. Serrano,** J. Gray and P. Hasler, "A precision CMOS amplifier using floating-gates for offset cancellation," IEEE Custom Integrated Circuits Conference, Sept. 2005, pp- 739-742.

- **G. J. Serrano**, P. D. Smith, et. al. "Automatic Rapid Programming of Large Arrays of Floating-gate Elements," IEEE International Symposium on Circuits and Systems, May. 2004, pp-373-376.

Funding

- NSF-BRIGE, **PI**, "*Development of Self-Programmable CMOS Analog Circuits and Systems,"* Sept. 2009 - Oct. 2011.
- NSF-CREST, **SP**, "*Nanotechnology Center for Biomedical and Energy Driven Systems and Applications,"* Sept. 2008 - Oct. 2013.

Patents

- US 7,714,650 B2 **–** *Method and Device for Performing Offset Cancellation in an Amplifier using Floating-Gate Transistors.*
- US 7,408,397 B2 **–** *Digital-to-Analog Converter with Programmable Floating Gate.*
- US 7,034,603 B2 **-** *Floating Gate Reference Circuit.*
- US 7,288,985 B2 **-** *Current Mirror with Programmable Floating Gate.*

Honors

- Best Poster Award at the 2010 IEEE Photovoltaic Specialists Conference.
- Best Student Paper Award at the 2005 IEEE Custom Integrated Circuits Conference.
- Presidential Fellowship at Georgia Institute of Technology.
- Research Assistantship at Georgia Institute of Technology.
- Full Scholarship at University of Puerto Rico, Mayaguez.

Synergistic Activities

- Reviewer on Transactions on Circuits and Systems I, II (TCAS).
- Reviewer of the Journal of Solid State Circuits (JSSC).
- Reviewer of the Midwest Symposium of Circuits and Systems (MWCAS).

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EDUCATION

Doctor of Philosophy in Electrical Engineering: University of Virginia, Charlottesville, VA *Dissertation Topic*: Biologically Inspired Architecture for Mobile Robot Navigation, *May 1998*

Master of Science in Electrical Engineering: University of Virginia, Charlottesville, VA *Master Thesis Title*: Mobile Robot Navigation with Vision-Based Neural Networks *Major*: Neural Networks applied to Robotics, *Minors*: Manufacturing Systems, and Image Processing, *May 1994*

Bachelor of Science in Electrical Engineering: University of Puerto Rico, Mayagüez, PR Major: Automatic Controls, Minor: Economics, *December 1991*

EXPERIENCE

Consultant for Baxter Corporation, Jayuya Puerto Rico. Evaluation of process automation lines. August 2007 – January 2008.

University of Puerto Rico, Mayagüez Campus, P.O. Box 9042, Mayagüez, Puerto Rico 00681-9042. Department of Electrical and Computer Engineering: **Professor** – *July 2007 to Present,* **Academic Senate** – *August 2008 to Present,* **Associate Professor –** *July 2002 to June 2007,* **Auxiliary Professor –** *July 1998 to June 2003,* **Associate Director** for Accreditation and Graduate Studies of the Department of Electrical and Computer Engineering: *August 2005 to June 2007*

Main Courses	***Other Activities***
• *Robotics and Automation* • *Intelligent Systems and Control* • *Machine Vision* • *Introduction to Control Systems*	• *Electronic Laboratories Coordinator* • *Committee for ABET Accreditation* • *Committee of Planning and Development*

The 49th IEEE Midwest Symposium on Circuits and Systems (MWSCAS 2006)
Volunteer as Track Chairperson and Review Committee Member for the Control Systems, Mechatronics & Robotics Track.
Volunteer as Session Chairperson for Neural Networks & Fuzzy Systems and Image Processing II Sessions.
August 2006.

University of Virginia, Charlottesville, VA
Department of Physics: *Production of electronic control boards to be used in nuclear reactor experiments*. Supervisor: Bill Stephens, *Summer 1996*

Honeywell Inc., 1985 Douglas Dr. N., Golden Valley, MN 55422-3992.
Home and Building Control Division: *New Product Development--design aid for damper actuators: Designing tests for new prototypes to ensure they meet their specifications*.
Supervisor: Larry Rodgers, *Summers of 1993 and 1992*

Puerto Rico Electric Power Authority (PREPA), P.O. Box 790, Mayagüez, Puerto Rico 00681. Mayagüez Regional Office: *Software development and computerize records. Introducing computer technology to personnel*. Supervisor: Gaspar Rodríguez, *Summer 1991*

University of Puerto Rico, Mayagüez Campus, P.O. Box 9042, Mayagüez, Puerto Rico 00681-9042. Department of Electrical Engineering: *Setting up experiments and searching for equipment for a new Control Laboratory*. Supervisor: Gerson Beauchamp, *October 1990 - May 1991*

Puerto Rico Electrical Power Authority, G.P.O. Box 4267 San Juan, PR 00936-4267 Electric System Training Center: Microprocessor application design for training courses. Supervisor: Carlos Taulet, *Summer 1990*

PUBLICATIONS

- Liu, Ziqian, and Torres, R.E., N. Patel, and Q. Wang, **"Further Development of Input-to-State Stabilizing Control for Dynamic Neural Network Systems"**, *IEEE Transactions on Systems, Man, and Cybernetics, Part A: Systems and Humans*, November 2008.

- Diaz, J., and Torres, R.E. , **"A fuzzy system approach for the classification of underwater AUV color images"**, *Image Processing: Algorithms and Systems V*: Electronic Imaging 2007 SPIE Proceedings Vol. 6497, January 2007.

- Diaz, J., and Torres, R.E. , **"Classification of Underwater Color Images with Applications in the Study of Deep Coral Reefs"**, The 49th IEEE Midwest Symposium on Circuits and Systems (MWSCAS), Vol. Image Processing II, August 2006.

- González Solano, N., Torres, R.E., **"Pattern Recognition and Text-Dependent Recognition for a Mobile Robot"**, The 49th IEEE Midwest Symposium on Circuits and Systems (MWSCAS), Vol. Neural Networks & Fuzzy Systems, August 2006.

- Torres Muñiz, R.E., **"Laboratorio de Medidas Eléctricas"**, Second Edition, Wiley & Son, December 2005. (ISBN 0-470-00915-2)

- Torres Muñiz, R.E., **"Laboratorio de Medidas Eléctricas"**, First Edition, Wiley & Son, November 2003. (ISBN 0-471-66987-3)

- Rivera F.J., Torres, R.E., and Jiménez, L.O., **"Hough transform for robust segmentation of underwater multispectral images",** SPIE-The International Society for Optical Engineering Proceeding: *AeroSense 2003-Technologies and Systems for Defense & Security*, Orlando, 2003.

- Torres, R.E., **"Biologically based neural network for mobile robot navigation",** Mobile Robots XIII, SPIE Proceedings, November 1998."

- Iñigo,R.M. and Torres, R.E., **"Mobile robot navigation with vision-based neural networks",** Mobile Robots IX, SPIE Proceedings Vol.2352, November 1994."

RESEARCH

- ***"Medical Devices Research Group (MDRG)."*** A group of professors from the College of Engineering at UPRM, each having an area of expertise related to the medical devices and biomedical engineering field. The mission of MDRG is to assist medical device companies located in Puerto Rico solve research and development problems related to manufacturing processes or to the development of new products and technologies.

Project Title	***Sponsor***
"Development of Technologies for the Manufacture of Cardiac Pacing and Defibrillation Leads", August 2003-December 2003	Medtronic - Villalba
"Development of Technologies for the Manufacture of Cardiac Pacing and Defibrillation Leads: Phase II", January 2004 - August 2004	Medtronic - Villalba

- ***"Center for Subsurface Sensing and Imaging Systems (CenSSIS)."*** Develop of a robust algorithm for objects segmentation and classification. The development focus in the identification of coral reefs. This research is sponsored by a NSF grant.

- ***"Robotic Soccer."*** Multidisciplinary research to design a team of five robots that play autonomously controlled by a main computer. A vision system is used to identify the field, ball, foe robots and our own robots using color segmentation. Position and velocities calculated from the vision system are passed to an AI strategy module that plans the game moves. Finally the our own designed robots read a wireless signal and execute the commands. F-180 rules of the RoboCup organization are followed.

- Industrial Affiliates Program 2006: "Plantain Processing Automation." A project of peeling plantain automatically for a agriculture production site in Puerto Rico.

- Industrial Affiliates Program 2003 - 2004: ***"Assistance Technology for Handicap and Impaired People."*** The Program of Technological Assistance of Puerto Rico asked for the design of several devices to aid impaired and handicap people. Among these devices are a low cost robotic arm (below $400) to be attached to wheelchair and mobile vehicles to guide blind people.

- Industrial Affiliates Program 2000 - 2001: ***"Tele-operating the Khepera Mobile Robot through an eye-tracking device."*** A helmet with an infrared vision system and a head tracker (based in both magnetic sensors and external vision system) were used to determine the site where the operator was looking inside an remote image sent by the robot. The robot, then was commanded to go the site of interest.

- Industrial Affiliates Program 2000 - 2001: ***"Design of a control system of a multi-legged mobile robot."*** A de-centralized controller was designed to handle low-level tasks such as walking, and high-level tasks like retrieving occluded objects.

- Industrial Affiliates Program 1999 - 2000: "***Assembly competition of mobile robots***." Organizer of event and advisor of teams for a beacon-finding competition. Students built and compete for being the first in finding a hidden beam by the use of autonomous robots. This research was sponsored by Motorola.

- "***Assembly and Testing of the Talrik II Mobile Robot.***" Undergraduate research to expose students to the different parts of a mobile robot.

- "***Image Acquisition Device for the Human Eye.***" Undergraduate research that proposes alternatives for applications involving eye-related sciences.

- Industrial Affiliates Program 1998 - 1999: ***"Study of noise readings in infrared sensors and their effect in the Khepera Miniature Mobile Robot's performance."*** Designing digital filters that adjust themselves to work under different types of illumination.

WORKSHOPS

- **Peer-Led Team Learning: The Workshop Model,** *Center for Professional Enhancement at UPRM, January 2008*
- **Ethics in the Engineering and Surveying Field in Puerto Rico,** *Seminar sponsored by CIAPR, November 2007*
- **Ethics across the Curriculum Endeavor: Collaborative Development of EAC Modules,** *Sponsor: Center for Professional Enhancement at UPRM, September 2007*
- **Time Management: Managing Multiple Priorities,** *Sponsor: Center for Professional Enhancement at UPRM and Texas Instruments, September 2007*
- **Videometrics IX, Human Vision and Electronic Imaging XII, Image Processing: Algorithms and Systems V and Vision Geometry XV,** *Sponsors: SPIE – International Society for Optical Engineering and IS&T – The Society for Image Science and Technology. Conference: Electronic Imaging 2007*
- **ABET Accreditation Workshop**, *Sponsor: System for the Evaluation of Education Office at UPRM, April 2006*
- **Orientation on Institutionalizing Assessment in the Administrative / Service Units,** *Sponsor: UPRM, April 2006*
- **Organizational Savvy and Ethical Lobbying,** *Sponsor: Texas Instrument, October 2006*
- **Intellectual Property at the University of Puerto Rico and the Law of Ethics,** *Sponsor: Center for Professional Enhancement at UPRM, May 2006*
- **Assessment 101,** *Sponsor: Center for Professional Enhancement at UPRM, March 2006*
- **Building Surveys,** *Sponsor: Center for Professional Enhancement at UPRM, September 2005*
- **Design of WEB based courses using WEBCT,** *Sponsor: "Instituto para el Desarrollo de la Enseñanza y el Aprendizaje en Línea (IDEAL)" at UPRM, May 2004*
- **PowerPC and M-Core Seminar:** *Sponsor: Motorola DNA Academy, August 2001*
- **Learning Styles: Felder Model,** *Sponsor: Center for Professional Enhancement, February 2001*
- **ABET EC 2000 Workshop,** *Sponsor: Engineering Dean Office at UPRM, September 2001*
- **Ethics Across the Curriculum,** *Sponsor: Engineering Dean Office at UPRM, April 2001*
- **Engineering Ethics,** *Sponsor: Department of Humanities at UPRM, October 2000*
- **Microcontroller 68HC12 Family,** *Sponsor: Motorola DNA Academy, Lecturer: Norbel Navarro*, March 1999
- **Sensor Fusion and Decentralized Control in Robotic Systems,** *Sponsor: SPIE – International Society for Optical Engineering,* November 1998
- **Mobile Robots XIII and Intelligent Transportation Systems,** *Sponsor: SPIE – International Society for Optical Engineering,* November 1998
- **Preparing Syllabus,** *Sponsor: Center for Professional Enhancement at UPRM, February 2001*
- **Green Lights and Energy Star Buildings Workshop**. *Sponsor: United States Environmental Protection Agency Lecturer: Alden Hathaway*
- **Programmable Logic Controller (PLC) Seminar.** *Sponsor: JR Electronics & Pneumatics*, *Ave. Campo Rico #829, Country Club, Rio Piedras, P.R. 00924 Lecturer: Carlos Rivera*

HONORS

- NSF Ph.D. Fellow (1994-1997)
- GEM Fellow of the National Consortium for Graduate Degrees for Minorities in Engineering and Science (1992-1993).
- Dean's List (1989-1991)
- First Prize in the Calculus Bowl, celebrated in Cayey Campus, University of Puerto Rico (1988).
- Third Prize in the Second Iberoamerican Mathematics Bowl celebrated in Uruguay (1987).
- Honorable Mention in National Hispanic Scholar Awards Program Competition, College Board (1987).
- First Prize in the Science Fair of the District of San Juan, Department of Education, Commonwealth of Puerto Rico (1986).
- National Honor Society, Hortus Chapter (1986).

PROJECTS AT GRADUATE SCHOOL

- Geometrical object recognition using neural networks for variable perspective, orientation, and translation.
- Extracting features from images for mobile robot navigation.
- Neural network training for answering mathematical aptitude tests.
- Cutting paper with laser technology.
- Manufacturing process simulations of industries.
- Robotic camera calibration for grasping geometrical objects.

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University of Puerto Rico at Mayagüez
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Professional Preparation:

Ph.D.	Massachusetts Institute of Technology, September 1992
Electrical Engineer	Massachusetts Institute of Technology, June 1988
S.M.E.E.	Massachusetts Institute of Technology, June 1988
B.S.E.E.	University of Puerto Rico Mayagüez Campus, June 1985

Appoinments:

Department of Electrical and Computer Engineering,
University of Puerto Rico Mayagüez Campus, Mayagüez, P.R.

Professor	July 2000-Present
Associate Professor	July 1995-June 2000
Assistant Professor	July 1992-June 1995

United States Air Force Research Laboratories, Hanscom Air Force Base, Boston, MA, Summer 2002.
NASA Goddard Space Flight Center, Greenbelt, MD. Summer 1997.
United States Air Force Phillips Laboratory, Hanscom Air Force Base, Boston, MA, Summer 1996.

Journal Publications (Last 5 years)

A. Mukerjee, M. Velez-Reyes, and B. Roysam, “Interest Points for Hyperspectral Image Data”. In **IEEE Transactions on Geosciences and Remote Sensing**, Vol. 47, No. 3, March 2009, pp. 748 - 760.

J.M. Duarte-Carvajalino, G. Sapiro, M. Vélez-Reyes, and P.E. Castillo, “Multiscale Representation and Segmentation of Hyperspectral Imagery using Geometric Partial Differential Equations and Algebraic Multigrid Methods.” In **IEEE Transactions on Geosciences and Remote Sensing**, Vol. 46, No. 8, August 2008, pp. 2418-2434.

V. Manian and M. Velez-Reyes, “Support vector classification of land cover and benthic habitat from hyperspectral images,” In **International Journal of High Speed Electronics and Systems**, Vol. 18, No. 2, June 2008, pp. 337-348.

J.M. Duarte-Carvajalino, P. Castillo, and M. Vélez-Reyes, “Comparative Study of Semi-implicit Schemes for Nonlinear Diffusion in Hyperspectral Imagery.” In **IEEE Transactions on Image Processing**, Vol. 16, No.5, May 2007, pages: 1303 – 1314.

L.O. Jiménez-Rodríguez, E. Arzuaga-Cruz, and M. Vélez-Reyes, "Unsupervised Feature Extraction Techniques for Hyperspectral Data and its Effects on Supervised and Unsupervised Classification." In **IEEE Transactions on Geosciences and Remote Sensing**., Vol. 45, no. 2, February 2007, pages:469 – 483.

A.A. Irizarry-Rivera, M. Rodríguez-Martínez, B. Vélez, M. Vélez-Reyes, A.R. Ramirez-Orquin, E. O’Neill-Carrillo, J.R. Cedeño, “Intelligent power routers: A distributed coordination approach for electric energy processing networks.” In **International Journal of Critical Infrastructures**, Vol. 3, Nos. 1/2, 2007, pages: 20-57.

N. Dukhan, P.D. Quiñones-Ramos, E. Cruz-Ruiz, M. Vélez-Reyes, E.P. Scott, “One-dimensional heat transfer analysis in open-cell 10-ppi metal foam.” In **International Journal of Heat and Mass Transfer**, Vol. 48, December 2005, pages: 5112–5120.

Conference Proceedings (Last 5 years)

Dorado, L.P., and M. Velez-Reyes, “A Vector SIFT Operator for Interest Point Detection in Hyperspectral Imagery.” In **Proceedings of the Second IEEE Workshop on Hyperspectral Image and Signal Processing: Evolution in Remote Sensing (WHISPERS)**, 14-16 June 2010.

A. Santos-García and M. Velez-Reyes, “Identifiability of Geometric Models for Linear Unmixing at Different Spatial Resolutions in Hyperspectral Unmixing. .” In **Proceedings of the Second IEEE Workshop on Hyperspectral Image and Signal Processing: Evolution in Remote Sensing (WHISPERS)**, 14-16 June 2010.

M. Marin-McGee and M. Velez-Reyes, “Denoising of hyperspectral images by best multilinear rank approximation of a sensor.” In **Proceedings of SPIE: Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XVI**, Vol. 7695, April 2010.

C. Peña-Ortega and M. Vélez-Reyes, "Evaluation of different structural models for target detection in hyperspectral imagery." In **Proceedings of SPIE: Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XVI**, Vol. 7695, April 2010.

N. Rey-Villamizar and M. Velez-Reyes " Using k-MST, k-EC and k-VC neighbor graphs construction methods with spatial coherent distance for manifold learning in hyperspectral image processing." In **Proceedings of SPIE: Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XVI**, Vol. 7695, April 2010.

A. Santos-García and M. Velez-Reyes, "Understanding the impact of spatial resolution in unmixing of hyperspectral images." In **Proceedings of SPIE: Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XVI**, Vol. 7695, April 2010.

M.C. Torres-Madronero, M. Velez-Reyes, and J.A. Goodman, "Fusion of hyperspectral imagery and bathymetry information for inversion of bioptical models." In **Proceedings of SPIE: Remote Sensing of the Ocean, Sea Ice, and Large Water Regions 2009**, Vol. 7473, September 2009.

C. Peña-Ortega and M. Vélez-Reyes, "Comparison of basis-vector selection methods for structural modeling of hyperspectral imagery." In **Proceedings of SPIE: Imaging Spectrometry XIV**, Vol. 7457, August 2009.

M.C. Torres-Madronero, M. Velez-Reyes, and J.A. Goodman, "Underwater unmixing and water optical properties retrieval using HyCIAT." In **Proceedings of SPIE: Imaging Spectrometry XIV**, Vol. 7457, August 2009.

S. Rosario-Torres and M.Velez-Reyes, "Speeding up the MATLAB™ Hyperspectral Image Analysis Toolbox using GPUs and the Jacket Toolbox." In **Proceedings of First IEEE Workshop on Hyperspectral Image and Signal Processing: Evolution in Remote Sensing (WHISPERS)**, 26-28 Aug. 2009 Page(s):1 – 4.

J. Certuche, M. Velez-Reyes, "A Reconfiguration Algorithm for a DC Zonal Electric Distribution System Based on Graph-Theory Methods". In **Proceedings of the IEEE Electric Ship Technologies Symposium (ESTS 2009)**, Baltimore, MD, 20-22 April 2009.

L.P. Dorado-Muñoz, M. Velez-Reyes, B. Roysam, and A. Mukherjee, "Interest Point Detection for Hyperspectral Imagery." In **Proceedings of SPIE: Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XV**, Vol.7334, April 2009, (9 pages).

E. Veronica Morales and M.Velez-Reyes, "Effects of image restoration in classification and visual analysis of LANDSAT imagery over Puerto Rico." In **Proceedings of SPIE: Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XV**, Vol.7334, April 2009, (10 pages).

A. Santos-García, M. Vélez-Reyes, S. Rosario-Torres, and J.D. Chinea, "A comparison of unmixing algorithms for hyperspectral imagery." In **Proceedings of SPIE: Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XV**, Vol.7334, April 2009, (12 Pages).

J. Goodman, M. Velez-Reyes, and S. Rosario-Torres, "An Update on SeaBED: A TesBED for Validating Subsurface Aquatic Hyperspectral Remote Sensing Algorithms." In **Proceedings of SPIE: Remote Sensing of the Ocean, Sea Ice, and Large Water Regions 2008**, Vol. 7105, October 2008.

M.E. Torres-Hernández, and M. Vélez-Reyes, "Hierarchical Control of Hybrid Power Systems." In **Proceedings of the 2008 IEEE International Conference on Power Electronics (CIEP '08)**, Cuernavaca, Mexico, August 24-27, 2008.

C. Gerardino-Neira, J. Goodman, M. Vélez-Reyes, W. Rivera-Gallego, "Sensityvity analysis of hyperspectral inversion model for remote sensing of coastal acosystems." In **Proceedings IEEE International Geosciences and Remote Sensing Symposium**, Boston, July 2008.

J. Goodman, M. Velez-Reyes, S. Rosario-Torres, S. Hunt, F. Gilbes, "Development of a field test environment for the validation of coastal remote sensing algorithms: Enrique Reef, Puerto Rico." In **Proceedings of the 11th International Coral Reef Symposium**, Fort Lauderdale, FL, July 7-11, 2008.

Y. .M. Masalmah, and M. Vélez-Reyes, "A full algorithm to compute the constrained positive matrix factorization and its application in unsupervised unmixing of hyperspectral.imagery." In **Proceedings of SPIE: Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XIV**, Vol. 6966, April 2008.

D. González, C. Sánchez, R. Veguilla, N.G. Santiago, S. Rosario-Torres, M. Vélez-Reyes, “Abundance Estimation Algorithms using NVIDIA® CUDA™ Technology.” In **Proceedings of SPIE: Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XIV**, Vol. 6966, April 2008.

J.M. Duarte-Carvajalino, G. Sapiro, and M. Vélez-Reyes, “Unsupervised Spectral-Spatial Classification of Hyperspectral Imagery using Real and Complex Features and Generalized Histograms.” In **Proceedings of SPIE: Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XIV**, Vol. 6966, April 2008.

M. Vélez-Reyes, J. Goodman, S. Rosario-Torres, and A. Castrodad-Carrau, “Subsurface unmixing with application to underwater classification.” In **Proceedings of SPIE: Remote Sensing of the Ocean, Sea Ice, and Large Water Regions 2007**, Vol. 6743, October 2007.

R.A. Rosado and M. Vélez-Reyes, “The Space Information Laboratory at the University of Puerto Rico Mayaguez Campus”. In **Proceedings of the 32nd International Symposium on Remote Sensing of Environment**, San Jose, Costa Rica, June 25 – 29, 2007, 4 pages.

J.G. Gómez–Gualdrón, M.Vélez-Reyes and L.J. Collazo, “Self-Reconfigurable Electric Power Distribution System using Multi-Agent Systems.” In **Proceedings of the IEEE Electric Ship Technologies Symposium (ESTS 2007)**, Arlington, VA, May 21 to 23, 2007.

J.M. Duarte-Carvajalino, G. Sapiro, M. Vélez-Reyes, and P. Castillo, “Fast Multi-Scale Regularization and Segmentation of Hyperspectral Imagery via Anisotropic Diffusion and Algebraic Multigrid Solvers.” In **Proceedings of SPIE: Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XIII**, Vol. 6565, May 2007.

Y.M. Masalmah, and M. Vélez-Reyes, “The Impact of Initialization Procedures on Unsupervised Unmixing of Hyperspectral Imagery using the Constrained Positive Matrix Factorization.” In **Proceedings of SPIE: Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XIII**, Vol. 6565, May 2007.

S. Rosario-Torres, M. Vélez-Reyes, S.D. Hunt and L.O. Jiménez, “New Developments and Application of the UPRM MATLAB Hyperspectral Image Analysis Toolbox.” In **Proceedings of SPIE: Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XIII**, Vol. 6565, May 2007.

M. Vélez-Reyes, S. Rosario-Torres, J. Goodman, E. M. Alvira-Concepción, and A. Castrodad-Carrau, “Hyperspectral image unmixing over Benthic habitats.” In **Proceedings of SPIE: Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XIII**, Vol. 6565, May 2007.

C.E. Niño and M. Vélez-Reyes, “Dealing with Ill Conditioning in Recursive Parameter Estimation for a Synchronous Generator.” In **Proceedings of the IEEE Industrial Electronics Conference**, Paris, France, November 2006.

A. Aquino-Lugo and M. Vélez-Reyes, “Gray-Box Modeling of Electric Drives using Recursive Identification and Radial Basis Functions.” In **Proceedings of the IEEE Industrial Electronics Conference**, Paris, France, November 2006.

J.A. Goodman, M. Vélez-Reyes, S. Hunt, and R. Armstrong, “ Development of a field test environment for the validation of coastal remote sensing algorithms: Enrique Reef, Puerto Rico.” **Proceedings of SPIE: Remote Sensing of the Ocean, Sea Ice, and Large Water Regions 2006**, Vol. 6360, Oct. 6, 2006.

M. Vélez-Reyes, J.A. Goodman, A. Castrodad-Carrau, L.O. Jiménez-Rodriguez, S.D. Hunt, and Roy Armstrong. “Benthic habitat mapping using hyperspectral remote sensing.” **Proceedings of SPIE: Remote Sensing of the Ocean, Sea Ice, and Large Water Regions 2006**, Vol. 6360, Oct. 6, 2006.

Y.M. Masalmah and M. Vélez-Reyes, “Unsupervised Unmixing of Hyperspectral Imagery.” In **Proceedings of the IEEE Midwest Symposium on Circuits and Systems**, San Juan, Puerto Rico, 2006.

A. Aquino-Lugo and M. Vélez-Reyes, “Recursive Identification of Electric Drives using Gray-Box Models.” In **Proceedings of the IEEE Midwest Symposium on Circuits and Systems**, San Juan, Puerto Rico, 2006.

J.G. Gómez–Gualdrón and M.Vélez-Reyes, “Simulating a Multi-Agent based Self-Reconfigurable Electronic Power Distribution System.” In **Proceedings of the IEEE Workshop on Computers in Power Electronics**, July 2006, pages: 1-7.

Y.M. Masalmah and M. Vélez-Reyes, “Unsupervised unmixing of hyperspectral imagery using the constrained positive matrix factorization.” In **Proceedings of SPIE: Independent Component Analyses, Wavelets, Unsupervised Smart Sensors, and Neural Networks IV**, Vol. 6247, April 2006.

J.M. Duarte-Carvajalino, M. Vélez-Reyes, and P. Castillo, “Scale-space in hyperspectral image analysis.” In **Proceedings of SPIE: Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XII**, Vol. 6233, May 2006.

A. Umaña-Díaz and M. Vélez-Reyes, “Restoration of hyperspectral imagery.” In **Proceedings of SPIE: Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XII**, Vol. 6233, May 2006.

V. Ortiz-Rivera, M. Velez-Reyes, B. Roysam, “Change Detection in Hyperspectral Imagery using Temporal Principal Components.” In **Proceedings of SPIE: Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XII**, Vol. 6233, May 2006.

Y.M. Masalmah and M. Vélez-Reyes, “A comparison of algorithms to compute the positive matrix factorization and their application to unsupervised unmixing.” In **Proceedings of SPIE: Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XII**, Vol. 6233, May 2006.

J.G. Gómez–Gualdrón and M.Vélez-Reyes. “A multi-agent approach for a self-reconfigurable electric power distribution system.” In **Proceedings of SPIE: Intelligent Computing: Theory and Applications IV**, Vol. 6229, May 2006.

A. Castrodad-Carrau, M. Vélez-Reyes, and J.A. Goodman, “An algorithm to retrieve coastal water optical properties, bathymetry, and bottom albedo from hyperspectral imagery.” In **Proceedings of SPIE: Photonics for Port and Harbor Security II**, Vol. 6204, May 2006.

Books and Book Chapters (Last 5 years):

M.Velez-Reyes and J. A. Goodman, “Spectral Subsurface Imaging.” In B.E. Saleh, ed., **Introduction to Subsurface Imaging**, Cambridge University Press, 2011 (In Print).

A.A. Irizarry-Rivera, M. Rodríguez-Martínez, B. Vélez, M. Vélez-Reyes, A.R. Ramirez-Orquin, E. O’Neill-Carrillo, and J.R. Cedeño, “Intelligent Power Routers: Distributed Coordination for Electric Energy Processing Networks.” In J. Momoh and L. Mili, editors., **Operation and Control of Electric Energy Processing Systems**, IEEE Press, 2010.

M. Vélez-Reyes, W. Rivera-Gallego, and L.O. Jiménez-Rodríguez, “A Solutionware for Hyperspectral Image Processing and Analysis.” In A.J. Plaza and C.I. Chang, editors, **High-Performance Computing in Remote Sensing**, Chapman & Hall/CRC Press, September 2007.

Active Grants (Last 5 years):

PI, **PR NASA EPSCoR: Hyperspectral Imaging for Biodiversity Assessment of Coastal and Terrestrial Ecosystems**, 2009 NASA Experimental Program to Stimulate Competitive Research, $1.5M, ($750k-NASA, $750k UPRM), September 1, 2009-August 31, 2012.

Co-I, **Awareness and Localization of Explosives-Related Threats**, DHS Centers of Excellence Program, $500k (UPRM Component), July 1, 2008 to June 30, 2010.

Co-I, **National Center for Maritime, Island, and Extreme Environment Security (CIMES)**, DHS Centers of Excellence Program, $800k (UPRM Component), July 1, 2008 to June 30, 2010.

Investigator in **A Biomedical Imaging Acceleration Testbed** (PI David Kaeli, Northeastern University, Co-PI Nayda Santiago UPRM), NSF EEC Innovation Awards. December 15, 2009 to November 20, 2010.

Collaborator in **Intelligent Diagnostic for Aging Civil Infrastructure**, NSF IGERT, (PI Sara Wadia-Fascetti NEU, and Co-PI Ingrid Padilla, UPRM)$ 600,000, September 1, 2007 to August 31, 2008.

PI in **A Geometrical Approach for the Analysis of Hyperspectral Imagery**, 2006 National Geospatial-Intelligence Agency Historically Black Colleges & Universities and Minority Institutions (HBCU-MI) Research Initiatives Broad Agency Announcement (BAA) HM1582-06-BAA-0005, $140,000. August 1, 2006 to December 31, 2008.

PI in **Improving Algorithms for Target Detection in Hyperspectral Infrared Imagery**, 2005 DoD Instrumentation and Research Support Program for Hispanic-Serving Institutions, $485,057. November 15, 2005 to November 14, 2009.

Co-PI in **Failure Probabilities for Risk-Based Maintenance and Parameter Estimation of Synchronous Machines**, National Science Foundation Industry University Cooperative Research Centers, $99,444.

Co-PI in **Intelligent Power Routers for Distributed Coordination in Electric Energy Processing Networks**, NSF/ONR Partnership in Electric Power Networks Efficiency and Security (EPNES) Program, October 1, 2002 to August 31, 2006, $499,849.

Awards:

2010 Elected SPIE Fellow

2006 Inducted in the Puerto Rico Academy of Arts and Sciences

1997 NSF Presidential Early Career Award for Scientists and Engineers.

2000 Senior Member of the Institute of Electrical and Electronics Engineers (IEEE)

1999 IEEE Walter Fee Outstanding Young Engineer Award, IEEE.

1997-98 Distinguished Professor, UPRM ECE Department.

1998 Distinguished Professor, of the Puerto Rico Professional Engineers and Land Surveyors Association Mayagüez Chapter.

Current Professional Memberships and Affiliations:

Licensed Engineer in Puerto Rico since 1996

Institute for Electrical and Electronics Engineers (IEEE)

President IEEE Puerto Rico Western Chapter April 1998-2000

Vice-President IEEE Puerto Rico Western Chapter from January 1995 to April 1998

American Society for Engineering Education

SPIE – The International Society for Optical Engineering

SACNAS

SIAM

Academic Service Activities:

Program Evaluator for Electrical Engineering, Accreditation Board for Engineering and Technolgy (ABET), elected by IEEE, 2003-2008.

Co-Chair, SPIE Conference on Remote Sensing of the Ocean, Sea Ice, and Large Water Regions, 2006-current.

Program Committee Member, SPIE Conference on Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imager, 2004-present.

Chairman, 2002 IEEE Workshop on Computers in Power Electronics

Associate Editor, IEEE Transactions on Power Electronics Special Issue on Digital Control, 2002

Region 9 Representative, IEEE Power Electronics Society Administrative Committee. 2000-2003

Member, IASTED Technical Committee on Control.

Member, IEEE Power Electronics Society Committee on Modeling and Simulation.

Program Committee Member, IEEE Applied Power Electronics Conference, 2000-2002.

Program Committee Member, IASTED Intelligent Systems and Control Conference.

Reviewer for

Annual Meeting of the IEEE Industry Applications Society

ASEE Frontiers in Education Conference, San Juan, PR

IEEE Applied Power Electronics Conference

IEEE Power Electronic Specialists Conference

IEEE International Electric Machines and Motor Drives Conference

IEEE Transactions on Industry Applications

IEEE Transactions on Power Electronics

IEEE Transactions on Education

IEEE Transactions on Power Systems

IEEE Transactions on Geoscience and Remote Sensing

IEEE Transactions on Control Technology

International Journal of Critical Infrastructures (2005)

Served in several National Science Foundation and NASA Proposal Review Panels

Number of graduate students supervised in the past 5 years: 20

Luis O. Jimenez-Rodriguez

Department of Electrical and Computer Engineering
University of Puerto Rico at Mayaguez
P.O. Box 9042
Mayaguez, Puerto Rico, 00681-5000
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Email: lojimenez@gmail.com

Dr. Luis O. Jimenez received the BSEE from University of Puerto Rico at Mayaguez, in 1989. He received his MSEE from University of Maryland at College Park in 1991 and his Ph.D. from Purdue University in 1996. Currently he is an Associate Professor of Electrical and Computer Engineering at the University of Puerto Rico, Mayaguez Campus.

He was the director of the UPRM component of an Engineering Research Center entitled the Center for Subsurface Sensing and Imaging Systems (CenSSIS). He was CoPI of the whole center that is composed by a consortium of four universities: Northeastern University (lead partner), Boston University, Rensselaer Polytechnic Institute, and the University of Puerto Rico at Mayagüez. The objective of this particular center is to revolutionize our ability to detect and image bio-medical and environmental-civil objects or conditions that are underground, underwater, or embedded in the human body. This consortium has a budget of $2.6 million for the first year of NSF support to the ERC through a five-year cooperative agreement, which is renewable in year three and in year six.

Dr. Jimenez has finished in the summer 2012 another doctoral degree in interdisciplinary issues and relations. Although this doctoral degree is in theology (S.T.D.), his work is about the epistemological foundation for a *dialogue and articulation across multiple disciples*: natural and applied sciences, social sciences, technology, philosophy (ethics) and fundamental theology, among others.

Currently Dr. Jimenez is the Director of the Laboratory for Applied Remote Sensing and Image Processing at the University of Puerto Rico, Mayagüez Campus. He is Profesional Engineer, P.E.

Date of Birth: January 2, 1967
Academic Rank: Professor

VISITING PROFESSOR:

June 2004-December 2004. Department of Telecommunication Systems, and Department of Philosophy and Theology, Pontificia Universidad Católica Madre y Maestra. Teaching a course on Social Ethics and teaching a course on Pattern Recognition.

EDUCATION:

B.S., Electrical Engineering, University of Puerto Rico, Mayaguez, P.R., 1989

M.S., Electrical Engineering, University of Maryland, College Park, Maryland, 1991.

Ph.D., Electrical Engineering, Purdue University, West Lafayette, Indiana, 1996. Thesis under Prof. David A. Landgrebe on “High Dimensional Feature Reduction Via Projection Pursuit.”

Graduate Courses in the areas of: Remote Sensing Image Analysis, Statistical Pattern Recognition, Artificial Neural Network, Machine Learning, Image Processing, Digital Signal Processing, Estimation and Detection Theory, Stochastic Process, Numerical Methods in Multivariate Statistical Analysis, Communication Systems, Information Theory, Coding and Error Control.

RESEARCH PUBLICATIONS:

Book Chapters:

S. Rosario-Torres, M. Vélez-Reyes, L.O. Jiménez-Rodríguez, and S. Hunt, “The MATLAB Hyperspectral Image Analysis Toolbox.” Accepted for publication in R. Rajesh, editor, **Introduction to Advanced Scientific Softwares and Toolboxes**, International Association of Engineers Press, 2007.

Miguel Vélez-Reyes, Wilson Rivera-Gallegos, and Luis O. Jiménez-Rodríguez, “An Integrated Process for Hyperspectral Image Processing and Analysis” Chapter 15 in **High-Performance Computing in Remote Sensing,** Chapman & Hall/CRC Press, *Antonio J. Plaza and Chein-I Chang, Editors*.

Journal Publications:

L.O. Jimenez, E. Arzuaga-Cruz. M. Velez-Reyes, “Unsupervised Linear Feature-Extraction Methods and Their Effects in the Classification of High-Dimensional Data.” *IEEE Transactions on Geoscience and Remote Sensing*, Vol 45, Issue 2, Feb. 2007, pp. 469-483.

V. Manian and L. O. Jimenez, "Land cover and benthic habitat classification using texture features from multispectral and hyperspectral images," *SPIE Journal of Electronic Imaging*, Vol. 16, No. 2, June 2007.

L. O. Jimenez and D.A. Landgrebe, “Supervised Classification in High Dimensional Space: Geometrical, Statistical, and Asymptotical Properties of Multivariate Data,” *IEEE Transactions on Systems, Man and Cybernetics*, Vol 28, No. 1, February 1998, pp. 39-54.

L.O., Jimenez, A., Morales, A., Creus, “Classification of Hyperdimensional Data Based On Feature and Decision Fusion Approaches Using Projection Pursuit, Majority Voting, and Neural Networks,” *IEEE Transactions on Geoscience and Remote Sensing,* Vol. 37, No. 3, May 1999, pp.1360-1366.

Jimenez, L.O., Landgrebe, D.A., Hyperspectral Data Analysis and Supervised Feature Reduction Via Projection Pursuit, *IEEE Transactions of Geoscience and Remote Sensing*, Vol 37, No. 6, November 1999, pp. 2653-2667.

Cruz-Pol, S., Velez-Reyes, M., Hunt, S., Parsiani, H., Colom-Ustaris, J., Jimenez, L.O., and Vasquez, R., The Laboratory for Applied Remote Sensing and Image Processing at University of Puerto Rico at Mayaguez, IEEE Geoscience and Remote Sensing News Letter, December 2001.

L.O. Jiménez, J. Rivera-Medina, E. Rodríguez-Díaz, E. Arzuaga, M. Ramírez, “Integration of Spatial and Spectral Information by means of Unsupervised Extraction and Classification for Homogenous Objects Applied to Multispectral and Hyperspectral Data.” *IEEE Transactions on Geoscience and Remote Sensing*, Vol 43, Issue 4, April 2005, pp. 844-851.

L.O. Jimenez, E. Arzuaga-Cruz. M. Velez-Reyes, “Unsupervised Linear Feature-Extraction Methods and Their Effects in the Classification of High-Dimensional Data.” *IEEE Transactions on Geoscience and Remote Sensing*, Vol 45, Issue 2, Feb. 2007, pp. 469-483.

V. Manian and L. O. Jimenez, "Land cover and benthic habitat classification using texture features from multispectral and hyperspectral images," *SPIE Journal of Electronic Imaging*, Vol. 16, No. 2, June 2007.

Publications in Conference Proceedings:

L. O. Jimenez and D.A. Landgrebe, "High Dimensional Feature Reduction Via Projection Pursuit," presented at the *International Geoscience and Remote Sensing Symposium (IGARSS'94*), Pasadena California, 1994.

L. Jimenez and D.A. Landgrebe, "Projection Pursuit for High Dimensional Feature Reduction: Parallel and Sequential Approaches," presented at the *International Geoscience and Remote Sensing Symposium (IGARSS'95*), Florence Italy, July 10-14, 1995.

L. Jimenez and D.A. Landgrebe, "Projection Pursuit in High Dimensional Data Reduction: Initial Conditions, Feature Selection and the Assumption of Normality," presented at the *IEEE International Conference on Systems, Man and Cybernetics*, Vancouver Canada, October 1995.

L. O. Jimenez, "Supervised Classification Techniques for Hyperspectral Data," *1997 NASA University Research Center's Technical Conference on Education, Aeronautics, Space, Autonomy, Earth and Environment (URC-TC'97),* Albuquerque, New Mexico, February 16-19, 1997.

L. O. Jimenez, "Supervised Classification Techniques for Hyperspectral Remote Sensing Data," presented at *Geomatics in the Era of RADARSAT (GER'97) Conference*, Ottawa Canada, 1997.

L. O. Jimenez, "Image Analysis: An Educational Environment using MultiSpect," presented at *ADMI Annual Workshop*, Washington D.C., 1997.

L.O. Jimenez, "On the Use of Remote Sensing for Land Use and Land Cover," presented at *First Congress on Ecoturism*, Jarabacoa, Dominican Republic, June 1997.

L.O. Jimenez, and Y. Chaar, "Clustering Algorithm for Hyperspectral Data," *1998 NASA University Research Center's Technical Conference on Education, Aeronautics, Space, Autonomy, Earth and Environment (URC-TC'98),*

L.O. Jimenez, R. Figueroa, and S. Hunt, "Supervised Classification of Hyperspectral Remote Sensed Data with the use of Parametric Projection Pursuit and Artificial Neural Networks," *ISSSR 1997*, San Diego, California, December 1997.

M. Velez-Reyes, L.O. Jimenez, F. Pagan, and G. Fernandez, "Subset Selection for the Analysis of Hyperspectral Data," *ISSSR 1997*, San Diego, California, December 1997.

F. Pagán, G. Fernández, M. Vélez-Reyes, and L. O. Jiménez, "Dimension Reduction in AVIRIS and LANDSAT Images using Subset Selection Methods." In Proceedings of the 1998 NASA URC Technical Conference on Aeronautics, Space Science and Technology, Earth System Sciences, Global Hydrology, and Education, February 22-26, Huntsville AL, February 22-26, 1998.

M. Vélez-Reyes and L. O. Jiménez, "Subset Selection Analysis for the Reduction of Hyperspectral Imagery." In Proceedings IEEE International Geosciences and Remote Sensing Symposium, July 6-10, Seattle, WA, 1998.

F.M. Fontan, and L.O. Jimenez, "Modified Fuzzy C-Means Clustering on Multispectral Images", 1998 Computing Research Conference (CRC '98), University of Puerto Rico, Mayaguez Campus.

L. O. Jimenez, M.Velez-Reyes, Y. Chaar, F. Fontan, and C. Santiago, "Partially Supervised Detection Using Band Subset Selection in Hyperspectral Data." SPIE Conference, Orlando Florida, 1999,

L. O. Jimenez and J. Rivera-Medina, “On the Integration of Spatial and Spectral Information in Unsupervised Classification for Multispectral and Hyperspectral Data.” SPIE Conference, Florence, Italy, September 1999.

M. Vélez-Reyes, L. O. Jiménez, D.M. Linares, and H.T. Velazquez. “Comparison of matrix factorization algorithms for band selection in hyperspectral imagery.” To appear in Proceedings of SPIE Aerosense, Orlando, FL, 2000.

Ramirez-Velez, M. D., Rivera-Medina, J.L., Jimenez, L.O., Velez-Reyes, M., “Study of different classification algorithms on AVIRIS data taken over the Kennedy Space Center, Florida” To be presented at the National Alliance of NASA University Research Centers, Nashville, Tennessee, April 2000.

Rivera-Medina, J.L., Jimenez, L.O., Velez-Reyes, M., Ramirez-Velez, M. D., “Unsupervised Classification of High Spatial and Spectral Resolution Data based on the Unsupervised ECHO Classifier,” To appear in Proceedings of IGARSS, 2000, Honolulu, Hawaii.

Jimenez, L.O., Velez-Reyes, M., Rivera-Medina, J.L., Velasquez, H.T., “Unsupervised Decision Fusion for Hyperspectral Data,” To appear in Proceedings of SPIE- International Symposium on Remote Sensing, Toulouse, France, September 2001.

Cruz-Pol, S., Velez-Reyes, M., Hunt, S., Parsiani, H., Colom-Ustaris, J., Jimenez, L.O., and Vasquez, R., The Laboratory for Applied Remote Sensing and Image Processing at University of Puerto Rico at Mayaguez, IEEE Geoscience and Remote Sensing News Letter, December 2001.

M. Velez-Reyes, D.M. Linares, L.O. Jimenez-Rodriguez, "Two-stage band selection algorithm for hyperspectral imagery." In **Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery VIII**, Proceedings of SPIE Vol. 4725, April 2002.

Jimenez, L.O., Arzuaga, E., Velez-Reyes, M., “Unsupervised Feature Extraction Techniques for Hyperspectral Data and its Effects on Unsupervised Classification,” SPIE Europe, Crete, Greece, September 2002.

Jimenez, L.O., Rodriguez-Diaz, E., Velez-Reyes, M., DiMarzio, C., “Image Reconstruction and Subsurface Detection by the Application of Tikhonov Regularization to Inverse Problems in Hyperspectral Images,” SPIE Asia-Pacific, Hangzhou China, October 2002.

Ramirez, M., Jimenez, L.O., “Regularization Techniques for Parameter Estimation and Object Detection on Hyperspectral Data,” SPIE AeroSense 2003, Orlando, Florida, April 2003.

Arzuaga, E., Jimenez, L.O., “Feature Extraction and Band Subset Selection techniques based on Relative Entropy Criteria for Hyperspectral data Analysis,” SPIE AeroSense 2003, Orlando, Florida, April 2003.

Rodriguez-Diaz, E., Jimenez-Rodriguez, L.O., Velez-Reyes, M., Subsurface “Detection of Coral Reefs in Shallow Waters using Hyperspectral Data,” SPIE AeroSense 2003, Orlando, Florida, April 2003.

Rivera-Maldonado, F.J., Torres-Muñiz, R.T., Jimenez-Rodriguez, L.O., “Hough transform for robust segmentation of underwater multispectral images,” SPIE AeroSense 2003, Orlando, Florida, April 2003.

Jimenez-Rodriguez, L. O., Arzuaga, E., Rivera-Medina, J., “Application of Unsupervised Feature Extraction and Classification Techniques by means of Projection Pursuit and UnECHO on LANDSAT 7 Imagery for Environment Assessment,” Conference on Remote Sensing of the Environment, Santiago , Chile, April 2003

E. Arzuaga-Cruz, L.O. Jimenez-Rodriguez, M. Velez-Reyes, D. Kaeli, E. Rodriguez-Diaz, H.T. Velazquez-Santana, A. Castrodad-Carrau, L.E. Santos-Campis, and C. Santiago. “A MATLAB Toolbox for Hyperspectral Image Analysis.” In *Proceedings IEEE International Geosciences and Remote Sensing Symposium*, Alaska, 2004.

L.O. Jiménez, Alejandra Umana-Diaz, Jose Diaz-Santos, Carolina Gerardino-Neira, Javier Morales-Morales, Eladio Rodriguez, *Subsurface Object Recognition by Means of Regularization Techniques for Mapping Coastal Waters Floor*, SPIE Europe, Brugges, Belgium, September 2005.

V. Manian, L.O. Jiménez, M. Velez-Reyes, *A comparison of statistical and multiresolution texture features for improving hyperspectral image classification*, SPIE Europe, Brugges, Belgium, September 2005.

V. Manian, L.O. Jiménez, *Land Cover and Benthic Habitat Classification using Textures Features from Hyperspectral and Multispectral Images*, SPIE Algorithms and Technologies for Multispectral, Hyperspectral and Ultraspectral Imagery XII, April 17-22, Orlando Florida, 2006.

V. Manian, L.O. Jiménez, M. Velez-Reyes, *Support Vector and Wavclet Domain Hyperspectral and Wavelet Domain in Hyperspectral Benthic Habitat Classification* International Conference in Image Processing Conference, *ISSSR 2006 Intl. Symposium on Spectral Sensing Research , Bar Harbor, Maine, June 2006.*

S. Rosario-Torres, M. Vélez-Reyes, S.D. Hunt and L.O. Jiménez, “New Developments and Application of the UPRM MATLAB Hyperspectral Image Analysis Toolbox.” In **Proceedings of SPIE: Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XIII**, Vol. 6565, May 2007.

PUBLICATIONS IN EDUCATION, PHILOSOPHY AND ENGINEERING ETHICS

Buxeda, R., Jimenez, L.O., and Morell, L. “Transforming An Engineering Course To Enhance Student Learning”, Presented at the ICEE Conference, Oslo, Norway, August 2001

L.O. Jiménez, E. O’Neill-Carrillo, E. Marrero, *Creating Ethical Awareness in Electrical and Computer Engineering Students: A Learning Module on Ethics*, IEEE Frontiers In Education Conference: Pedagogies and Technologies, for the Emerging Global Economy, Indianapolis, Indiana, October 2005.

J.A. Cruz-Cruz, W.J. Frey, L.O. Jiménez, E. O’Neill-Carrillo, and H.D. Sanchez, *The EAC Ethics Matrix: Beyond ABET Re-accreditation*, IEEE Frontiers In Education Conference: International, Social and Cultural Borders, San Diego California, October 28-31, 2006.

L.O. Jimenez, E. O’Neill, W.J. Frey, R. Rodríguez-Solis, A. Irizarry, and S. Hunt, *A Learning Module of Social and Ethical Implications for ECE Capstone Design Courses*, IEEE Frontiers In Education Conference: International, Social and Cultural Borders, San Diego California, October 28-31, 2006.

E. O’Neill, L.O. Jimenez, *Social, Ethical and Global Issues in Engineering*, IEEE Frontiers In Education Conference: Global Engineering, Knowledge without Borders, Opportunities without Passports, Milwaukee, Wisconsin, October 10-13, 2007.

L.O. Jimenez-Rodríguez, *Mathematical realism in Jean Ladrière and Xavier Zubiri: a comparative analysis over the philosophical status of mathematical objects, method and truth*”, in Peer Review Electronic Journal ***Xavier Zubiri Review***, Vol. 11, 2011, p. 5-25.

L.O. Jiménez-Rodriguez, Zubiri’s notion of mentality and the multiplicity of systems of reference in reason’s quest: the contributions and challenges of an interdisciplinary research of complex realities, in Peer Review Journal, ***Revista Portuguesa de Filosofía***, submitted Feb 2013.

TECHNICAL REPORTS:

L.O. Jimenez and D.A. Landgrebe , “High Dimensional Feature Reduction Via Projection Pursuit,” School of Electrical Engineering Purdue University, Technical Report, TR-ECE 96-5, April 1996.

L. O. Jiménez, J. L. Cruz-Rivera, R. E. Vásquez-Espinosa, “Fingerprint Verification System: A Vectorial Approach,” Technical Report TR-97-01, Biomega Project, February 1997.

J.L. Cruz-Rivera, L.O. Jimenez, R. Vasquez-Espinosa, “Algorithmic and Architectural Development of a Fingerprint Verification System,” Technical Report TR-97-02, Biomega Project, May 1997.

L.O. Jimenez, J. L. Cruz-Rivera, R. Vasquez-Espinosa, “Algorithmic and Architectural Development of a Fingerprint Verification System,” Technical Report TR-97-02, Biomega Project, April 1998.

L.O. Jimenez, M. Velez-Reyes, “Clustering and Subset Selection Research for Hyperspectral Data Analysis,” Technical Report, TR-97-01, U.S. Army Topographic Engineering Center, Department of the Army, December 1997.

L.O. Jimenez, M. Velez-Reyes, “Clustering and Subset Selection Research for Hyperspectral Data Analysis,” Technical Report, TR-98-01, U.S. Army Topographic Engineering Center, Department of the Army, March 1998.

RESEARCH PROJECTS:

PI of Funded Proposals:

Title	Description	Time	Funding	Company/ Agency
Center for Subsurface Sensing and Imaging System	ERC jointly with NU, BU, RPI	July 2000-June 2005	$12.5 M	NSF ERC Program
Fingerprint Verification System: A Vectorial Approach	Design of a fingerprint verification system	January 97-July 98	$228,989.87	Biometrics Imageneering, Inc.
Clustering and Subset Selection for Hyperspectral Data Analisis	Design of clustering algorithms for hyperspectral data. The algorithms are based on Statistical Pattern Recognition	Oct 1997-Oct 2000	$314 862.00	Topographic Engineering Center of the US Army Corps of Engineering.
Unsupervised Classification Algorithms for Hyperspectral Data Analysis	Design of unsupervised classification algorithms. The techniques used are based on Fuzzy Logic and Neural Network.	Nov 1997-Nov 2000	$390,481.00	DEPSCoR
Atmospheric Correction for Hyperspectral Data	Design of an atmospheric correction scheme based on the data information	Jan 2000-Jun 2001	$25,000	General Dynamics

Integration of Hyperspectral Pattern Recognition and Computer Vision Shape Detection for Subsurface Object Identification	Integration of Computer Vision and Pattern Recognition techniques in inversion methods, feature extraction and classification methods of hyperspectral data.	Aug 2001-Sept 2003	$100,000.00	National Mapping and Imaging Agency
Remote Sensing Data Analysis: A Comparison between Statistical Pattern Recognition and Neural Networks Methods	Comparison between Statistical Pattern Recognition and Neural Network in Remote Sensing Data.	Jan -May 97	$1500.00	Industrial Affiliated Program
Graphical User Interphase and Fingerprint Database for a Biometric Verification System	Design of a GUI for a Fingerprint Verification System.	Aug 97 - May 98	$2700.00	Industrial Affiliated Program
Statistical Pattern Recognition Educational Matlab Toolbox	Design of a Pattern Recognition Matlab Toolbox for Image Analysis	Aug 97 - May 98	$2850.00	Industrial Affiliated Program

PARTICIPATION IN OTHER RESEARCH PROJECTS:

Advanced Automated Image Analysis Project (AAIA), in the grant **Tropical Center For Earth And Space Studies**, NASA.

Information Processing And Extraction Group (IPEG), in the grant **Tropical Center For Earth And Space Studies**, NASA.

Partnership for Spatial and Computational Research (**PASCoR**), NASAs Mission to Planet Earth

COURSE TAUGHT:

INEL 3115, Introduction to Electrical and Computer Eng.
INEL 3106, Circuit Analysis I
INEL 4102, Circuit Analysis II
INEL 4075, Fundamentals of Electrical Engineering
INEL 4301, Telecommunication Theory I
ICOM 5015, Introduction to Artificial Intelligence
INEL 5995, Pattern Recognition and Image Analysis
INEL 5046, Pattern Recognition and Image Analysis
INEL 5309, Digital Signal Processing
INEL 6007, Introduction to Remote Sensing
INEL 6078, Estimation Detection and Stochastic Process
INEL 6087, Artificial Intelligence: Techniques and Applications
INEL 6088, Computer Vision

COURSES DEVELOPED:

INEL 5315, Theory of Communications II.
INEL 5XXX, Image Processing

INEL 5046, Pattern Recognition
INEL 6XXX, Digital Communication

SIGNIFICANT PRESENTATION:

E. Arzuaga-Cruz, L.O. Jimenez-Rodriguez, D. Kaeli, M. Velez-Reyes, E. Rodriguez-Diaz, L.E. Santos-Campis, and C. Santiago, “A MATLAB Toolbox for Hyperspectral Image Analysis.” Presented at the **IEEE Workshop on Advances in Techniques for Analysis of Remotely Sensed Data**, NASA Goddard Visitor Center, Washington DC, USA October 27/28, 2003.

L.O. Jimenez, "Unsupervised Feature Extraction Techniques for Hyperspectral Data and its Effects on Unsupervised Classification", presented to the **PRECISE & Doctoral Program in CISE Computing and Information Sciences and Engineering Technical Lecture Series**, R&D Conference Room, February 13, 2003

L.O. Jimenez,"Ethics in Electrical Engineering and Technology," December 2002, **ECE Department** at UPRM.

L.O. Jimenez, and E. Oneill, "Research Ethics and Graduate School", August 2006**, Center for Professional Enhancement** at UPRM.

L.O. Jimenez, “*Hyperspectral Unsupervised Feature Extraction*”, **First European School on Hyperspectral Imaging**, Caceres, España, October 2007. For more information http://hyperinet.multimediacampus.it/event1.htm.

L.O. Jimenez, “*L’agir de l’homme et son impact sur l’environnement : aspects technologiques et philosophiques*”, **Interdisciplinary Day at Centre Sèvres**, Paris, December 2007. (Presentation on Remote Sensing, its ethical and global impact to students and faculty members)

L.O. Jiménez-Rodríguez, W. Frey, F. Maldonado, D. Valdés, E. O’Neill, *Estrategia efectiva para la conducta ética*, Colegio de Ingenieros y Agrimensores, Capítulo de Mayagüez, Mayo 2012.

PARTICIPATION IN PANEL DISCUSSION:

“Graduate School for Minority Students,” at *ADMI Annual Workshop*, Washington D.C., 1997.

“Integration of Academic Research, Federal Agencies Requirements, and Private Enterprises in Multispectral and Hyperspectral Images,” ISSSR’97, December 15, 1997, San Diego California.

NASA Peer Review Panel To Evaluate Proposals In The Carbon Cycle Science Program Area, March 2001, Washington.

SINERGISTIC ACTIVITIES:

Dr. Luis O. Jimenez in collaboration with Dr. Miguel Vélez-Reyes (UPRM) and David Kaeli (NEU) have developed an MATLAB Toolbox for Hyperspectral Image Analysis.

Dr. Luis O. Jimenez in collaboration with Dr. Miguel Vélez-Reyes developed a software system for the ARMY Topographic Engineering Center in Ft. Belvoir, VA based on the algorithms developed as part of their work in hyperspectral image processing. This is currently used by TEC researchers in the analysis of hyperspectral data.

Dr. Luis O. Jimenez has served as panelist in NASA PEER REVIEW PANEL to evaluate proposals in The Carbon Cycle Science Program Area, March 2001, Washington.

Dr. Jimenez currently is Assistant of the Dean to develop an Ethics Across the Engineering Curriculum Program to accomplish ABET requirements and UPRM Institutional Values.

AWARDS:

2000-2001 Distinguished Professor, UPRM ECE Department.

2001-2002 Distinguished Researcher of the University of Puerto Rico, recognition from the President of the University of Puerto Rico.

JOURNAL REVIEWER:

IEEE Transactions on Geoscience and Remote Sensing

IEEE Transactions On Biomedical Imaging

Optical Engineering, The International Society for Optical Engineering

RESEARCH INTEREST:

Pattern Recognition, Computer Vision, Artificial Intelligence, Remote Sensing, and Image Processing, Engineering Ethics, Engineering Education

LANGUAGE SKILLS

Spanish: excellent (native speaker), English: excellent (spoken & written), French: very good (spoken & written), German: basic knowledge (reading), Ancient Greek: basic knowledge (reading).

LIST OF COLLABORATORS AND CO-EDITORS:

Dr. Efrain O'Neill, UPRM
Dr. Michael Silevitch, Northeastern University
Dr. Charles DiMarzio, Northeastern University
Dr. Shawn Hunt, UPRM
Dr. Eddie Marrero UPRM
Dr. Miguel Vélez-Reyes, UPRM
Dr. Rosa Buxeda, UPRM
Ms. Lueny Morell, Hewlett Packard
Dr. David Castañon, Boston University
Dr. David Kaely, Northeastern University

LEON-COLON, LEYDA

Academic rank: Assistant Professor

Degrees and certificate with fields, institution, and date:

BS	Electrical Engineering	University of Puerto Rico, Mayagüez Campus	2001
MS	Electrical Engineering	University of Puerto Rico, Mayagüez Campus	2004
PhD	Electrical Engineering	Colorado State University	2010

Appointments:

Assistant Professor at UPRM	2010 to Present
Research Assistant at CSU	2005-2010
Assitant Profesor at PUPR	2002-2005

Publications

"Active Rain Gauge Concept For Moderate To Heavy Precipitation Using W-Band And S-Band Doppler Radars." Leyda V. León-Colón, Sandra L. Cruz-Pol, PhD., Stephen M. Sekelsky, PhD. Electrical and Computer Engineering Department, University of Puerto Rico-Mayagüez Campus and University of Massachusetts-Amherst. IGARSS 03, Toulouse, France, 2003.

"Active Rain-Gauge Concept for Liquid Clouds using Vertically Oriented W-band and S-band Doppler Radars." Leyda V. León, Sandra L. Cruz-Pol, PhD., Stephen M. Sekelsky, PhD. Electrical and Computer Engineering Department, University of Puerto Rico-Mayagüez Campus and University Massachusetts-Amherst, SPIE 9th International Symposium on Remote Sensing, Crete, Greece, 2002.

"Rain and Wet Hail Specific Attenuation Estimation for a 3D Supercell case using RAMS model to simulate CASA X-band and WSR-88D S-band radar signals" L.V. León, G.J. Huang, Y.X. Liu, V.N. Bringi, A. LoftusElectrical and Computer Engineering Department, Colorado State University. 33th Radar Conference on Radar Meteorology Conference,Cairns, Australia, 2007.

"Estimation and Correction of Wet Ice Attenuation at X-band during a convective storm Using the X-band CASA radar network IP1 and WSR-88D KOUN Radar" Leyda León, V.N. Bringi and V. Chandrasekar Electrical and Computer Engineering Department, Colorado State University. Fifth European Conference on Radar in Meteorology and Hydrology, Helsinki, Finland, 2008.

"Low Cost and Minimal Infrastructure Off-The-Grid X-Band Radar Network Development for the West Coast of Puerto Rico" Jorge Trabal, José Colom-Ustariz, Gianni Pablos-Vega, José Ortiz, Wilson Castellanos, Sandra Cruz-Pol, Leyda León and Rafael Rodríguez-Solis: 2011, IEEE Radar Conference, Kansas City, MO.

"Wet *Ice Specific Attenuation Retrieval and Correction for X-band using a Piece-wise Forward Correction Method"* Leyda León, V.N. Bringi, Brenda Dolan: 2011, 35th Radar Conference on Radar Meteorology Conference, AMS, Pittsburgh, PA.

"Implementation and Development of an Attenuation Correction Algorithm for Off-The-Grid X-Band Radar Network" Keyla Mora, Leyda León, Sandra Cruz-Pol: 2012, AMS-93th Annual Conference, Austin, TX.

Courses Created at UPRM:

Undergraduate: Introduction to Radar Meteorology

Courses Taught at UPRM:

Introduction to Radar Systems, Introduction to Radar Meteorology, Electromagnetics I and II, Introduction to Electrical Engineering.

Professional societies:

IEEE

Collaborations

Collaborators and Co-authors

Dr. V. N. Bringi (Colorado State University)

Dr. C. Chandrasekar (Colorado State University)

Dr. Huang (Colorado State University)

Dr. Brenda Dolan (Colorado State University)

Dr. Stephen Frasier (University of Massachusetts)

Thesis Advisor

Keyla Mora: DEVELOPMENT AND IMPLEMETATION OF AN ATTENUATION CORRECTION ALGORITHM FOR CASA OFF THE GRID X-BAND RADAR NETWORK"

Andrés Saavedra: "DIGITAL SIGNAL ANALYSIS FOR AIR BUBBLES DETECTION ON ARTIFICIAL THIGH VESSELS"

EMMANUEL ARZUAGA CRUZ

Academic rank: *Assistant Professor*

Degrees with fields, institution, and date:

BS	Computer Engineering	University of Puerto Rico, Mayagüez Campus	2000
MS	Computer Engineering	University of Puerto Rico, Mayagüez Campus	2002
PhD	Computer Engineering	Northeastern University, Boston, MA	2012

Faculty service at UPRM:

Date of original appointment: March 2012

Dates of advancement in rank:

Total years of service: 0

Areas of professional expertise:

Datacenter Resource Efficiency and Performance Analysis, Computer Systems and Virtualization Infrastructure, I/O Storage Systems, Computer and Network Security, Workload Characterization, Computer Architecture, Pattern Recognition, Remote Sensing.

Other related experience—academic or industrial:

Research Assistant, May 2005 – December 2011.

Northeastern University Computer Architecture Research Group (NUCAR), ECE Department, Northeastern University.

PhD research: resource efficiency of virtualized enterprise systems. Using virtual machine migration to improve resource efficiency including system power consumption. Modeling and analysis of storage systems. Implementation of commercial workloads based on the TPC-C and TPC-H specifications. Installation, configuration and system administration of a 33 node computer cluster and its 16 TB storage array.

Bernard M. Gordon Center for Subsurface Sensing and Imaging Systems (Gordon-CenSSIS), ECE Department, Northeastern University.

Software Engineer of the CenSSIS Solutionware team. Provide software engineering support to the CenSSIS partner universities.

MTS Intern, July 2009 - January 2010.

VMware Inc, Cambridge, Massachusetts.

Software development engineer for R&D kernel development in the ESX I/O subsystem. Study I/O subsystem to identify performance enhancements for virtual machine execution.

Graduate Intern Technical, May - August 2008.

Intel Corporation, Fort Collins Design Center, Fort Collins, Colorado.

Create a synthetic enterprise workload that approximates the behavior of the TPC-C workload to model, simulate, and evaluate performance enhancement possibilities for Itanium processor designs.

Research Intern, July 2006 - January 2007.

ExaGrid Systems Inc, Westborough, Massachusetts.

Software performance evaluation and testing; contrast and compare the effectiveness of delta compression techniques as well as other data de-duplication techniques.

Software Developer, September 2002 - August 2004.

Gordon-CenSSIS, Laboratory for Applied Remote Sensing and Image Processing

(LARSIP), ECE Department, University of Puerto Rico Mayagüez Campus.

Development of software tools for image processing and train LARSIP students and professors on how to use the software being developed.

Teaching Assistant, September 2004 - April 2005.

ECE Department, Northeastern University.

ECEU324 Computer Architecture. The course presents computer organization and architecture and covers all elements of a computer system, including the CPU, memory hierarchy, I/O and network.

ECEU326 Optimization Methods. This course covers design and implementation of basic data structures, including arrays, lists, stacks, queues, trees, and graphs.

Instructor, August - December 2003.

ECE Department, University of Puerto Rico Mayagüez Campus.

INEL5046 Pattern Recognition. This course aims to introduce the students to the fundamental concepts of pattern recognition enabling them the ability to design algorithms to analyze signals and images.

Consulting, patents:

State(s) in which registered:

Principal publications of last five years: (2006-2011)

Increasing Power/Performance Resource Efficiency on Virtualized Enterprise Servers,
Arzuaga, E. and Kaeli, D.R., ACM International Conference on Computing Frontiers, 2011.

Quantifying Load Imbalance on Virtualized Enterprise Servers,
Arzuaga, E. and Kaeli, D.R., First ACM/SPEC International Conference on Performance Engineering, 2010.

M/G/1 Queue Model for Multiple Applications on Storage Area Networks,
Arzuaga, E., Kaeli, D.R., Workshop on Computer Architecture Evaluation using Commercial Workloads (CAECW), in conjunction with the International Conference on High Performance Computer Architecture (HPCA), 2008.

Unsupervised Feature Extraction Methods and their Effects in the Classiffication of High Dimensional Data,
Jiménez-Rodríguez, L.O., Arzuaga-Cruz, E., Vélez-Reyes, M., IEEE Transactions on Geoscience and Remote Sensing (45-2), 2007.

Grants or externally funded project active during the last five years: (2006-2011)

Scientific and professional societies of which a member:

ACM, IEEE, IEEECS, SPIE

Honors and awards:

Eta Kappa Nu Electrical and Computer Engineering Honor Society.

Student Travel awards to attend: HPCA 2008 and Computing Frontiers 2011.

Institutional and professional service in the last five years: (2006-2011)

Associate Director UPRM LARSIP

2012 Google Drive program panelist University of Puerto Rico Mayagüez

2013 HackPR event faculty participant

2013 Talk about UPRM ECE graduate programs at Turabo University

2013 Ta Talk about UPRM ECE graduate programs at Polytechnic University of Puerto Rico

Professional development activities in the last five years: (2006-2011)

Reviewer for:

Journals:

IEEE Transactions on Geoscience and Remote Sensing.

IEEE Transactions on Parallel and Distributed Systems

Conferences:

IPDPS 2013 The international Parallel and Distributed Processing Symposium (Program Committee Member)

ISCA 2007, The International Symposium on Computer Architecture (Reviewer)

IGARSS 2007, The International Symposium on Geoscience and Remote Sensing (Reviewer)

Offered Courses in the past two years

Operating Systems

Cryptography and Network Security

Community service activities: (2006-2011)

Appendix D:
Publications List

Doctoral Faculty Publications by Track Area:

Conf. Papers	EMAG	Signal and System	Electronics	Energy Systems	Education	Total
2010	3	19	8	12	5	47
2009	4	14	0	8	5	31
2008	5	20	4	12	4	45
2007	8	32	6	6	5	57
2006	5	34	11	10	4	64
2005	10	13	8	13	4	48
2004	8	6	5	6	9	34
2003	8	21	10	5	5	49
2002	6	14	2	2	5	29
2001	3	4	1	4	3	15
Total	60	177	55	78	48	418

Journal Papers	EMAG	Signal and System	Electronics	Energy Systems	Education	Total
2010	1	2	3	2	2	10
2009	2	10	1	2	0	15
2008	2	10	5	3	0	20
2007	1	6	1	1	0	9
2006	0	1	2	0	0	3
2005	0	6	2	0	0	8
2004	1	0	1	1	0	3
2003	2	0	0	1	1	4
2002	0	2	0	0	0	2
2001	1	0	0	1	0	2
Total	10	37	15	11	3	77

Books Ch.	EMAG	Signal and System	Electronics	Energy Systems	Total
2010				1	1
2007		1			1
2003					0
Total		1		1	2

Magazines	EMAG	Signal and System	Electronics	Energy Systems	Total
2009		0	1		1
2002	1				1
Total	1	0	1		3

Applied Electromagnetics

2010 Peer Reviewed Conference

1. Arocho Meaux, S., A. Mercado Vargas, G. A. Pablos-Vega, E. W. Harmsen, S. Cruz-Pol and J. Colom Ustáriz, "Calibration and validation of CASA radar rainfall estimation" Proceedings of the AWRA Summer Specialty Conference, Tropical Hydrology and Sustainable Water Resources in a Changing Climate. San Juan, Puerto Rico., 2010
2. Cordoba-Erazo, M.F.; Rodriguez-Solis, R.A. Cavity-backed Folded-slot Antenna. Source: 2010 IEEE International Symposium Antennas and Propagation and CNC-USNC/URSI Radio Science Meeting, p 4 pp., 2010
3. Gianni A. Pablos-Vega[1], José G. Colom-Ustáriz[1], Sandra Cruz-Pol[1], Jorge M. Trabal[2], V. Chandrasekar[3], Jim George[3], and Francesc Junyent[3], "DEVELOPMENT OF AN OFF-THE-GRID X-BAND RADAR FOR WEATHER APPLICATIONS ", IGARSS 2010, Hawaii

2010 Journal

2010 Magazines and Letters

1. José G. Colom, Sandra Cruz-Pol, Gianni Pablos, María F. Córdoba, Wilson Castellanos, Melisa Acosta, José A. Ortiz, Benjamín de Jesús, "UPRM Weather Radars at the Central American and Caribbean Games at Mayagüez 2010," GRS Newsletter, Sept. 2010.

2009 Peer Reviewed Conference

1. Galvez, Miguel B. , José G. Colom, V. Chandrasekar, Francesc Junyent, Sandra Cruz-Pol, Rafael Rodriguez, "Salient Features of The Radar Nodes In The Puerto Rico Tropical Weather Testbed" IGARSS 2009, Cape Town, South Africa, July 15, 2009.
2. Ramirez-Beltran, Nazario D.; Kuligowski, Robert J.; Castro, Joan M.; Cardona, Melvin J.; Vasquez, Ramon, "A projection algorithm for satellite rainfall detection" Source: WSEAS Transactions on Systems, v 8, n 6, p 763-772, 2009.
3. Ramirez-Beltran, Nazario D.; Kuligowski, Robert J.; Cardona, Melvin J.; Cruz-Pol, Sandra "Warm rainy clouds and droplet size distribution" Source: WSEAS Transactions on Systems, v 8, n 1, p 75-85, 2009.
4. A. Rivera Albino and R.A. Rodríguez Solís, "Design of Tapered Slot Antenna Array for Space Distributed Class-E Power Amplifier", 2009 IEEE Antennas and Propagation Society International Symposium, June 2009, pp. 1-4.

2009 Journal

1. Rojas-Gonzalez, A.M.; Harmsen, E.W.; Pol, S.C. "Performance evaluation of MPE rainfall product at hourly and daily temporal resolution within a hydro-estimator pixel" Source: WSEAS Transactions on Environment and Development, v 5, n 7, p 178-87, July 2009.
2. McLaughlin, D., D. Pepyne, V. Chandrasekar, B. Philips, J. Kurose, M. Zink, K. Droegemeier, S. Cruz-Pol, F. Junyent, J. Brotzge, D. Westbrook, N. Bharadwaj, Y. Wang, E. Lyons, K. Hondl, Y. Liu, E. Knapp, M. Xue, A. Hopf, K. Kloesel, A. Defonzo,

P. Kollias, K. Brewster, R. Contreras, B. Dolan, T. Djaferis, E. Insanic, S. Frasier, and F. Carr, 2009: Short-Wavelength Technology and the Potential For Distributed Networks of Small Radar Systems. Bull. Amer. Meteor. Soc., 90, 1797–1817. 2009

2008 Peer Reviewed Conference

1. Colom, J.; Castañeda, L.; Knapp, E. (2008). Phase shifter system using vector modulation for X-band phased array radar applications. International Geoscience and Remote Sensing Symposium (IGARSS), p 2750-2753.
2. Harmsen, E.; Mesa, S.; Ramirez-Beltran, N.D.; Pol, S.C.; Kuligowski, R.J.; Vasquez, R. (2008). Remote sensing QPE uncertainties associated with sub-pixel rainfall variation. Proceedings of the 12th WSEAS International Conference on Systems, p 789-98.
3. Marrero-Fontanez, V. & Rodriguez-Solis, R. (2008). Low cross-polarization antenna array for CASA's student test bed radar. International Geoscience and Remote Sensing Symposium (IGARSS), p 2746-2749.
4. Ramirez-Beltran, N.; Kuligowski, R.; Harmsen, E.; Castro, J.; Cruz-Pol, S.; Cardona-Soto, M. (2008). Validation and strategies to improve the Hydro-Estimator and NEXRAD over Puerto Rico. Proceedings of the 12th WSEAS International Conference on Systems, p 799-806.
5. Vega, M. & Colom, J. (2008). Student developed meteorological radar network for the western part of Puerto Rico: First node. International Geoscience and Remote Sensing Symposium (IGARSS), p 3057-3059.

2008 Journal

1. Parsiani, H. & Mendez, J. (2008). Aerosol size distribution using lidar data and a typical lidar assembly. WSEAS Transactions on Systems, v 7, n 11, p 1218-1227.
2. Ramírez-Beltrán, N.; Kuligowski, R.; Harmsen, E.; Castro, J.; Cruz-Pol, S.; Cardona, M. (2008). Rainfall estimation from convective storms using the Hydro-Estimator and NEXRAD. *WSEAS Transactions on Systems,* v 7, n 10, p 1016-27.

2007 Peer Reviewed Conference

1. Arias, Diego; Sanabria, John; Rivera, Wilson; A grid based weather radar data retrieval and processing framework; Source: International Geoscience and Remote Sensing Symposium (IGARSS), p 2758-2762, 2007 IEEE International Geoscience and Remote Sensing Symposium, IGARSS 2007
2. Colom, Jose G.; Castaneda, Luis Giraldo; Knapp, Eric; Phase shifter system using vector modulation for X-band phased array radar applications; Source: International Geoscience and Remote Sensing Symposium (IGARSS), p 2750-2753, 2008, 2007 IEEE International Geoscience and Remote Sensing Symposium, IGARSS 2007
3. Marrero-Fontanez, Victor J.; Rodriguez-Solis, Rafael A., Dual polarized microstrip antenna array for X-band radar applications; Source: IEEE Antennas and Propagation Society, AP-S International Symposium (Digest), p 2144-2147, 2007 IEEE Antennas and Propagation Society International Symposium, AP-S, 2007
4. Marrero-Fontanez, Victor J.; Rodriguez-Solis, Rafael A.; Dual polarized aperture-coupled microstrip patch antenna for X-band series-fed array; Source: IEEE Antennas and Propagation Society, AP-S International Symposium (Digest), p 2148-2151, 2007 IEEE Antennas and Propagation Society International Symposium, AP-S, 2007

5. Marrero-Fontanez, Victor J.; Rodriguez-Solis, Rafael A.; Low cross-polarization antenna array for CASA's student test bed radar; Source: International Geoscience and Remote Sensing Symposium (IGARSS), p 2746-2749, 2007 IEEE International Geoscience and Remote Sensing Symposium, IGARSS 2007
6. Ortíz, Xiomara, Nazario Ramírez and Sandra Cruz Pol, "*An algorithm to improve the NEXRAD rain rate estimates*", IGARSS 2007, Barcelona, Spain, 2007.
7. Serrano-Guzman, Maria F.; Padilla, Ingrid; Rodriguez, Rafael; Bimodal detection of underground contamination in two dimensional systems; Source: Proceedings of SPIE - The International Society for Optical Engineering, v 6540, 2007, Optics and Photonics in Global Homeland Security III
8. Vega, Manuel A.; Colom, Jose; G.; Student developed meteorological radar network for the western part of Puerto Rico: First node; Source: International Geoscience and Remote Sensing Symposium (IGARSS), p 3057-3059, 2008, 2007 IEEE International Geoscience and Remote Sensing Symposium, IGARSS 2007

2007 **Journal**

1. Serrano, M F, Padilla, I Y, Rodriguez, R, (2007) "Electromagnetic Detection and Digital Visualization Of Dnapl Contaminants In A Two-dimensional Soilbed", Eos Trans. AGU, 88(23), Jt. Assem. Suppl., Abstract B41B-09.

2006 **Peer Reviewed Conference**

1. Amador-Perez, A.; Rodriguez-Solis, R.A., "Analysis of a CPW fed annular slot ring antenna using DOE", 2006 IEEE Antennas and Propagation Society International Symposium, p 4301-4,2006.
2. Baquero, Margarita;Cruz-Pol, Sandra; Bringi, V.N.; Chandrasekar, V., "Use of disdrometer data for X-band polarimetric radar simulation and tropical rain characterization", 2006 IEEE International Geoscience and Remote Sensing Symposium, IGARSS, 1906-1909.
3. McLaughlin, David J., V. Chandrasakar , Jim Kurose, Kelvin Droegemeier and Sandra Cruz-Pol, "Short Wavelength Technology and the Potential for Distributed Networks of Short-Range Radar Systems", IEEE IGARSS 06, Colorado, 2006.
4. Serrano-Guzman, Maria F. ; Padilla, Ingrid; Rodriguez, Rafael, "Two-Dimensional detection of underground contamination and buried objects using cross-well radar", Proceedings of SPIE - The International Society for Optical Engineering, v. 6210,2006.
5. Vega, M.A. ; Colom, J.G.; Orama, L. , "Student developed meteorological radar network for Western Puerto Rico", 49th IEEE International Midwest Symposium on Circuits and Systems, p 477-9, 2006

2006 **Journal**

2005 **Peer Reviewed Conference**

1. Baquero, Margarita, Cruz Pol, S. L., José Maeso, "*Rain-rate estimate algorithm evaluation and Rainfall characterization in Tropical environments using 2DVD , rain gauges and TRMM*", IEEE IGARSS 05, Korea.
2. Cruz-Pol, S. L., Morales, J.; Trabal, J.; ; Sekelsky, S. "Ice Water Content (IWC) retrieval from cirrus clouds using millimeter-wave radar and in-situ ice crystal airborne data M."

Source: International Geoscience and Remote Sensing Symposium (IGARSS), v 7, p 5069-5072, 2005, 25th Anniversary IGARSS 2005: IEEE International Geoscience and Remote Sensing Symposium

3. Cruz-Pol, S.; Bringi, V.N.; Chandrasekar, V. Rain , & Baquero, M. "Rate estimate algorithm evaluation and rainfall characterization in tropical environments using 2DVD, rain gauges and TRMM data" ; Source: International Geoscience and Remote Sensing Symposium (IGARSS), v 2, p 1146-1149, 2005, 25th Anniversary IGARSS 2005: IEEE International Geoscience and Remote Sensing Symposium
4. D. A. Del Río, R. A. Rodríguez-Solís, D. S. Filipovic, "Ways to Improve the Radiation Pattern of a LPFSA," 2005 IEEE Antennas and Propagation International Symposium, July 2005, vol. 1B, pp. 410 - 413.
5. Maeso, José, Cruz Pol, S. L., Margarita Baquero "DSD characterization and computations of expected reflectivity using data from a Two-Dimensional Video Disdrometer deployed in a Tropical Environment", IEEE IGARSS 05, Korea. .
6. McLaughlin, D.J., V. Chandrasekar, K. Droegemeier, S. Frasier, J. Kurose, F. Junyent, B. Philips, S. Cruz-Pol, and J. Colom. 2005: Distributed Collaborative Adaptive Sensing (DCAS) for Improved Detection, Understanding, and Prediction of Atmospheric Hazards, 9th Symp. Integrated Obs. Assim. Systems - Atmos. Oceans, Land Surface (IOASAOLS), Amer. Meteor. Soc., San Diego, CA.
7. Hamed Parsiani, Maritza Torres, Pedro Rodriguez, "Material Characteristics in Fourier Domain (MCFD) formulation, a signature to determine soil type, moisture, and vegetation health, based on multilayer ground penetrating radar reflection", Proceedings of IASTED SIP 2004, Aug. 23-25, 2004, Hawaii.
8. Hamed Parsiani, Enrico Mattei "Open Field Soil Moisture Measurements with Radar", WSEAS 2005 Proceedings, Nov. 2005, Italy.
9. M. Sanchez, JG. Colom, "Microstrip Corporate Feed with Taylor Distribution for an X-Band Radar Antenna," IASTED 2005 International Conference on Antennas, Radar, and Wave Propagation, Ontario, Canada.
10. J. A. Torres-Rosario, S. Rondineu, R. A. Rodríguez-Solís, S. Hunt, Z. Popovic, "Adaptive Discrete Lens Antenna Array for Direction of Arrival Detection," 2005 IEEE Antennas and Propagation International Symposium, July 2005, vol. 4A, pp. 122 - 125.

2005 **Journal**

2004 **Peer Reviewed Conference**

1. Carrasquillo-Rivera, I.Solis, R.A.R.; Colom-Ustariz, J.G. "Tunable and dual-band rectangular slot-ring antenna" Source: IEEE Antennas and Propagation Society Symposium (IEEE Cat. No.04CH37529), p 4308-11 Vol.4, 2004
2. Jaramillo-Henao, Carlos; Rodriguez-Solis, Rafael A.; Rosario-Roman, Dennis; Gonzalez-Barreto, David "Analysis of concentric slot ring antenna arrays using DOE and FDA" Source: IEEE Antennas and Propagation Society, AP-S International Symposium (Digest), v 1, p 1074-1077, 2004, IEEE Antennas and Propagation Society Symposium 2004 Digest held in Conjunction with: USNC/URSI National Radio Science Meeting
3. Morales, Jose; Trabal, Jorge; Cruz-Pol, Sandra L.; Sekelsky, Stephen M. "Cirrus clouds millimeter-wave reflectivity comparison with in-situ ice crystal airborne data" Source:

Proceedings of SPIE - The International Society for Optical Engineering, v 5654, p 75-83, 2004, Microwave Remote Sensing of the Atmosphere and Environment IV

4. Parsiani, Hamed; Torres, Maritza; Rodriguez, Pedro "Material characteristics in fourier domain (MCFD) formulation, a signature to determine soil type, moisture, and vegetation health, based on multilayer ground penetrating radar reflection" Source: Sixth IASTED International Conference on Signal and Image Processing, p 602-607, 2004, Sixth IASTED International Conference on Signal and Image Processing
5. Hamed Parsiani, Pedro Rodriguez, "Subsurface Material Type Determination from Ground Penetrating Radar Signatures", Proceedings of SPIE 2004, Gran Canaria, Spain, Sept. 13-16, 2004.
6. Hamed Parsiani, Maritza Torres, "High-resolution vegetation index as measured by radar and its validation with spectrometer", Proceedings of SPIE 2004, Gran Canaria, Spain, Sept. 13-16, 2004.
7. Maritza Torres, Hamed Parsiani, " Non-linearity of Soil Dielectric as a Function of Radar Frequency and Soil Moisture Content", CRC"2004 Proceedings, April 2, 2004, Mayaguez, P.R.
8. Pedro Rodriguez, Hamed Parsiani, "Moisture Determination Based on Ground Penetrating Radar Measurements," CRC"2004 Proceedings, April 2, 2004, Mayaguez, P.R.

2004 **Journal**

1. Rosado-Romana, J.M. (Dept. of Electr. & Comput. Eng., Puerto Rico Univ., Mayaguez, Puerto Rico); Swartz, W.E.; Farley, D.T. "Plasma instabilities observed in the E region over Arecibo and a proposed nonlocal theory" Source: Journal of Atmospheric and Solar-Terrestrial Physics, v 66, n 17, p 1593-602, Nov. 2004

2003 **Peer Reviewed Conference**

1. Carrasquillo-Rivera, I.; Popovic, Z.; Solis, R.A.R.; "Tunable slot antenna using varactors and photodiodes," IEEE Antennas and Propagation Society International Symposium. Digest. (Cat. No.03CH37450), p 532-5 vol.4, 2003
2. Castro-Vilaró, Amada M.; Rodríguez Solís, Rafael A.; "Tunable folded-slot antenna with thin film ferroelectric material," IEEE Antennas and Propagation Society, AP-S International Symposium (Digest), v 2, p 549-552, 2003
3. J. Colom-Ustáriz, R. Rodríguez-Solís, S. Vélez, and S. Rodríguez-Acosta, "Frequency Agile Microwave Components using Ferroelectric Materials," Proceedings of the SPIE 9th International Conference on Remote Sensing, vol. 4881, April 2003, pp. 280-286
4. López-Rivera, Néstor D.; Rodriguez-Solís, Rafael A.; "Input impedance and resonant frequency characterization for folded slot antennas through DOE techniques," IEEE Antennas and Propagation Society, AP-S International Symposium (Digest), v 2, p 545-548, 2003
5. S. Rodríguez-Acosta, R.A. Rodríguez-Solís, and J.G. Colom Ustáriz, "Design and Characterization of a Tunable Aperture Coupled Microstrip Patch Antenna with Ferroelectric Films," 2003 IEEE Antennas and Propagation International Symposium, June 2003 vol. 4, pp. 536-539.

6. Salazar-Cerreno, J.; Rodriguez-Solis, R.A.; “Broadband log-periodic normal mode helical antenna,” IEEE Antennas and Propagation Society International Symposium. Digest., p 249-52 vol.1, 2003
7. Maritza Torres, Hamed Parsiani, “Improved Subsurface Radiation Pattern Determination of 1.5 GHz SIR-20 Bow-Tie Antenna”, NOAA-CREST/NASA Symposium 2003, Talahassee, Fl, March 30-April 3, 2003.
8. Trabal del Valle, J.M.; Colom-Ustariz, J.G.; Cruz-Pol, S.L.; Sekelsky, S.M.; “Puerto Rico deployable radar network design; site survey,” 2003 IEEE International Geoscience and Remote Sensing Symposium. Proceedings (Cat. No.03CH37477), p 2353-5, vol.4, 2003

2003 **Journal**

1. J. G. Colom, R. Medina, and Y. Perez, "Simulation of single-stage tunable amplifier using ferroelectric materials," Integrated Ferroelectrics, vol. 56, pp. 1131-1140, 2003.
2. J. G. Colom, R. Medina, and R. Rodriguez, "Design of tunable balanced amplifier using ferroelectric materials," Integrated Ferroelectrics, vol. 56, pp. 1097-1106, 2003.

2002 **Peer Reviewed Conference**

1. Colom-Ustariz, José; Rodríguez-Solís, Rafael A.; Vélez, Salmir; Rodríguez-Acosta, Snaider, "Frequency agile microwave components using ferroelectric materials," Proceedings of SPIE - The International Society for Optical Engineering, v 4881, p 280-286, 2002
2. Colón-Díaz, Nivia; Cruz-Pol, Sandra L.; Sekelsky, Stephen M., "Cloud images retrieval and characterization using ground-based dual-wavelength radar at millimeter wavelengths," Proceedings of SPIE - The International Society for Optical Engineering, v 4882, p 240-249, 2002
3. Léon-Colón, Leyda; Cruz-Pol, Sandra L.; Sekelsky, Stephen M., "Active rain-gauge concept for liquid clouds using W-band and S-band doppler radars," Proceedings of SPIE - The International Society for Optical Engineering, v 4882, p 294-303, 2002
4. Lopez-Rivera, N.; Rodriguez-Solis, R.A., "Impedance matching technique for microwave folded slot antennas," IEEE Antennas and Propagation Society International Symposium (IEEE Cat. No.02CH37313), p 450-3 vol.3, 2002
5. Villa, Jorge M.; Cruz-Pol, Sandra L.; Sekelsky, Stephen M., "Performance of scanning millimeter-wave radar in a tropical environment," International Geoscience and Remote Sensing Symposium (IGARSS), v 1, p 284-286, 2002
6. Villa, Jorge M.; Cruz-Pol, Sandra L.; Colom-Ustáriz, José; Sekelsky, Stephen M., "Modeling, simulation and comparison study of cirrus clouds' ice crystals," Proceedings of SPIE - The International Society for Optical Engineering, v 4882, p 250-258, 2002

2002 Journal

2002 Magazines and Letters

1. J. G. Colom, R. A. Rodriguez-Solis, J. Almodovar, and M. Castaneda, "Design and simulation of a tunable multilayer Lange coupler," Integrated Ferroelectrics, vol. 42, pp. 313-321, 2002.

2001 Peer Reviewed Conference

1. Colom, J.G.; Cruz-Pol, S.L. (2001) Remote sensing modules to increase interest in traditionally difficult courses. Proceedings of the IEEE 2001 International Geoscience and Remote Sensing Symposium. Vol. 5. P. 2469-71.
2. J.G. Colom Ustáriz, R.R. Barton, L.A. Carpenter, and R.A. Rodríguez Solís, “A Novel Graphical Technique for Selection of a Robust Design Point,” 2001 ASEE Annual Conference and Exposition Proceedings, June 2001, Albuquerque, NM.
3. Cruz Pol, S.L.; Colón Diaz, N.; Sekelsky, S. (2001) Multidimensional cloud images retrieval from dual-frequency millimeter-wave radar. IEEE 2001 International Geoscience and Remote Sensing Symposium. Vol. 6. P. 2642-6.

2001 **Journal**

1. Cruz Pol, S., M. Vélez, J. Colom, R. Rodríguez, H. Parsiani, L. Jiménez, R. Vásquez, “Laboratory for Remote Sensing and Image Processing”, IEEE Geoscience and Remote Sensing Newsletter, Dec. 2001.

Signals and Systems

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Appendix E: Sample Program of Studies for the Different Tracks

Sample study plan for a student entering with a BS to the Signals and Systems Track: Example 1

Courses	First Semester	Credits
INEL 6001	Feedback Control Systems	3
INEL 6078	Estimation, Detection, and Stochastic Processes	3
INEL 5505	Linear Systems Analysis	3
INEL 8998	Doctoral Seminar	0
		Total 9

Courses	Second Semester	Credits
INEL 6000	Nonlinear Control Systems	3
INEL 6059	Intelligent Systems and Control	3
MATE 6025	Numerical Optimization	3
INEL 8998	Doctoral Seminar	0
		Total 9

Courses	Third Semester	Credits
INEL 6048	Digital Control Systems	3
INEL 8595	Advanced Topics in Control Systems	3
MATE 6025	Numerical Linear Algebra	3
INEL 8998	Doctoral Seminar	0
		Total 6

Courses	Fourth Semester	Credits
INEL 8595	Advanced Topics in Control Systems	3
-----------	Elective Course	3
-----------	Elective Course	3
INEL 8998	Doctoral Seminar	0
		Total 9

Qualifying Exam

Courses	Fifth Semester	Credits
INEL 8999	Doctoral Dissertation	3
INEL 8998	Doctoral Seminar	0
		Total 3

Courses	Sixth Semester	Credits
INEL 8999	Doctoral Dissertation	3
INEL 8998	Doctoral Seminar	0
		Total 3

Courses	Seventh Semester	Credits
INEL 8999	Doctoral Dissertation	3
INEL 8998	Doctoral Seminar	0
		Total 3

Courses	Eight Semester	Credits
INEL 8999	Doctoral Dissertation	3
INEL 8998	Doctoral Seminar	1
		Total 4

Sample study plan for a student entering with a BS to the Electronics Track

Courses	First Semester	Credits
INEL 6055	Solid State Electronics	3
INEL 6080	VLSI Systems Design	3
INEL 6009	Computer Architecture	3
INEL 8998	Doctoral Seminar	0
		Total 9

Courses	Second Semester	Credits
INEL 6075	Integrated Circuits Fabrication	3
INEL 5065	Analog Integrated Circuit Design	3
MATE 6026	Numerical Optimization	3
INEL 8998	Doctoral Seminar	0
		Total 9

Courses	Third Semester	Credits
INEL 6048	Advanced Microprocessor Interfacing	3
INEL 8295	Advanced Topics in Electronics	3
MATE 6025	Numerical Linear Algebra	3
INEL 8998	Doctoral Seminar	0
		Total 6

Courses	Fourth Semester	Credits
INEL 8295	Advanced Topics in Electronics	3
-----------	Elective Course	3
-----------	Elective Course	3
INEL 8998	Doctoral Seminar	0
		Total 9

Qualifying Exam

Courses	Fifth Semester	Credits
INEL 8999	Doctoral Dissertation	3
INEL 8998	Doctoral Seminar	0
		Total 3

Courses	Sixth Semester	Credits
INEL 8999	Doctoral Dissertation	3
INEL 8998	Doctoral Seminar	0
		Total 3

Courses	Seventh Semester	Credits
INEL 8999	Doctoral Dissertation	3
INEL 8998	Doctoral Seminar	0
		Total 3

Courses	Eight Semester	Credits
INEL 8999	Doctoral Dissertation	3
INEL 8998	Doctoral Seminar	1
		Total 4

Sample study plan for a student entering with a BS to the Applied Electromagnetics Track

Courses	First Semester	Credits
INEL 6216	Advanced Electromagnetics	3
INEL 6078	Estimation, Detection and Stochastic Systems	3
INEL 6115	Microwave Active Circuits	3
INEL 8998	Doctoral Seminar	0
		Total 9

Courses	Second Semester	Credits
INEL 6068	Microwave Antenna Engineering	3
INEL 6105	Active Remote Sensing Techniques	3
MATE 6677	Elementary Partially Differential Equations	3
INEL 8998	Doctoral Seminar	0
		Total 9

Courses	Third Semester	Credits
INEL 6106	Introduction to Radar Systems	3
INEL 8695	Advanced Topics in Applied Electromagnetics	3
MATE 6025	Numerical Linear Algebra	3
INEL 8998	Doctoral Seminar	0
		Total 6

Courses	Fourth Semester	Credits
INEL 8495	Advanced Topics in Power Systems	3
-----------	Elective Course	3
-----------	Elective Course	3
INEL 8998	Doctoral Seminar	0
		Total 9

Qualifying Exam

Courses	Fifth Semester	Credits
INEL 8999	Doctoral Dissertation	3
INEL 8998	Doctoral Seminar	0
		Total 3

Courses	Sixth Semester	Credits
INEL 8999	Doctoral Dissertation	3
INEL 8998	Doctoral Seminar	0
		Total 3

Courses	Seventh Semester	Credits
INEL 8999	Doctoral Dissertation	3
INEL 8998	Doctoral Seminar	0
		Total 3

Courses	Eight Semester	Credits
INEL 8999	Doctoral Dissertation	3
INEL 8998	Doctoral Seminar	1
		Total 4

Sample study plan for a student entering with a BS to the Energy Systems Track: Example 1

Courses	First Semester	Credits
INEL 6085	Analysis and Design of Power Semiconductor Circuits	3
INEL 6025	Advanced Energy Conversion	3
INEL 6055	Solid State Electronics	3
INEL 8998	Doctoral Seminar	0
		Total 9

Courses	Second Semester	Credits
INEL 6058	High Frequency Power Converters	3
INEL 6066	Control of Electric Drive Systems	3
MATE 6026	Numerical Optimization	3
INEL 8998	Doctoral Seminar	0
		Total 9

Courses	Third Semester	Credits
INEL 6096	Electric Power Quality	3
INEL 8496	Advanced Topics in Power Electronics	3
MATE 6025	Numerical Linear Algebra	3
INEL 8998	Doctoral Seminar	0
		Total 6

Courses	Fourth Semester	Credits
INEL 8496	Advanced Topics in Power Electronics	3
-----------	Elective Course	3
-----------	Elective Course	3
INEL 8998	Doctoral Seminar	0
		Total 9

Qualifying Exam

Courses	Fifth Semester	Credits
INEL 8999	Doctoral Dissertation	3
INEL 8998	Doctoral Seminar	0
		Total 3

Courses	Sixth Semester	Credits
INEL 8999	Doctoral Dissertation	3
INEL 8998	Doctoral Seminar	0
		Total 3

Courses	Seventh Semester	Credits
INEL 8999	Doctoral Dissertation	3
INEL 8998	Doctoral Seminar	0
		Total 3

Courses	Eight Semester	Credits
INEL 8999	Doctoral Dissertation	3
INEL 8998	Doctoral Seminar	1
		Total 4

Sample study plan for a student entering with a BS to the Energy Systems Track: Example 2

Courses	First Semester	Credits
INEL 6027	Dynamics and Control of Integrated Power Systems	3
INEL 5505	Linear Systems Analysis	3
INEL 6025	Advanced Energy Conversion	3
INEL 8998	Doctoral Seminar	0
	Total	9

Courses	Second Semester	Credits
INEL 6028	Optimization and Economic Operation of Integrated Power Systems	3
INEL 6077	Surge Phenomena in Power Systems	3
ESMA 6600	Probability Theory	3
INEL 8998	Doctoral Seminar	0
	Total	9

Courses	Third Semester	Credits
INEL 6026	Computational Methods for Power Systems Analysis II	3
INEL 8495	Advanced Topics in Power Systems	3
MATE 6025	Numerical Optimization	3
INEL 8998	Doctoral Seminar	0
	Total	6

Courses	Fourth Semester	Credits
INEL 8495	Advanced Topics in Power Systems	3
-----------	Elective Course	3
-----------	Elective Course	3
INEL 8998	Doctoral Seminar	0
	Total	9

Qualifying Exam

Courses	Fifth Semester	Credits
INEL 8999	Doctoral Dissertation	3
INEL 8998	Doctoral Seminar	0
	Total	3

Courses	Sixth Semester	Credits
INEL 8999	Doctoral Dissertation	3
INEL 8998	Doctoral Seminar	0
	Total	3

Courses	Seventh Semester	Credits
INEL 8999	Doctoral Dissertation	3
INEL 8998	Doctoral Seminar	0
	Total	3

Courses	Eight Semester	Credits
INEL 8999	Doctoral Dissertation	3
INEL 8998	Doctoral Seminar	1
	Total	4

Sample study plan for a student entering with a BS to the Signals and Systems Track: Example 2

Courses	First Semester	Credits
INEL 6078	Estimation, Detection, and Stochastic Processes	3
INEL 6049	Multidimensional Signal Processing	3
INEL 5046	Pattern Recognition	3
INEL 8998	Doctoral Seminar	0
		Total 9

Courses	Second Semester	Credits
INEL 6076	Adaptive and Optimal Signal Processing	3
INEL 6007	Introduction to Remote Sensing	3
ESMA 6661	Theory of Statistics I	3
INEL 8998	Doctoral Seminar	0
		Total 9

Courses	Third Semester	Credits
INEL 6050	Advanced Digital Signal Processing Algorithms	3
INEL 8395	Advanced Topics in Signal Processing	3
MATE 6025	Numerical Linear Algebra	3
INEL 8998	Doctoral Seminar	0
		Total 6

Courses	Fourth Semester	Credits
INEL 8395	Advanced Topics in Signal Processing	3
-----------	Elective Course	3
-----------	Elective Course	3
INEL 8998	Doctoral Seminar	0
		Total 9

Qualifying Exam

Courses	Fifth Semester	Credits
INEL 8999	Doctoral Dissertation	3
INEL 8998	Doctoral Seminar	0
		Total 3

Courses	Sixth Semester	Credits
INEL 8999	Doctoral Dissertation	3
INEL 8998	Doctoral Seminar	0
		Total 3

Courses	Seventh Semester	Credits
INEL 8999	Doctoral Dissertation	3
INEL 8998	Doctoral Seminar	0
		Total 3

Courses	Eight Semester	Credits
INEL 8999	Doctoral Dissertation	3
INEL 8998	Doctoral Seminar	1
		Total 4

Appendix F: Syllabuses of Existing Courses

UniversityofPuertoRico
MayagüezCampus
CollegeofEngineering
DepartmentofElectricalandComputerEngineering
BachellorofScienceinElectricalEngineering

CourseSyllabus

1. General Information:

Alpha-numeric codification:INEL 5046
CourseTitle: PatternRecognition
Numberofcredits:3
ContactPeriod: 3hoursof lectureperweek.
ElectivesinINELandICOM

2. CourseDescription:

English: An introductiontothefieldofPatternRecognition:statisticaldecisionmaking,non-parametricdecision making,clustering,artificialneuralnetworks,learningtechniques,evaluationofclassificationrulesandapplications.

Spanish: Una introducciónaláreade reconocimientodepatrones,incluyendoevaluacióndedecisionesestadísticas, evaluacióndedecisionesno-paramétricas,redesneuronales,técnicasdeaprendizaje,evaluaciónde reglasde clasificaciónyaplicaciones.

3. Pre/Co-requisitesandotherrequirements:

(INEL 4095 or INEL 4301) and (ININ 4010 or ININ 4011)

4. CourseObjectives:

Aftercompletingthecourse,the studentshouldbeable to:classifydatausingparametric,non-parametricandneural networkmethods,clusterdata,designpatternrecognitionbasedalgorithms toanalyzedata.

5. InstructionalStrategies:

☒conference ☐discussion ☐computation ☐laboratory

☐seminarwithformalpresentation ☐seminarwithout formalpresentation ☐workshop

☐artworkshop ☐practice ☐trip ☐thesis ☐specialproblems ☐tutoring

☐research ☐other,pleasespecify:

6. MinimumorRequiredResources Available:

Materials,equipment,andphysicalfacilities neededtofulfillthecourseobjectives.

7. Course time frameandthematicoutline

Outline	ContactHours
Introduction	2
ProbabilityReview	2
BayesianDecisionTheory	6
ParameterEstimation	4
Non-ParametricDecisionMaking	5
LinearDiscriminantFunctions	4
ArtificialNeuralNetworks	6
UnsupervisedLearningandClustering	5
Applications	5
AdvancedTopics	5
Exams	1
Totalhours: (equivalenttocontactperiod)	45

8. GradingSystem

☒Quantifiable(letters) ☐ NotQuantifiable

9. EvaluationStrategies (Suggested):Thefacultymemberteachingthecoursewillprovidethe studentwith theevaluationstrategyhe/shewillbeusingthroughoutthesemester. Thiswillbedonewithinthefirstweekof classes.

	Quantity	Percent
☒ Exams	1	25
☒ Final Exam	1	25
☒ ShortQuizzes	varies	10
☒ OralReports	1	5
☐ Monographies		
☐ Portfolio		
☐ Projects	1	25
☒ Journals		
☒ Other,specify: Homework	varies	10
TOTAL:		100%

10. Bibliography:

Textbook:

(1) Webb, A.R.; Copsey, K.D.; Statistical Pattern Recognition; 3rd Edition;Wiley; 2011.

References:

(2) Duda, R.; Hart, P.; Stork, D.; Pattern Classification; 2nd ed.; John Wiley; 2001. [Available at the Circulation Collection (Q327 .D83 2001)

(3) Gose, E.; Jonhsonbaugh, R.; Jost, S.; *Pattern Recognition and Image Analysis*; Prentice Hall; 1996. (Classical textbook).

(4) *Pattern Recognition: The Journal of the Pattern Recognition Society*: http://www.sciencedirect.com/science/journal/00313203.

(5) Melin, P.; *Modular Neural Networks and Type-2 Fuzzy Systems for Pattern Recognition*; Springer; 2012. http://dx.doi.org/10.1007/978-3-642-24139-0.

(6) Bunke, H.; Kandel, A.; Last, M.; *Applied Pattern Recognition*; Springer; 2008. http://dx.doi.org/10.1007/978-3-540-76831-9.

11. AccordingtoLaw51

Students will identify themselves with the Institution and the instructor of the course for purposes of assessment (exams) accommodations. For more information please call the Student with Disabilities Office which is part of the Dean of Students office (Office #4) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258 or by email at virgen.aponte@upr.edu .

12.Contribution of Course to meet the requirements of ABET Criterion5:

Math	Basic Science	General	Engineering Topic
			√

13.CourseOutcomes **Mapto Program Outcomes**

- Apply statisticaltechniquestocomputedecisionbounaries (a)
- Applyhistogramandkernelestimatestointerpretdata (b)
- Applyfeaturereductionmethods (a)
- Applysimilarity metricsandcriteriastoclusterdata (k)
- Developa classificationsystemforgivendata (e)
- Trainneuralnetworkswithdifferentlearningrules (a)
- Applyneuralnetworktosolvea classificationproblem (k)
- Performliteraturesurveyonapatternrecognitiontopic (i)
- Performtheanalysisofa patternrecognitionsystem (g)
- Evaluatetheperformanceofclassifiersystemsondata (k)

Person(s) who prepared this description and date of preparation: Luis O. Jiménez-Rodríguez, February 2013.

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachellor of Science in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 5205
Course Title: Instrumentation
Number of credits: 3
Contact Period: 3 hours of lecture per week
Elective in INEL

2. Course Description:

English: Signals from transducers; signal conditioning, data conversion and transmission; effects of noise. Data storage and display; use of microprocessors in instrumentation.

Spanish: Transductores y sus señales; acondicionamiento de señales, transmisión y conversión de datos; efectos de ruido. Despliegue y almacenamiento de datos; uso de microprocesadores para instrumentación.

3. Pre/Co-requisites and other requirements:

INEL 4202 and INEL 4206

4. Course Objectives:

Understand the principles of operation of various types of transducers.
Analyze and design signal conditioning and transmission circuits.
Design and implement an electronic measuring instrument that meets a given a set of specifications.

5. Instructional Strategies:

☒conference ☒discussion ☒computation ☒laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Electronic measurement equiment, electronic components, data acquisition systems, personal computers.

7. Course time frame and thematic outline

Outline	Contact Hours
Introduction	1
Operational Amplifiers and Configurations	6
Signal Conditioning Circuits	8
Transducers (Temperature, displacement, pressure, flow, etc.)	15
Shielding and Grounding Practices	3
Optoelectronic devices	5
Noise in Electronic Circuits	2
Data Acquisition	3
Exams	2
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies (Suggested): The faculty member teaching the course will provide the student with the evaluation strategy he/she will be using throughout the semester. This will be done within the first week of classes.

	Quantity	Percent
☒ **Exams**	**2**	**40**
☒ **Final Exam**	**1**	**20**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		

	☒ **Projects**	**1**	**30**
	☐**Journals**		
	☒**Other, specify: Homework**	**Variable**	**10**
	TOTAL:		**100%**

10. Bibliography:

Textbook:

1. Morris, A.L., Langari, R.; Measurement and Instrumentation: Theory and Applications; ISBN: 978-0-12-381960-4; Butterworth-Heinemann; 2011.

Additional References:

2. Glisson, T.H.; Operational Amplifiers II: AC Model and Applications; Introduction to Circuit Analysis and Design, Chapter 7; Springer; 2011.
3. Zhang, T.; Instrumentation, Measurement, Circuits and Systems; Springer; 2012.
4. Proulx, T.; Sensors, Instrumentation and Special Topics, Volume 6; Springer; 2011.
5. IEEE Instrumentation and Measurement Magazine; *ieee.org*.
6. Pasini, G.; Peretto, L.; Tinarrelli, R.; Study of the Acuracy Requirements of the Instrumentation for Efficiency Measurements is Power Conversion Systems; IEEE Transactions on Instrumentation and Measurement; Vol. 62, Issue 8, 2013, pp.2154-2160 *http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6553185*

11. According to Law 51

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12. Contribution of Course to meeting the requirements of Criterion 5:

Math	Basic Science	General	Engineering Topic
			√

13. Course Outcomes	**Map to Program Outcomes**
1. Understand the principles of operation of various types of transducers.	(a)
2. Analyze and design signal conditioning and transmission circuits.	(e)
3. Use modern engineering tools (MATLAB, LabVIEW, PSPICE…) for the design and implementation of an electronic instrument.	(k)
4. Design and implement an electronic measuring instrument that meets a given a set of specifications.	(c)
5. Preparation of an oral and written report about the final project.	(g)
6. Calibrate and test the instrument developed in class.	(b)
7. Work as part of a team.	(d)

Person(s) who prepared this description and date of preparation: Eduardo J. Juan, Submitted by: Guillermo Serrano, May 11, 2013.

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachellor of Science in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 5207
Course Title: ANALOG SYSTEMS DESIGN
Number of credits: 3
Contact Period: 3 credit hours, 3 hours of lecture per week
Elective in INEL

2. Course Description:

English: This course focuses on the design of analog integrated circuits' applications. It covers the characteristics and limitations of operational amplifiers in detail. Linear and non-linear applications, such as signal generators, voltage references, voltage regulators, A-D and D-A converters, logarithmic amplifiers, phase-lock-loops and analog filters are also discussed.

Spanish: Este curso esta enfocado al diseño de aplicaciones de circuitos análogos integrados. Cubre en detalle las características y limitaciones de los amplificadores operacionales. También discute aplicaciones lineares y no lineares, tales como generadores de onda, reguladores de voltaje, Voltajes de referencia, Convertidores AD y DA, amplificadores logarítmicos, PLLs y filtros análogos.

3. Pre/Co-requisites and other requirements:

INEL4201 and INEL4205

4. Course Objectives:

Design and analysis of applications using operational Amplifiers

5. Instructional Strategies:

☒conference ☒discussion ☐computation ☐laboratory

☒seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

7. Course time frame and thematic outline

Outline	Contact Hours
1. Course Introduction	1
2. Operational Amplifier (OA) Fundamentals (Chapter 1 in textbook;)	2
3. Examples of Linear OA Circuits (Instructor notes;)	3
4. Examples of Non-linear OA Circuits (Instructor notes;)	2
5. OA Limitations (Chapter 5 in textbook;)	5
6. Stability and Frequency Compensation (Ch. 6 in textbook)	3
7. Noise (Chapter 14 in textbook)	3
8. Current-feedback amplifiers (Instructor notes)	3
9. OA Building Blocks and Analog Integrated Circuits a) Active filters types and design methods (Chapters 3 and 4 in textbook) b) Signal generator (Chapter 8 in textbook) c) Voltage references (Chapter 9 in textbook) d) D/A and A/D Converters (Chapter 11 in textbook) e) Logarithmic Amplifiers (Chapter 12 in textbook) f) Phase-lock loops (instructor notes)	 6 3 3 3 3 4
Total hours: (equivalent to contact period)	44

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies (Suggested): The faculty member teaching the course will provide the student with the evaluation strategy he/she will be using throughout the semester. This will be done within the first week of classes.

	Quantity	Percent
☒ **Exams**	**3**	**75%**
☐ **Final Exam**		
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**25%**
☐ **Journals**		
☐ **Other, specify:**		
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Franco, S.; Design with Operational Amplifiers and Analog Integrated Circuits; Third Edition, ISBN: 0-07-021857-9;

References: (2) Vashchenko, V.A.; Shibkov, A.; ESD Design for Analog Circuits; Springer; 2010

(3) Steyaert, M.; van Roermund, A.H.M.; Analog Circuit Design; Springer; 2009

(4) Onabajo, M.; Silva-Martinez, J.; Analog Circuit Design for Process Variation-Resilient Systems-on-a-Chip, Springer; 2012

11. According to Law 51

Students will identify themselves with the Institution and the instructor of the course for purposes of assessment (exams) accommodations. For more information please call the Student with Disabilities Office which is part of the Dean of Students office (Office #4) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258 or by email at virgen.aponte@upr.edu .

12. Contribution of Course to meeting the requirements of Criterion 5:

Math	Basic Science	General	Engineering Topic
			√

13. Course Outcomes **Map to Program Outcomes**

1. Design and analysis of amplifiers (a)
2. Analog characteristics and limitations (b)
3. Design of applications to solve problem (e)
4. Be aware of Ethical Considerations (f)

Person(s) who prepared this description and date of preparation: Manuel Toledo,
Submitted by: Gladys O. Ducoudray, Feb 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachellor of Science in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 5209
Course Title: Introduction to Solid State Electronics
Number of credits: 3
Contact Period: 3 credit hours, 3 hours of lecture per week
Elective in INEL

2. Course Description:

English: Energy levels in atoms. Crystal properties, energy bands and charge carriers, semiconductors, transport properties of bulk materials. P-n junction diodes, bipolar transistors, field effect transistors

Spanish: Niveles de energia en átomos. Propiedades de cristales, bandas de energía, portadores de carga, semiconductores, propiedades de transporte de sustratos. Diodos de juntas p-n, transistores bipolares y transistores de efecto de campo.

3. Pre/Co-requisites and other requirements:

IINEL 4201

4. Course Objectives:

In this course the student will:

Determine the probability that an energy state at energy E is occupied by an electron, carrier statistics of semiconductor and Fermi-Dirac statistics .
Aqcuire the fundamental understanding of semiconductor physics that will allow them to desing semiconductor devices.
Solve the Schodinger awave equation for particular situations.
Design solid-state transistors, and diodes, given a list of materials to select.
Be introduced to the most recent advances in solid-state electronics and micro-electro-mechanical systems.
Search for scientific articles and analyze them in terms of their scientific content and potential applications of the technology described.

5. Instructional Strategies:

☒conference ☒discussion ☒computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

1COMSOL Multiphysics software

7. Course time frame and thematic outline

Outline	Contact Hours
Semiconductor Crystal Structures	4
Electronic Structure and Quantum Effects	4
Charge Carriers and Energy Band	7
Excess Carriers	5
The p-n Junction	7
Field Effect Transistors	5
Bipolar Junction Transistors	5
Optoelectronics	5
Tests	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies (Suggested): The faculty member teaching the course will provide the student with the evaluation strategy he/she will be using throughout the semester. This will be done within the first week of classes.

	Quantity	Percent
☐ **Exams**	**3**	**45**
☒ **Final Exam**	**1**	**25**
☐ **Short Quizzes**		
☒ **Oral Reports**	**4**	**15**
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**15%**
☐ **Journals**		
☐ **Other, specify:**		
TOTAL:		**100%**

10. Bibliography:

Textbook:

1. Streetman, B.G., Banerjee, S.; Solid State Electronic Devices; 6th ed.; ISBN: 013149726X; Prentice Hall.

Additional References:

2. Razegui, M.; Fundamentals of Solid State Engineering; Springer; 2009.
3. Schomburg, W.K.; Introduction to Microsystem Design; Springer; 2011.
4. Johnson, B.; Molnar, A.; An Orthogonal Current-Reuse Amplifier for Multi-Channel Sensing; IEEE Journal of Solid-State Circuits; Vol. 48 Issue 6; 2013; pp. 1487-1496 http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6510003

11. According to Law 51

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12. **Contribution of Course to meeting the requirements of Criterion 5:**

Math	Basic Science	General	Engineering Topic
			√

13. Course Outcomes

Map to Program Outcomes

1. The student will be able to determine the probability that an energy state at energy E is occupied by an electron, carrier statistics of semiconductor and Fermi-Dirac statistics .The student will aqcuire the fundamental understanding of semiconductor physics that will allow them to desing semiconductor devices.The student will be able to solve the Schodinger awave equation for particular situations. 1 — (a)
2. The student will be able to design solid-state transistors, and diodes, given a list of materials to select. — (e)
3. Students will be introduced to the most recent advances in solid-state electronics and micro-electro-mechanical systems. 3 — (j)
4. The students will search for scientific articles and analyze them in terms of their scientific content and potential applications of the technology described..

Person(s) who prepared this description and date of preparation: : Gladys O. Ducoudray, March, 2013. Submitted by: Gladys O. Ducoudray, March, 2013.

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachellor of Science in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 5265
Course Title: Analog Integrated Circuit Design
Number of credits: 3
Contact Period: 3 credit hours, 3 hours of lecture per week
Elective in INEL and ICOM

2. Course Description:

English: Design and Analysis of analog and mixed signal integrated circuits through the usage of analytical circuit design techniques and advanced cad tools. Discussion of issues involved in the layout and test of analog IC's.

Spanish: Análisis y Diseño de circuitos analógicos y de tecnología mixta (analógico-digital) mediante el uso de técnicas de diseño analíticas y herramientas avanzadas de diseño asistido por computadoras. Discusión de tópicos referentes al diseño físico y desarrollo de pruebas funcionales de circuitos integrados analógicos.

3. Pre/Co-requisites and other requirements:

INEL 4205 and INEL 4201.

4. Course Objectives:

To develop in the students the fundamental skills in the design and analysis of analog and mixed signal integrated circuits using advanced CAD tools, and to provide an understanding of the central issues involved in the layout and test of such a type of circuits.

5. Instructional Strategies:

☒conference ☒discussion ☐computation ☒laboratory

☒seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☒special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Basic Knowledge of Cadence Design Tools. All students are expected to have basic notions on:
1- Design techniques for digital circuits
2- Familiarity with transistor operation
3- Spice circuit modeling and simulation

7. Course time frame and thematic outline

Outline	Contact Hours
Models for large and small signal IC devices.	3
Model considerations in evolving technological trends.	3
Introduction to CAD tools for analog design.	6
Concepts of analog layout, Bipolar, MOS, and BiCMOS technologies.	2
Basic integrated circuit amplifiers: Darlington, differential pairs, and cascode configurations.	2
Dynamic range considerations in integrated amplifier circuits.	1
Current sources, active loads, and reference circuits.	3
Operational amplifier architectures: analysis and design considerations	3
Frequency response of ICs, feedback analysis, and stability.	1
Issues in the design of mixed signal ICs.	2
Test and measurement techniques of analog and mixed signal ICs.3	2
Total hours: (equivalent to contact period)	28

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies (Suggested): The faculty member teaching the course will provide the student with the evaluation strategy he/she will be using throughout the semester. This will be done within the first week of classes.

	Quantity	Percent
☒ **Exams**	**2**	**50%**
☐ **Final Exam**		
☐ **Short Quizzes**		
☒ **Oral Reports**	**1**	**25%**
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**25%**
☐ **Journals**		
☐ **Other, specify:**		
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Allen, P. E.; Holberg, D. R.; *CMOS Analog Circuit Design*; 3rd ed.; Oxford Univ. Press; 2012. [Available at the Circulation Collection (TK7874 .A428 2012), UPRM General Library]

Additional References:

(2) Wens, M.; Steyaert, M.; *Design and Implementation of Fully-Integrated Inductive DC-DC Converters in Standard CMOS*; Springer; 2011. http://dx.doi.org/10.1007/978-94-007-1436-6. [Available via Springer eBooks, UPRM General Library Databases]

(3) Redouté, J.-M.; Steyaert, M.; *EMC of Analog Integrated Circuits*; Springer; 2010. . http://dx.doi.org/10.1007/978-90-481-3230-0. [Available via Springer eBooks, UPRM General Library Databases]

11. According to Law 51

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12. Contribution of Course to meeting the requirements of Criterion 5:

Map to Program Outcomes

Math	Basic Science	General	Engineering Topic
			√

13. Course Outcomes

1. Analysis of medium complexity Analog and Mixed Signal Circuits (b)
2. Competence in Cadence Tools for Analog Environment (k)
3. Design Layout Mask generation of analog circuits (c)

Person(s) who prepared this description and date of preparation: Gladys O. Ducoudray, March 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachellor of Science in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 5307
Course Title: Optical Communication
Number of credits: 3
Contact Period: 3 hours of lecture per week
Elective in INEL and ICOM

2. Course Description:

English: Fiber Optic Communications systems, Optics, Light Wave Fundamentals, Integrated Optic Waveguides, Optic Fiber Waveguides, Light Sources and Detectors, Optical LAN Distribution, and Modulation.

Spanish:

3. Pre/Co-requisites and other requirements:

Prerequisite INEL 4301 & INEL 4152

4. Course Objectives:

This course is designed to introduce 5th year students to important results from the fields of optics and wave travel, fiber optic devices and systems, technology of combining optic components onto a single substrate, fiber as a waveguide, light sources, detectors, couplers, and distribution networks. After completing the course the student should be able to design and specify systems and to choose and evaluate system components such as fibers, light sources, detectors, and couplers.

5. Instructional Strategies:

☒ conference ☐ discussion ☐ computation ☐ laboratory

☐ seminar with formal presentation ☐ seminar without formal presentation ☐ workshop

☐ art workshop ☐ practice ☐ trip ☐ thesis ☐ special problems ☐ tutoring

☐ research ☐ other, please specify:

6. Minimum or Required Resources Available:

Fiber Optic Communications , Joseph C. Palais Fifth ed. 2005, Prentice Hall

7. Course time frame and thematic outline

Outline	Contact Hours
FIBER OPTIC COM. SYSTEMS	5
OPTICS REVIEW	5
LIGHT WAVE FUNDAMENTALS	10
INTEGRATED OPTIC WAVEGUIDES	5
OPTIC FIBER WAVEGUIDES	5
LIGHT SOURCES	5
LIGHT DETECTORS	4
DISTRIBUTION NETWORKS	3
Exams	3
Total hours: (equivalent to contact period)	

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies (Suggested): The faculty member teaching the course will provide the student with the evaluation strategy he/she will be using throughout the semester. This will be done within the first week of classes.

	Quantity	Percent
☒ **Exams**	**3**	**60**
☒ **Final Exam**	**1**	**28**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**12**
☐ **Journals**		
☐ **Other, specify:**		
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Palais, J.; Fiber Optics Communications; 5th Edition; John Wiley and Sons; 2004. (Classical textbook).

Additional References:

(2) Noé, R.; *Essentials of Modern Optical Fiber Communication*; Springer; 2010. http://dx.doi.org/10.1007/978-3-642-04872-2. [Available via Springer eBooks, UPRM General Library Databases]

(3) Azadeh, M.; *Fiber Optics Engineering*; Springer; 2009. http://dx.doi.org/10.1007/978-1-4419-0304-4. [Available via Springer eBooks, UPRM General Library Databases]

(4) Dimitrov, S.; Haas, H.; Information Rate of OFDM-Based Optical Wireless Communication Systems with Nonlinear Distortion; *IEEE Journal of Lightwave Technology*; Vol.31, no.6, 2013, pp. 918-929. http://dx.doi.org/10.1109/JLT.2012.2236642. [Available via IEEE Xplore, UPRM General Library Databases]

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12. Contribution of Course to meeting the requirements of Criterion 5:

Math	Basic Science	General	Engineering Topic
			√

13. Course Outcomes	**Map to Program Outcomes**
1. Learn the application of fiber optics in communications	(a)
2.	
3. Ability to use optics and trace correctly a ray through them	(a)
4. Ability to analyze and understand how ray and wave theories can be used to explain the behavior of light in a fiber	(b)
5. Know the functioning of integrated optics	(a)
6. Understand the functioning of different fibers as communication waveguides.	(a)
7. Ability to determine the data rate in different types of fibers	(b)
8. Know how the light sources (lasers) work and how they can be modulated either in a digital or analog format.	(b)
9. Know how different light detectors work	(a)
10. Ability to design a complete optical fiber system for a given data rate	(k)
11. Learn to use optical devices such as directional couplers, star couplers, etc. to create an optical distribution network	

Person(s) who prepared this description and date of preparation: Hamed Parsiani. Submitted by: Hamed Parsiani., July 2013.

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachellor of Science in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL5309
Course Title: Digital Signal Processing
Number of credits: 3
Contact Period: 3 hours of lecture per week
Elective in INEL and ICOM

2. Course Description:

English: Signal Classification; Z-transform and discrete Fourier transform; matrix representation of digital filters and digital systems; digital filter design; discrete Fourier transform algorithms.

Spanish: Clasification de señales, transormada de Z y transformada discreta de fourier; representaciones matriciales de filtros y sistemas digitales; diseño de filtros digitales; algoritmos de la transformada discreta de fourier.

3. Pre/Co-requisites and other requirements:

INEL 4301

4. Course Objectives:

After completing the course, the student should be able to: analyze discrete signals and systems using the DFT, DTFT and Z transforms; design FIR and IIR discrete filters; analyze discrete signals using the DFT.

5. Instructional Strategies:

☒conference ☐discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

7. Course time frame and thematic outline

Outline	Contact Hours
Introduction to DSP	1
Discrete Signals	4
Discrete Systems	4
Discrete Time Fourier Transform	4
Discrete Fourier Transform	4
Spectral Analysis	2
Z Transform	5
Frequency Representation of systems	3
Sampling and Reconstruction	3
Filter Specifications	3
IIR filter design	5
FIR filter design	4
Exams	3

	Total hours: (equivalent to contact period)	45	

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

(Suggested): The faculty member teaching the course will provide the student with the evaluation strategy he/she will be using throughout the semester. This will be done within the first week of classes.

	Quantity	Percent
☒ **Exams**	**3**	**60**
☒ **Final Exam**	**1**	**30**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☐ **Projects**		
☐ **Journals**		
☒ **Other, specify: Homeworks**	**3 or more**	**10**
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Mitra, S.; *Digital Signal Processing: A Computer Based Approach*; 4th ed.; McGraw Hill; 2010.

Additional References:

(2) Karrenberg, U.; *Signals, Processes, and Systems: An Interactive Multimedia Introduction to Signal Processing*; 3rd ed.; Springer; 2013.

(3) Dutoit, T.; Marqués, F. *Applied Signal Processing*; Springer; 2009. http://dx.doi.org/10.1007/978-0-387-74535-0. [Available via Springer eBooks, UPRM General Library Databases]

(4) Couillet, R.; Debbah, M.; Signal Processing in Large Systems: A New Paradigm; *IEEE Signal Processing Magazine*; Vol.30, no.1, 2013, pp. 24-39. http://dx.doi.org/10.1109/MSP.2012.2207490. [Available via IEEE Xplore, UPRM General Library Databases]

11. According to Law 51

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12. Contribution of Course to meeting the requirements of Criterion 5:

Math	Basic Science	General	Engineering Topic
			√

13. Course Outcomes

Map to Program Outcomes

1. Compute the DFT, DTFT and Z transforms (a)
2. Apply the DFT and DTFT for the spectral analysis of discrete signals (b)
3. Apply the DTFT and Z-transform for the analysis of discrete systems (a)
4. Perform operations such as convolution, addition and multiplication of sequences (a)
5. Determine system properties such as linearity, causality, time invariance,… (a)
6. Calculate the transfer function and frequency response of discrete LTI systems (a)
7. Use and explain the Nyquist theorem for sampling and reconstruction of continuous band limited signals (a)
8. Design discrete IIR and FIR filters based on specifications (c)
9. Use of MATLAB for analysis and design of discrete time systems (k)
10. Determine the inverse Z transform using the partial fractions expansion method (a)

Person (s) who prepared this description and date of preparation: Shawn Hunt. Submitted by: Miguel Vélez, jul 07.
Revised by Lizdabel Morales, September 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachellor of Science in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 5315
Course Title: Theory of Communications II
Number of credits: 3
Contact Period: 3 hours of lecture
Elective in INEL

2. Course Description:

English: Preface: Information Theory. Coding Theory. Signal Design. Noise and Probability Error.

Spanish: Prefacio: Teoría de Información. Teoría de Códigos. Diseño de Señales. Ruido y Probabilidad de Error.

3. Pre/Co-requisites and other requirements:

ININ 4011 and INEL 4301

4. Course Objectives:

Theory of communications II (INEL 5315) helps students to discover the theoretical Underpinnings of modern telecommunication systems. After studying random processes the student should be able to: analyze systems driven by random signals and subjected to noise, calculate the information content of signals to help attain efficient transmission, discuss various error-control mechanisms for reliable communications over noisy channels.

5. Instructional Strategies:

☒conference ☐discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☒other, please specify: (Short) Project. Take-home problems.

6. Minimum or Required Resources Available:

Materials, equipment, and physical facilities needed to fulfill the course objectives.

7. Course time frame and thematic outline

Outline	Contact Hours
Background and preview	1
Random processes: Stationary processes; Ergodic processes; Power spectral density; Gaussian process	6
Random processes: Narrowband noise. Representations in-phase and in-quadrature, envelope and phase. Application: flat fading channel	4
Elements of information theory: Entropy and information. Source-coding theorem. Data compaction.	5
Elements of information theory: Discrete memoryless channels. Mutual information. Channel capacity. Channel-coding theorem. Differential entropy and mutual information. Information capacity theorem	8
Error-control coding: Linear block codes. Cyclic codes. Convolutional	9

codes.Trellis-coded modulation	
Error-control coding: Introduction to compound codes (Turbo codes)	1
Baseband and passband digital transmission	8
Spread-spectrum modulation	1
Exams	2
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

(Suggested): The faculty member teaching the course will provide the student with the evaluation strategy he/she will be using throughout the semester. This will be done within the first week of classes.

	Quantity	Percent
☒ **Exams**	**2**	**50**
☒ **Final Exam**	**1**	**25**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**10**
☐ **Journals**		
☒ **Other, specify: Take-home, papers and oral reports.**	**2**	**15**
TOTAL:		**100%**

10. Bibliography:

Textbook:
(1) Ziemer, R.E.; Tranter, W.H.; *Principles of Communications: Systems Modulation and Noise*; 6th ed.; Wiley; 2009.
Additional References:
(2) Jay Kuo, C.C.; Tsai, S.H.; *Precoding Techniques for Digital Communication Systems*; Springer; 2008. http://dx.doi.org/10.1007/978-0-387-71769-2. [Available via Springer eBooks, UPRM General Library Databases]
(3) Zeng, D.; *Advances in Control and Communication*; Springer; 2012. http://dx.doi.org/10.1007/978-3-642-26007-0. [Available via Springer eBooks, UPRM General Library Databases]
(4) Alencar, M., Da Rocha, V.C.; *Communication Systems*; Springer; 2005. (Classical textbook). http://dx.doi.org/10.1007/b138483. [Available via Springer eBooks, UPRM General Library Databases]
(5) Stuber, G.L.; *Principles of Mobile Communication*; Springer; 2012. http://dx.doi.org/10.1007/978-1-4614-0364-7. [Available via Springer eBooks, UPRM General Library Databases]

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12. Contribution of course to meeting the requirements of Criterion 5

Math	Basic Science	General	Engineering Topic
			√

12. Course Outcomes	Map to ABET Outcomes
1. Apply random process models for the analysis of communication systems	a
2. Develop analytical and computational skills to analyze data transmission in white Gaussian noise.	a, k
3. Analyze the importance of M-ary data communication systems.	a
4. Evaluate communication systems using information theory.	a
5. Apply methods that provide data integrity using forward error correcting codes.	a

Person who prepared this description and date of preparation: Approved by Miguel Vélez abril 08. Revised by Lizdabel Morales, September 2013.

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachellor of Science in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL5327
Course Title: Image Processing
Number of credits: 3
Contact Period: 3 hours of lecture per week
Elective in INEL and ICOM

2. Course Description:

English: Mathematical representation of 2-D digital signals. 2 D-filter design. Image coding standards. Image filtering, enhancement and comprensiion.

Spanish: Representación matemática de señales digitales de dos dimensiones. Diseño de filtros de dos dimensiones. Codificiación de imágenes. Filtraje, rexantación y comprensión de imágenes.

3. Pre/Co-requisites and other requirements:

INEL 5309, Digital Signal Processing

4. Course Objectives:

5. Instructional Strategies:

☒conference ☒discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

7. Course time frame and thematic outline

Outline	Contact Hours
Introduction	5
Digital Image fundamentals	5
Image Enhancement in Spatial domain	9
Image Enhancement in Frequency domain	8
Image Restoration	10
Image Compression	8
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies (Suggested): The faculty member teaching the course will provide the student with the evaluation strategy he/she will be using throughout the semester. This will be done within the first week of classes.

	Quantity	Percent
☒ **Exams**	**2**	**40**
☒ **Final Exam**	**1**	**25**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**2**	**35**
☐ **Journals**		
☐ **Other, specify:**		
TOTAL:		**100%**

10. Bibliography:

(1) Petrou, M.; *Image Processing: The Fundamentals*; 2nd ed.; Wiley; 2010.

Additional References:

(2) Umbaugh, S.E; *Digital Image Processing and Analysis: Human and Computer Vision Applications with CVIP tools*; 2nd ed.; CRC Press; 2010.

(3) Gonzalez, R.; Woods, R.; Eddins, S.L.; *Digital Image Processing Using MATLAB*; 2nd ed.; Gatesmark Publishing; 2009.

(4) Gonzalez R.; Woods, R.; *Digital Image Processing*, 3rd ed., Prentice Hall; 2008. [Available at the Circulation Collection (TA1632 .G66 2008), UPRM General Library]

(5) R. Kountchev; K. Nakamatsu; *Advances in Reasoning-Based Image Processing Intelligent Systems*; Springer; 2012. http://dx.doi.org/10.1007/978-3-642-24693-7. [Available via Springer eBooks, UPRM General Library Databases]

(6) Yin X.; Ng B.W.-H.; Abbott D.; *Terahertz Imaging for Biomedical Applications*; Springer; 2012. http://dx.doi.org/10.1007/978-1-4614-1821-4. [Available via Springer eBooks, UPRM General Library Databases]

(7) Ram, I.; Elad, M.; Cohen, I.; Image processing using smooth ordering of its patches; *IEEE Transactions Image Processing*; Vol. 22, no.7, 2013, pp. 2764-2774. http://dx.doi.org/10.1109/TIP.2013.2257813. [Available via IEEE Xplore, UPRM General Library Databases]

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12. Contribution of Course to meeting the requirements of Criterion 5:

Math	Basic Science	General	Engineering Topic
			√

13. Course Outcomes — **Map to Program Outcomes**

Course Outcome	Map to Program Outcomes
1. Sensing, acquisition, sampling, and relationships in Digital image	(a)
2.	
3. Describe relationships in Digital image	(b)
4. Ability to enhance images using spatial transformations & spatial filters	(k)
5. Ability to smoothen & sharpen images using frequency domain filters	(k)
6. Restoration of images due to noise and degradations	(k)
7. Compression of images using different coding techniques	(k)
8.	

Person(s) who prepared this description and date of preparation: Hamed Parsiani. Submitted by: Miguel Vélez, Julio 07. Revised by Luis O. Jiménez Rodríguez, February 2013.

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachellor of Science in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 5406
Course Title: DESIGN OF TRANSMISSION AND DISTRIBUTION SYSTEMS
Number of credits: 3
Contact Period: 45 hours (Elective in INEL)

2. Course Description:

English: Design of electric power distribution systems with special attention to distribution transformer connections and energy rates. Transmission line design with emphasis on conductor selection, sag and tension. Review of transmission line parameters..

Spanish: Diseño de sistemas de distribución con énfasis en conexión de transformadores y tarifas de energía. Diseño de líneas de transmisión con énfasis en la selección de conductores, tensión y vano en la línea. Repaso de parámetros de líneas de transmisión.

3. Pre/Co-requisites and other requirements:

Prerequisite: INEL 4415

4. Course Objectives:

The purpose of this course is to prepare students to be proficient in designing interior and exterior illumination systems.

5. Instructional Strategies:

☒conference ☒discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

All students are expected to bring a solid background in electric systems analysis. Students must work on projects by applying the technics discused in class.

7. Course time frame and thematic outline

Outline	Contact Hours
Light, eye, and vision	1.5
Color	1.5
Photometric units and terminology	2
Light sources	10
Optics and control of light	3
Luminaries	3
Lighting economics	3

Interior lighting design	9
Exterior lighting design	9
Exams	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies (Suggested): The faculty member teaching the course will provide the student with the evaluation strategy he/she will be using throughout the semester. This will be done within the first week of classes.

	Quantity	Percent
☒ **Exams**	**3**	**60%**
☒ **Final Exam**	**1**	**30%**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	1	**10%**
☐ **Journals**		
☐ **Other, specify: Homework**	_____	
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Gönen, T.; *Electric Power Distribution System Engineering;* CRC; 2008.

Additional References:

(2) Zhang, X.P.; Rehtanz, C.; Pal, B.; *Flexible AC Transmission Systems: Modelling and Control*; Springer; 2012. http://dx.doi.org/10.1007/978-3-642-28241-6. [Available via Springer eBooks, UPRM General Library Databases]

(3) Glover, J. D.; Sarma, M.S., Overbye, T.J.; *Power System Analysis and Design*; Cengage Learning; 2012. [Available at the Circulation Collection (TK1005 .G57 2012), UPRM General Library]

(4) Gönen, T.; *Electric Power Transmission System Engineering: Analysis and Design*; 2nd ed.; CRC Press; 2009.

(5) Haarla, L.; Koskinen, M.; Hirvonen, R.; Labeau, P.E.; *Transmission Grid Security*; Springer; 2011. http://dx.doi.org/10.1007/978-0-85729-145-5. [Available via Springer eBooks, UPRM General Library Databases]

(6) *IEEE Transactions on Power Delivery*. http://ieeexplore.ieee.org/servlet/opac?punumber=61. [Available via IEEE Xplore, UPRM General Library Databases]

(7) Kim, J.C.; Cho, S.M.; Shin, H.S.; Advanced power distribution systems configuration for smart grid; *IEEE Transactions on Smart Grid*; Vol. 4, no. 1, 2013, pp. 353-358. http://dx.doi.org/10.1109/TSG.2012.2233771. [Available via IEEE Xplore, UPRM General Library Databases]

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Contribution of Course to meeting the requirements of Criterion 5:

Math	Basic Science	General	Engineering Topic
			√

12. Course Outcomes | **Map to Program Outcomes**

Course Outcomes	Map to Program Outcomes
1. The student is able to apply mathematics and science fundamentals to solve or to analyze an engineering problem or principle within the course material.	(a)
2. The students are able to follow logical and orderly design procedures, and complete a design to meet the given set of specification. The students document the design process, and include considerations of codes and engineering standards related to the design area.	(c)
3. Students are able to compare different alternatives to present a suitable solution. Their solution shows their ability of physical thinking, approximation and simplification.	(e)
4. The work complies with safety standards, and their final design solution avoids ethical compromises.	(f)
5. The students work reflect proper use of the language (Spanish or English) and their ability to communicate graphically using schematics, tables, mathematical equations, and any necessary technical documentation.	(g)
6. Students prove their ability to find information related to their discipline by including a reference list of articles related to their course work.	(i)
7. Students discuss different alternatives to solve their problem with emerging technologies and their associated cost, and comment on their importance and how they cope with the needs of their design.	(j)
8. Students are able to make an appropriate choice and use of specialized tools, and software to complete a design.	(k)

Person(s) who prepared this description and date of preparation: Lionel R. Orama. Submitted by: Lionel R. Orama, June, 19, 2008, Committee Coordinator; Updated by Eduardo Ortiz, October 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachellor of Science in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 5407
Course Title: COMPUTER AIDED POWER SYSTEM DESIGN
Number of credits: 3
Contact Period: 45
Elective in INEL

2. Course Description:

English: Design of power systems using digital computers; load flow, economic load dispatch, symmetrical and unsymmetrical faults. Selection of breakers.

Spanish: Diseño de sistemas de potencia haciendo uso de la computadora digital: flujo de potencia, despacho económico de generación, fallas simétricas y asimétricas, selección de interruptores.

3. Pre/Co-requisites and other requirements:

INEL 4415

4. Course Objectives:

This course is designed to give students in electric power engineering a comprehensive experience in the computer aided design of power systems. The students will apply knowledge gained from previous courses in the solution of practical problems.

5. Instructional Strategies:

☒conference ☒discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☒special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

All students are expected to bring a solid background in electric power systems analysis. Students must work on projects by applying the algorithms discussed in class.

7. Course time frame and thematic outline

Outline	Contact Hours
Representation of power system components	2
Load flow solution using computers	11
Symmetrical and unsymmetrical fault analysis	11
Economic load dispatch	11
Calculation of interrupting duty of breakers	10
Total hours: (equivalent to contact period)	45

8. Grading System

☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies:

(Suggested): The faculty member teaching the course will provide the student with the evaluation strategy he/she will be using throughout the semester. This will be done within the first week of classes.

	Quantity	Percent
☐ Exams		
☐ Final Exam		
☐ Short Quizzes		
☐ Oral Reports		
☐ Monographies		
☐ Portfolio		
☒ Projects	4	100%
☐ Journals		
☐ Other, specify: Homework	_____	
TOTAL:		100%

10. Bibliography:

Textbook:

(1) Glover, J.D.; Power System Analysis and Design; 3rd Ed.; Pacific Grove, CA, Brooks/Cole, Inc.; 2002.

Additional References:

(2) Stojkovic, Z.; Computer – Aided Design in Power Engineering; Springer; 2012.

(3) Wan, X.; Electrical Power Systems and Computers; Springer; 2011.

11. According to Law 51

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12. Contribution of Course to meeting the requirements of Criterion 5:

Math	Basic Science	General	Engineering Topic
			√

12. Course Outcomes

	Map to Program Outcomes
-Possess sufficient knowledge of power system analysis and operation, including short circuits to plan system expansion.	(a)
-Be able to apply computer simulation and analysis to the solution of power system problems.	(c)
-Students are able to compare different alternatives to present a suitable solution. Their solution shows their ability of physical thinking, approximation and simplification	(e)
-Students are able to write a project report or paper for each mini-project.	(g)
-Students prove their ability to find information related to the stated problems by including a reference list of articles related to their course work. The references are included and discussed in their report.	(i)
-Students discuss different alternatives to solve their problem.	(k)
-Students are able to make an appropriate choice and use of specialized tools, software, or hardware to complete a design or to collect and analyze data.	

Person(s) who prepared this description and date of preparation: Lionel R. Orama. Submitted by: Lionel R. Orama, Jun 2008. Updated by Eduardo Ortiz, October 2013.

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachellor of Science in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 5408
Course Title: Electric Motors Control
Number of credits: 3
Contact Period: 3 hours of lecture per week
Elective in INEL

2. Course Description:

English: Electric motor drive systems, modeling of D.C and A.C machines, Characteristics and selection, analysis and design of converter fed open loop and closed loop D.C and A.C drive systems, design of controllers, braking methods

Spanish:

3. Pre/Co-requisites and other requirements:

INEL4405, INEL4416 and INEL4505

4. Course Objectives:

After completing the course, students will be able to understand the basic architecture and methodology for the design of open loop and closed loop electric drives. Students will also be able to select drives according to applications, taking into consideration mechanical load and operational characteristics needed.

5. Instructional Strategies:

☒conference ☒discussion ☒computation ☒laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

P-Spice, MATLAB, and demonstration of Practical Drive Systems in Laboratory

7. Course time frame and thematic outline

Outline	Contact Hours
Introduction to Electric Drive Systems	1
Mechanical system requirements	2
Review of power converters for drive systems	3
Modeling of D.C motors	2
Phase and chopper controlled D.C drives	6
Feedback controller design	3
Polyphase induction motors-Review of steady state analysis	2
Performance calculation of voltage and current sourse inverter fed induction motors, static rotor resistance control, slip power recovery control, closed loop control of induction motor drives	10
Polyphase synchronous motors-Review of steady state analysis	2
Open loop and closed loop synchronous motor drives	4
Introduction to reluctance and permanent magnet motor drives Three class tests	3 6
Total hours: (equivalent to contact period)	44

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies (Suggested): The faculty member teaching the course will provide the student with the evaluation strategy he/she will be using throughout the semester. This will be done within the first week of classes.

	Quantity	Percent
☒ Exams	3	60
☒ Final Exam	1	30
☐ Short Quizzes		
☐ Oral Reports		
☐ Monographies		
☐ Portfolio		
☒ Projects	1	10
☐ Journals		
☐ Other, specify:		
TOTAL:		100%

10. Bibliography:

Textbook:
(1) Dubey, G.K.; 'Fundamentals of Electric Drives'; CRC Press; 2002.
Additional References:
(2) De Doncker, R., Pulle, D.; Veltman, A.; Advanced Electrical Drives; Springer; 2011.
(3) Liu, L., Li, H., Hwang, S.H., Kim, J.M.; An Energy-Efficient Motor Drive With Autonomous Power Regenerative Control System Based on Cascaded Multilevel Inverters and Segmented Energy Storage; IEEE; Volume: 41, Issue: 1; Pgs. 178 – 188; 2013.
(Link: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6359902)

11. According to Law 51

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12. Contribution of Course to meeting the requirements of Criterion 5:

Math	Basic Science	General	Engineering Topic
			√

13. Course Outcomes | **Map to Program Outcomes**

Course Outcomes	Map to Program Outcomes
1. Mechanical system requirements for electric drives	(a)
2. Modeling of D.C Motors	(a)
3. Phase and chopper controlled D.C Drives	(a)
4. Design of feedback controllers for D.C Drives	(c)
5. Design of feedback controllers for D.C Drives	(k)
6. VSI and CSI fed induction motor drives-performance calculation	(a)
7. Closed loop control and static slip power recovery scheme for induction motors	(a)
8. Closed loop induction motor drives	(e)
9. Synchronous motor drives-Performance calculation	(a)
10. Closed loop control of a synchronous motor drive system	(e)

Person(s) who prepared this description and date of preparation: Efrain O’Neill Nov. 2006
Submitted by: Eduardo I. Ortiz-Rivera, October 11, 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachellor of Science in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 5415
Course Title: Power System Protection
Number of credits: 3
Contact Period: 45
Electives in INEL

2. Course Description:

English: Design and selection of protective devices used in generation, transmission, and distribution for electrical systems: relays, fuses, breakers, reclosers, arresters. Protection coordination. Selection of other system components such as sectionalizers and throw-overs. Insulation coordination.

Spanish: Diseño y selección de dispositivos de protección usados en sistemas de generación, transmisión y distribución de energía eléctrica: relevadores, fusibles, interruptores, restauradores y pararrayos. Coordinación de protección, selección de otros componentes del sistema tales como: seccionalizadores y conmutadores de dos direcciones. Coordinación de aislación.

3. Pre/Co-requisites and other requirements:

INEL 4415

4. Course Objectives:

This is a course for majors in electric power engineering. After completing the course, the student should be able to specify and set up relays for the protection of a power system.

5. Instructional Strategies:

☒conference ☒discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☒special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

All students are expected to bring a solid background in electric power systems fundamentals. Students must always bring to class the textbook and a scientific calculator (preferably one that handles complex numbers).

7. Course time frame and thematic outline

Outline	Contact Hours
Protective Relaying Introduction & Philosophy	3
CT Performance	3
Operating Principles of Electro-Magnetic Relays	3
Current Diferential Relaying,Transformer Protection, Bus Protection	7
Electromagnetic Induction Relays	3
Directional Relays, Application of Overcurrent Relays,Case Studies	9
Distance Relays, Application Case Study	5
Step Distance Protection, Pilot Relaying, Case Study	9
Generator Protection Survey	3

	Total hours: (equivalent to contact period)	45	

8. Grading System

☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies (Suggested): The faculty member teaching the course will provide the student with the evaluation strategy he/she will be using throughout the semester. This will be done within the first week of classes.

	Quantity	Percent
☐ **Exams**		
☐ **Final Exam**		
☒ **Short Quizzes**	**7**	**80%**
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**20%**
☐ **Journals**		
☐ **Other, specify: Homework**		
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Blackburn, J. L.; Domin, T.J.; *Protective Relaying Principles and Applications*; CRC; 2013.

Additional References:

(2) Rebizant, W.; Szafran, J.; Wiszniewski, A.; *Digital Signal Processing in Power Systems Protection and Control*; Springer, 2011. [Available via Springer eBooks, UPRM General Library Databases]

(3) Wu, Q.H.; Lu, Z.; Ji, T.Y.; *Protective Relaying of Power Systems Using Mathematical Morphology*; Springer, 2009. [Available via Springer eBooks, UPRM General Library Databases]

(4) Clowe, B.; Everyday modern protective relay engineering applications: Review of interesting electric power utility events, challenges, & concern; 2012; *65th Annual Conference for Protective Relay Engineers*, 2-5 April 2012, pp.22-42. http://dx.doi.org/10.1109/CPRE.2012.6201219. [Available via IEEE Xplore, UPRM General Library Databases]

(5) Simms, J.; Johnson, G.; Protective Relying Methods for Reducing Arc Flash Energy; *IEEE Transactions on Industrial Application*s; Vol.49, no.2, 2013, pp.803-813. http://dx.doi.org/10.1109/TIA.2013.2240645. [Available via IEEE Xplore, UPRM General Library Databases]

11. According to Law 51

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12. Contribution of Course to meeting the requirements of Criterion 5:

Math	Basic Science	General	Engineering Topic
			√

13. Course Outcomes	**Map to Program Outcomes**
1. Possess sufficient knowledge of power system analysis and operation, including short circuits to specify the set up and coordination of protective relaying .	(a)
2. Understand faulted electric power system to succesfully to identify applicable protection schemes.	(a)
3. Be able to apply complex variable concepts to the solution of relaying coordination problems.	(a)
4. Be able to follow logical and orderly design procedures to choose the best solution for the relaying of the power system.	(c)
5. Be able to determine criteria to to compare the designed outcome.	(c)
6. Be aware of modern protection schemes using combination of microprocessor based relays.	(k)

Person (s) who prepared this description and date of preparation: Lionel Orama, March 2008; Submitted by Eduardo Ortiz, October 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachellor of Science in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 5505
Course Title: Linear System Analysis
Number of credits: 3
Contact Period: 3 hours of lecture per week
Elective in INEL

2. Course Description:

English: Linear spaces and matrices; state variables representations for linear continuous and discrete time systems; the Z-transform and its applications; stability; controllability and observability; state estimators.

Spanish: Espacios lineales y matrices, representación de sistemas lineales de tiempo continuo y discreto mediante variables de estado, la Transformada Z y sus aplicaciones, estabilidad, controlabilidad y observabilidad, estimadores de estado.

3. Pre/Co-requisites and other requirements:

INEL 4505.

4. Course Objectives:

Analyze linear systems and design of state-feedback controllers.
Develop dynamical models for simple linear systems using state-space representation.
Evaluate and interpret properties of linear systems such as stability, controllability, and observability.
Design state-feedback controllers for single-input single-output linear systems.
Implement the controllers using digital computers and validate its performance.

5. Instructional Strategies:

☒conference ☒discussion ☒computation ☒laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Eight workstations equipped with mechanical systems to be controlled, electrical measurements equipment, personal computers with data acquisition boards and software (Matlab, Simulink, RTW, and LabVIEW).

7. Course time frame and thematic outline

Outline	**Contact Hours**
System classification and structures	2
Introduction to linear algebra	8
Mathematical description of systems and examples of physical systems	3
The solution of the state equation	5
Linearization of dynamical systems	2
Discrete time systems, difference equations, and the Z-transform and its application	4
Discretization of continuous time systems	2
Stability of continuous and discrete time linear systems	4
Controllability and Observability State feedback an pole placement	7 4
State estimators	2
Exams	2
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies (Suggested): The faculty member teaching the course will provide the student with the evaluation strategy he/she will be using throughout the semester. This will be done within the first week of classes.

	Quantity	Percent
☒ **Exams**	**2**	**50**
☒ **Final Exam**	**1**	**20**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**20**
☐ **Journals**		
☒ **Other, specify: Homework Sets**	**4**	**10**
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Chen, C.T.; *Linear System Theory and Design*, 3rd ed.; Oxford University Press; 1999. (Classical textbook). [Available at the Circulation Collection (QA402 .C44 1999), UPRM General Library]

Additional References:

(2) Hespanha, J.; *Linear Systems Theory*, 2009; Princeton University Press; 2009.

(3) Caravani, P.; *Modern Linear Control Design*, Springer, 2013

(4) Arico, A.; Donatelli, M.; Nagy, J.; *Numerical Linear Algebra in Signals, Systems and Control*; Springer; 2011. http://dx.doi.org/10.1007/978-94-007-0602-6. [Available via Springer eBooks, UPRM General Library Databases]

(5) Duncan, T.E.; Pasik-Duncan, B.; Discrete Time Linear Quadratic Control with Arbitrary Correlated Noise, *IEEE Transactions on Automatic Control*; Vol.58, no.5, 2013, pp. 1290-1293. http://dx.doi.org/10.1109/TAC.2012.2220444. [Available via IEEE Xplore, UPRM General Library Databases]

(6) Heemels, W.P.M.H.; Donkers, M.C.F.; Teel, A.R.; Periodic Event-Triggered Control for Linear Systems, *IEEE Transactions on Automatic Control*; Vol.58, no.4, 2013, pp. 847-861. http://dx.doi.org/10.1109/TAC.2012.2220443. [Available via IEEE Xplore, UPRM General Library Databases]

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12. Contribution of Course to meeting the requirements of Criterion 5:

Math	Basic Science	General	Engineering Topic
			√

13. Course Outcomes | **Map to Program Outcomes**

1. Analyze linear systems and design of state-feedback controllers. (a)
2. Develop dynamical models for simple linear systems using state-space representation. (a)
3. Evaluate and interpret properties of linear systems such as stability, controllability, and observability. (a)
4. Design state-feedback controllers for single-input single-output linear systems. (c)
5. Implement the controllers using digital computers and validate its performance. (b)
6. Use modern engineering tools (MATLAB, LabVIEW, PSPICE…) for the design and implementation of a control system. (k)
7. Work as part of a team. (d)
8. Preparation of a written report about the final project. (g)

Person(s) who prepared this description and date of preparation: Gerson Beauchamp,
Submitted by: Eduardo J. Juan, May 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachellor of Science in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 5506
Course Title: PROCESS INTRUMENTATION AND CONTROL ENGINEERING
Number of credits: 3
Contact Period: 3 hours of lecture per week
Elective in INEL 5506

2. Course Description:

English: Design of process instrumentation and control systems, based on analog and digital instruments and mini or microcomputers. Standards and practical considerations emphasized.

Spanish: Diseño de sistemas de instrumentación y control de procesos basados en instrumentación analógica y digital y en mini o microcomputadoras. Enfasis en normas establecidas y consideraciones prácticas.

3. Pre/Co-requisites and other requirements:

INEL 4505 Y INEL 4206

4. Course Objectives:

Design of practical process instrumentation and control systems using computers and analog and/or digital instruments. Selection of measurement systems, controllers, and final control elements necessary to achieve system design specifications while satisfying standards and established practices.

5. Instructional Strategies:

☒conference ☒discussion ☒computation ☒laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Electrical measurement equipment, electronic components, personal computers with data acquisition boards and software.

7. Course time frame and thematic outline

Outline	Contact Hours
Elements in process control standards and practical consideration	9
Transducers	12
Analog and digital signal conditioning	4
PID control: practical considerations for both analog and digital controllers	10
Discrete-state process control programmable controllers and industrial applications	9
Mid-term exam	1
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies (Suggested): The faculty member teaching the course will provide the student with the evaluation strategy he/she will be using throughout the semester. This will be done within the first week of classes.

	Quantity	Percent
☒ **Exams**	**1**	**20**
☒ **Final Exam**	**1**	**20**
☐ **Short Quizzes**		

☐ **Oral Reports**			
☐ **Monographies**			
☐ **Portfolio**			
☒ **Projects**	**2**	**60**	
☐ **Journals**			
☐ **Other, specify:**			
TOTAL:		**100%**	

10. Bibliography:

Textbook:

(1) Johnson, C. D.; *Process Control Instrumentation Technology*, 8th ed.; Prentice Hall, New Jersey; 2008.

Additional References:

(2) Korbicz, J.; *Modeling, Diagnostics and Process Control*, Springer; 2011. http://dx.doi.org/10.1007/978-3-642-16653-2. [Available via Springer eBooks, UPRM General Library Databases]

(3) Liu, T.; Gao, F.; *Industrial Process Identification and Control Design*; Springer; 2011. http://dx.doi.org/10.1007/978-0-85729-977-2. [Available via Springer eBooks, UPRM General Library Databases]

(4) Eren, H.; *Instrument Engineers' Handbook*; CRC Press; 2011.

(5) Levine, W. S.; *The Control Handbook*; CRC Press; 2010.

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12. Contribution of Course to meeting the requirements of Criterion 5:

Math	Basic Science	General	Engineering Topic
			√

13. Course Outcomes — **Map to Program Outcomes**

1. Analyze and design signal conditioning and transmission circuits. (e)
2. Understand the principles of operation of various types of transducers. (a)
3. Design of practical process instrumentation and control systems using computers and analog and/or digital instruments. (c)
4. Selection of measurement systems, controllers, and final control elements necessary to achieve system design specifications while satisfying standards and established practices. (e)
5. Preparation of an oral and written report about the final project. (g)
6. Work as part of a team. (d)
7. Learn about the role and scope of regulating agencies such as the Occupational Safety and Health Administration (OSHA), the National Fire Protection Association (NFPA), and the Food and Drug Administration (FDA). (j)
8. Learn about the role and scope of professional societies such as Instrumentation, systems and Automation (ISA) society and the Institute of Electrical and Electronics Engineers (IEEE). (i)
9. Implementation and testing of a process control and instrumentation system. (b)
10. Understanding of professional and ethical responsibility. (f)
11. Use modern engineering tools (MATLAB, LabVIEW, PSPICE…) for the design and implementation of a process control and instrumentation system. (k)

Person(s) who prepared this description and date of preparation: Eduardo J. Juan, Submitted by: Eduardo J. Juan, Feb 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachellor of Science in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 5508
Course Title: Digital Control Systems
Number of credits: 3
Contact Period: 3 hours of lecture per week
Elective in INEL 5508

2. Course Description:

English: Analysis and design of digital control systems. Stability, controllability, and observability of discrete systems. Practical considerations when implementing a digital control system.

Spanish: Análisis y diseño de sistemas de control digital. Se estudia la estabilidad, controlabilidad y observabilidad de sistemas de tiempo discreto. Se enfatizan consideraciones prácticas para la implantación de los sistemas de control digital.

3. Pre/Co-requisites and other requirements:

INEL 4505

4. Course Objectives:

Analyze, design and implement digital control systems for single-input single-output physical systems.
Discretize simple physical systems and specify performance criteria.
Design a single-input single-output feedback controller capable of achieving the design criteria for the system.
Implement a digital controller using a digital computer and software, and validate the performance of the closed-loop system.

5. Instructional Strategies:

☒conference ☒discussion ☒computation ☒laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Eight workstations equipped with mechanical systems to be controlled, electrical measurements equipment, personal computers with data acquisition boards and software (Matlab, Simulink, RTW, and LabVIEW).

7. Course time frame and thematic outline

Outline	Contact Hours
Modeling of digital and discrete systems	3
Discrete Time Systems and the Z-transform	6
State space representation of discrete systems. Properties of the models	4
Sampling and reconstruction	7
Analysis of sampled data open-loop and closed-loop control systems	5
System time-response characteristics	5
Stability analysis	3
Digital controller design	9
Exams	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies (Suggested): The faculty member teaching the course will provide the student with the evaluation strategy he/she will be using throughout the semester. This will be done within the first week of classes.

	Quantity	Percent
☒ Exams	2	50
☒ Final Exam	1	20
☐ Short Quizzes		
☐ Oral Reports		
☐ Monographies		
☐ Portfolio		
☒ Projects	1	20
☐ Journals		
☒ Other, specify: Homework Sets	4	10
TOTAL:		100%

10. Bibliography:

Textbook:

(1) Sami Fadali, M.; *Digital Control Engineering, Analysis and Design*; 2nd ed.; Academic Press

Additional References:

(2) Hyun Seong, P.; *Reliability and Risk Issues in Large Scale Safety-critical Digital Control Systems*; Springer; 2009. http://dx.doi.org/10.1007/978-1-84800-384-2. [Available via Springer eBooks, UPRM General Library Databases]

(3) Levine, W. S.; *The Control Hardbook*; 2 ed.; CRC Press; 2010. DOI: 10.1201/b10383-14.

(4) Emadi, A.; Khaligh, A.; Nie, Z.; Joo Lee, Y.; *Integrated Power Electronic Converters and Digital Control*; CRC Press; 2009. http://dx.doi.org/10.1201/9781439800706. [Available via ElectricalENGINEERINGnetBASE, UPRM General Library Databases]

(5) Kirsten, A.L.; Dalla Costa, M.A.; Rech, C.; *Digital Control Strategy for HID Lamp Electronic Ballasts*; *IEEE Transactions on Industrial Electronics*; Vol.60, no.2, 2013, pp. 608-618. http://dx.doi.org/10.1109/TIE.2012.2205363. [Available via IEEE Xplore, UPRM General Library Databases]

(6) Wu, X.L.; Xia, G.C.; Lei, B.; Simplified Discrete-Time Modeling for Convenient Stability Prediction and Digital Control Design; *IEEE Transactions on Power Electronics*; Vol.28, no.11, 2013, pp. 5333-5342. http://dx.doi.org/10.1109/TIE.2012.2205363. [Available via IEEE Xplore, UPRM General Library Databases]

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12. Contribution of Course to meeting the requirements of Criterion 5:

Math	Basic Science	General	Engineering Topic
			√

13. Course Outcomes	**Map to Program Outcomes**
1. Analyze, design and implement digital control systems for single-input single-output physical systems.	(a)
2. Discretize simple physical systems and specify performance criteria.	(a)
3. Design a single-input single-output feedback controller capable of achieving the design criteria for the system.	(c)
4. Implement a digital controller using a digital computer and software.	(e)
5. Validate the performance of the closed-loop system.	(b)
6. Work as part of a team.	(d)
7. Preparation of a written report about the final project.	(g)
8. Use modern engineering tools (MATLAB, LabVIEW, PSPICE…) for the design and implementation of a process control and instrumentation system.	(k)

Person(s) who prepared this description and date of preparation: Gerson Baeuchamp, Submitted by: Eduardo J. Juan, May 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachellor of Science in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 5516
Course Title: AUTOMATION AND ROBOTICS
Number of credits: 3
Contact Period: 3 hours of lecture per week and 12 hours of laboratory in the semester
Elective in INEL

2. Course Description:

English: Analysis and design of automated pneumatic systems using programmable controllers. Programming of industrial robots .

Spanish: Analisis y diseño de sistemas neumáticos usando controladores programables. Programación de brazos mecánicos industriales.

3. Pre/Co-requisites and other requirements:

Prerequisites: INEL 4206 and INEL 4102 or
For students in Industrial Engineering : ININ 4057 or being in graduate standing.
For students in Mechanical Engineering: INME 4009, INEL 4076, INEL 4077 and INGE 3016, or being in graduate standing.
Prerequisites by topic:

1. Programming and design of flowchart algorithms.
2. Transfer functions, and physics (concepts such as pressure, temperature, fluid flow, voltage, current, electromagnetism, etc.)
3. Synchronous sequential machines and state diagrams.
4. Calculus and matrices math. Knowledge of MATLAB is encouraged.

4. Course Objectives:

After completing the course, the student should be able to understand, analyze and design automatic control systems for manufacturing processes using pneumatic equipment, programmable controllers and robotic arms.

5. Instructional Strategies:

☒conference ☐discussion ☐computation ☒laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☒practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Labs are considered a major part of the class, and all students are expected to participate.
Radios, tape recorders, and other audio or video equipment are not permitted in the lab or classroom at any time.
Smoking is not permitted in any area other than those areas designated for smoking.
Laboratory Projects:

Familiarization with programmable controllers. Demonstrations on how to use the equipment and applications. Small projects are required.
Familiarization with the CRS A255 or equivalent robot system. Demonstrations on how to use the equipment and applications. Small projects are required.
A final design project is required.

7. Course time frame and thematic outline

Outline	Contact Hours
Automation: definitions and manufacturing terminology, equipment used, and justifications	3
Manufacturing process simulation and design for assembly techniques	3
Industrial on-off sensors and actuators such as stepper and DC motors	5
Pneumatic systems: compressors, valves, cylinders, and air preparation devices	4
Programmable controllers	17
Robotics	12
Test	1
Total hours: (equivalent to contact period)	45

8. Grading System

☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

(Suggested): The faculty member teaching the course will provide the student with the evaluation strategy he/she will be using throughout the semester. This will be done within the first week of classes.

	Quantity	Percent
☐ **Exams**		
☒ **Final Exam**	**1**	**15**
☒ **Short Quizzes**	**4 to 6**	**15**
☒ **Oral Reports**	**1**	**12.25**
☒ **Laboratory Report**	**4**	**20**
☐ **Assignment**	**4 to 6**	**15**
☒ **Projects**	**1**	**22.75**
☐ **Journals**		
☐ **Other, specify:**		
TOTAL:		**100%**

10. Bibliography:

Professor notes and Supplemental Reading

Textbook:

1. D. W. Pessen, Industrial Automation: Circuit Design and Components, John Wiley and Sons, 1989.

References:

1. S. Y. Nof, Springer Handbook of Automation, Springer, 2009
2. R. N. Jazar, Theory of Applied Robotics, Springer , 2010
3. H. Gattringer; J. Gerstmayr; Multibody Systems Dynamics, Robotics and Control, Springer 2013
4. IEEE Industry Applications Society, IEEE Recommended Practice for Electrical Installations—Controls and Automation, IEEE Std 45.2-2011,2011, http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6096330

References (Classic):

1. M.P. Groover, M. Weiss, R.N. Nagel, N.G. Odrey, Industrial Robotics: Technology, Programming and Applications, McGraw-Hill 1986.
2. L.A. Bryan, E.A. Bryan, Programmable Controllers: Theory and Implementation, Industrial Text Co.,
3. H.L. Stewart, Pneumatics and Hydraulics, The Bobbs - Merrill Co., Inc., 1984.

R.E. Bateman, R.G. Bowden, T.J. Gogg, C.R. Harrell, and J.R.A. Mott, System Improvement Using Simulation, IST Corporation and JMI Consulting Group, Fifth Edition, 1997

W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Addison Wesley Longman, 1999.

NAIS Corporation, Programmable Controller: FPO Series—Hardware, Matsuhita Electric Works, 1998.

NAIS Corporation, Programmable Controller: FPO Series—Programming, Matsuhita Electric Works, 2002.

11. According to Law 51

Students will identify themselves with the Institution and the instructor of the course for purposes of assessment (exams) accommodations. For more information please call the Student with Disabilities Office which is part of the Dean of Students office (Office #4) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258 or by email at

12. Contribution of Course to meeting the requirements of Criterion 5:

Math	Basic Science	General	Engineering Topic
			√

13. Course Outcomes

1. Relationship of the course with program outcomes

Outcome (a) Ability to apply knowledge of mathematics, science, and engineering necessary to carry out analysis and design appropriate to electrical engineering problems.

The student must show sufficient knowledge of the basic physical and engineering sciences to implement a control project either by using pneumatic systems, robotic arms, or automation using PLC.

Extra credits will be awarded in this outcome if numerical cost analysis is included in the final report.

Extra credits will be awarded if a combination of technologies is presented in the final project.

Outcome (b) Ability to design and conduct experiments, as well as analyze and interpret data

Students will conduct laboratory works. Data will be collected and report in four laboratory reports. Part of the grade on this report includes the presentation and analysis of the data collected. These reports will not be collected for ABET purposes unless the final project does not reflect competency of this outcome.

The student will provide a final project of an original idea proposed by his group. Implementation is a major portion of the grade of the course.

Outcome (c) Ability to design a system, component, or process to meet desired needs

The students must show that they follow logical and orderly design procedures, choosing the best solution for their criteria.

Students must provide a final report that reflects competency documenting their work.

Outcome (d) Ability to function on multidisciplinary teams

Groups no greater of four members will be working towards all laboratory and project work. Peer evaluation will be asset, and an individual interview with the professor will be required previous to grant the final grade.

Each group must show originality in their work, the procedure to subdivide a complex problem in parts, and finally combining peer work into the final solution.

Outcome (e) Ability to identify, formulate, and solve engineering problems

Students will identify a problem where the automation skills could be applied.

Their idea, along with a plausible procedure, will be submitted by the working group in a proposal. The final report will include the explanation of the idea in the introduction part of the report.

Outcome (f) Understanding of professional and ethical responsibility.

Students should be able to identify the ethical issues faced on the solution of their final project.

Laboratory reports will provide practice to identify ethical and social issues. In the cases that the final report does not show evidence of competency on this outcome, one of this laboratory works will be provided as evidence.

Outcome (g) Ability to communicate effectively

Project groups must present an oral presentation and a written final report of their work.

Oral presentation and working demonstration of the students work is open to the public, and therefore should be understandable for the interested parties. Mathematical derivation and technical content is allowed in oral presentations. Attendants to these sessions should at least understand why the derivation is needed although fully comprehension is not expected.

Outcome (h) Broad education necessary to understand the impact of engineering solutions in a global and societal context

Ideas for projects should reflect awareness of societal needs.

Students should comment the impact to society reflected by acceptance of their design into society, impact in low skills personnel being replaced by their solution, impact to the environment, or benefits to the intended group of person.

Outcome (i) Recognition of the need for, and an ability to engage in lifelong learning

Student must include enough references to prove their ability to search for information. This information could be reflected in the theory part of the report, or in the finding of a technical tool or part not easily found in hardware store (as for example, an inductive sensor, or pneumatic valve).

Outcome (j) Knowledge of contemporary issues

Student should comment on different alternatives to solve their problem. These alternatives should include emerging technologies and their associated cost, although they are not implemented.

Outcome (k) Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Student must be able to program a PLC, or a robotic arm using the tools presented in class. The ladder logic diagram or the structured robotic program should go beyond the examination exercise by using them in the solution of their final project.

2. Relationship of the course with program objectives

Objective 1: Obtain a broad educational experience necessary to understand the impact of electrical engineering problems and solutions within a global and societal context.

Related Activity: Laboratory work and project.

Objective 2: Posses a combination of knowledge and analytical, computational, and experimental skills necessary to solve practical engineering problems.

Basic engineering design skills and in-depth knowledge of at least one EE area: (control).
Physical thinking, approximation, and simplification
Ability to integrate knowledge and skills across discipline boundaries.
Physical thinking, approximation and simplification.
Ability to integrate knowledge and skills across discipline boundaries.

Related Activity: Laboratory work, project, and assignments.

Objective 3: Have adequate communications skills both as an individual and as part of a team.
Ability to communicate effectively verbally and in writing in English and Spanish.
Ability to interpret graphical, numerical, and textual data
Ability to communicate effectively technical information to varied audiences in oral, written and graphical forms, both in English and Spanish
Ability to organize information
Ability to work in groups and to interact with the social environment
Ability to lead effectively.

Related Activity: Written proposal, oral presentation, laboratory reports and final project report.

Objective 4: Value the importance of lifelong learning.
Knowing how to ask questions and that there may be multiple answers.
Commitment to constantly upgrading fundamental knowledge and skills
Understanding that every situation is an opportunity for learning

Related Activity: Laboratory work and project.

Objective 5: Be aware of contemporary issues and thus be able to make decisions taking into consideration professional and societal needs, and ethical implications.
Consciousness of the ethical and societal aspects of their profession.

Related Activity: Laboratory work and project.

Person(s) who prepared this description and date of preparation: Raúl E. Torres, Submitted by: Raúl E. Torres, abril 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachelor of Science in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 5605
Course Title: ANTENNA THEORY AND DESIGN
Number of credits: 3
Contact Period: 3 hours of lecture per week
Elective in INEL

2. Course Description:

English: Radiation mechanisms, radiation patterns. Impedance concepts. Wire antennas. Antenna arrays. Frequency independent antennas. Aperture antennas. Antenna measurements and design.

Spanish: Mecanismos de radiación, patrones de radiación, concepto de impedancia; antenas de alambre, arreglos de antenas, antenas independientes de frecuencia, antenas de abertura, medidas y diseño de antenas.

3. Pre/Co-requisites and other requirements:

Prerequisite INEL 4301 & INEL 4152

4. Course Objectives:

After completing the course, the student should be able to describe the radiation mechanisms and the fundamental antenna principles and parameters and use them to understand different types of antennas and to analyze antenna systems. The students should also be able to choose the best type of antenna for different situations and to design antenna systems given a set of specifications.

5. Instructional Strategies:

☒conference ☐discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

C.A. Balanis, Antenna Theory, Analysis and Design. 3rd Edition. John Wiley and Sons, 2005.

7. Course time frame and thematic outline

Outline	**Contact Hours**
Introduction, radiation mechanisms	3
Fundamental parameters	5
Radiation integrals and vector potentials	1
Linear dipoles	5
Loop antennas	5
Antenna arrays and mutual impedance	8
Impedance matching	5
Broadband antennas, frequency independent antennas	4
Aperture, Horn, Microstrip patches and Reflector antennas	7
Exams	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies (Suggested): The faculty member teaching the course will provide the student with the evaluation strategy he/she will be using throughout the semester. This will be done within the first week of classes.

	Quantity	Percent
☒ **Exams**	**3**	**0-100%**
☒ **Final Exam**	**1**	**0-100%**
☒ **Short Quizzes**		**0-100%**
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**0-100%**
☐ **Journals**		
☒ **Other, specify: dependent on the instructor**		
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Stutzman, W. L.; Thiele, G.A.; *Antenna Theory and Design*, 3rd ed.; John Wiley and Sons; 2012.

Additional References:

(2) Carr, J.; Hippisley, G.; *Practical Antenna Handbook*; 5th ed. Mc Graw Hill; 2012.

(3) *IEEE Antennas and Propagation Magazine*: http://www.ieeeaps.org/magazine.html

(4) Kataja, J.; Nikoskinen, K.; The Parametric Optimization of Wire Dipole Antennas; *IEEE Transactions on Antennas and Propagation*; Vol.59, no.2, 2011, pp. 350-356. http://dx.doi.org/10.1109/TAP.2010.2096181. [Available via IEEE Xplore, UPRM General Library Databases]

(5) Yarman, B. S.; *Design of Ultra Wideband Antenna Matching Networks*; Springer, 2008. http://dx.doi.org/10.1007/978-1-4020-8418-8. [Available via Springer eBooks, UPRM General Library Databases]

11. According to Law 51

Students will identify themselves with the Institution and the instructor of the course for purposes of assessment (exams) accommodations. For more information please call the Student with Disabilities Office which is part of the Dean of Students office (Office #4) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258 or by email at virgen.aponte@upr.edu .

12. **Contribution of Course to meeting the requirements of Criterion 5:**

Math	Basic Science	General	Engineering Topic
			√

13. Course Outcomes	**Map to Program Outcomes**
1. Apply vectorial algebra and calculus with Maxwell equations to calculate the fields radiated from antenna	a
2. Explain how an antenna radiates	a
3. Compute antenna radiated electromagnetic fields	a
4. Design a network to match the antenna impedance to a transmission line	c,e
5. Select the appropriate antenna to be used for an application according to their beam width, radiation pattern, etc	b,c
6. Determine and calculate the antenna fundamental parameters	a
7. Design different types of antennas to comply with given requirements	c,e
8. Design antennas and antenna arrays using simulation tools	c,k
9. Properly model wire antennas using antenna simulation tools	k

Person who prepared this description and date of preparation: Electromagnetic Committee, Feb 12, 2013. Submitted by: Dr. Rafael Rodríguez, Committee Coordinator, Feb 12, 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 5606
Course Title: Microwave Engineering
Number of credits: 3
Contact Period: 3 hours of lecture
Elective in INEL

2. Course Description:

English: Rectangular and circular waveguides; passive components; tubes and solid state devices used in microwave systems.

Spanish: Guías de onda rectangulares y circulares; componentes pasivos; tubos y dispositivos de estado sólido utilizados en sistemas de microondas.

3. Pre/Co-requisites and other requirements:

INEL 4152, INEL 4201

4. Course Objectives:

This course is intended to provide senior students with the theory of operation of microwave devices and components, and with fundamentals of microwave transistor amplifier design, with the purpose of understanding the operation of microwave systems and circuits.

5. Instructional Strategies:

☒conference ☐discussion ☒computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify: Student presentations, Seminar by Industry Professionals (if available).

6. Minimum or Required Resources Available:

Individual and group assignments **requiring** the use of software packages to design and analyze microwave circuits. Software: HP Advanced Design System (ADS) available for the students.

7. Course time frame and thematic outline

Topic	Hours
Review: Transmission lines	2
Review: Smith Chart, load matching	2
Review: Microstrip lines	2
Scattering Parameters	3
ABCD matrix	2
Impedance matching	3
Noise in microwave circuits	2
Basic amplifier design	5
Power Dividers	3
Couplers and Hybrids	6
Microwave Filters	5
Waveguides	2

Mixers, switches	4
Microwave Systems	2
Exams	3

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies (Suggested): The faculty member teaching the course will provide the student with the evaluation strategy he/she will be using throughout the semester. This will be done within the first week of classes.

	Quantity	Percent
☒ Exams	2	50
☒ Final Exam	1	25
☐ Short Quizzes		
☐Oral Reports	1	
☐ Monographies		
☐ Portfolio		
☐ Projects		
☐Journals		
☒Other, specify: Assigned problems	6-8	25
TOTAL:		100%

10. Bibliography:

Textbook:

(1) Pozar, D. M.; *Microwave Engineering*; 4th ed.; John Wiley and Sons; 2011.

Additional References:

(2) Gustrau, F.; *RF and Microwave Engineering: Fundamentals of Wireless Communications*; 2nd ed.; Wiley; 2012

(3) *IEEE Microwave Magazine*; http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6668

(4) Alimenti, F.; Mezzanotte, P.; Dionigi, M.; Virili, M.; Roselli, L.; Microwave Circuits in Paper Substrates Exploiting Conductive Adhesive Tapes; *Microwave and Wireless Components Letters, IEEE*; Vol. 22, no. 12, 2012, pp.660-662. http://dx.doi.org/10.1109/LMWC.2012.2227141. [Available via IEEE Xplore, UPRM General Library Databases]

11. According to Law 51

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12. Contribution of Course to meeting the requirements of Criterion 5:

Math	Basic Science	General	Engineering Topic
			√

12. Course Outcomes — MAP to ABET Outcomes

➢ Describe the importance and necessity of microwave systems and circuits.	d, g, j
➢ Analyse active microwave components (amplifier)	a, e
➢ Analyze passive microwave components (filters, dividers, couplers)	a, e
➢ Analyze and derive S-parameters for different components.	a, e
➢ Use of state of the art CAD tools for simulation of microwave active and passive components	k

Person who prepared this description and date of preparation: Electromagnetic Committee, Feb, 12, 2013. Submitted by: Dr. Rafael Rodríguez, Committee Coordinator, Feb, 12, 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 5616
Course Title: Wireless Communications
Number of credits:
Contact Period: 3 hours of lecture
Elective in INEL

2. Course Description:

English: Introduction to modern wireless communication systems. Concepts of cellular radio. The wireless communication channel. Large-scale path loss, multipath, small-scale fading. Modulation techniques. Diversity and channel coding. Multiple access techniques. LTE and 4G Wireless. Introduction to wireless networking, systems and standards. Survey of various topics: The FCC, The Telecommunications Board of Puerto Rico, Telecommunications Law, Biological effects of electromagnetic radiation.

Spanish: Introducción a sistemas modernos de comunicaciones inalámbricas. Conceptos de radio celular. El canal de comunicaciones inalámbrico. Pérdidas en trayectorias largas, multi-trayectorias, desvanecimiento en escalas cortas. Técnicas de modulación. Diversidad y codificación del canal. Técnicas de acceso múltiple. LTE e Inalámbricos 4G. Introducción a redes inalámbricas, sistemas asociados y normas propuestas. Visión panorámica de varios temas: La CFC, La Junta de las Telecomunicaciones de Puerto Rico, Leyes de Telecomunicaciones, Efectos biológicos de la radiación electromagnética.

3. Pre/Co-requisites and other requirements:

Theory of Communications I (INEL 4301), Electromagnetics II (INEL 4152)

4. Course Objectives:

Wireless Communications (INEL 5316) aims to give the student a solid theoretical, and some practical, exposure to fundamental concepts and techniques of wireless radio. After this course the student should be able to address problems associated with the design of a wireless communication system. Explains propagation models to account for large-scale and short-scale (fading) variations of the signal intensity. Supplements basic knowledge in modulation schemes. Makes students aware of diversity, channel coding, and multiple access techniques for wireless communications. Introduces wireless networking, and wireless systems and standards. Enables the student to appreciate the importance of: the agencies charged with promoting the vitality of telecommunications in the USA, the new telecommunications law of 1996, health issues associated with electromagnetic fields. After the course the student should appreciate the deleterious effects of fading and to understand the strategies to mitigate it.

5. Instructional Strategies:

☒conference ☐discussion ☒computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☒other, please specify: Student presentations, Seminar by Industry Professionals (if available).

6. Minimum or Required Resources Available:

Materials, equipment, and physical facilities needed to fulfill the course objectives.

7. Course time frame and thematic outline

Outline	Contact Hours
Introduction to wireless communications	1
Modern wireless communication systems (2G, 3G)	3
The cellular concept Frequency reuse. Interference. System capacity. Trunking. Improving coverage and capacity	11
Mobile radio propagation for large scales Reflection. Diffraction. Outdoor and indoor propagation models.	8
Mobile propagation for small scales Multipath channel. Parameters. Measurements. Types of fading.Statistical models for fading channels. Shape factors.	9
Modulation techniques for mobile radio	3
Diversity and channel coding	2
Multiple access techniques for wireless communications	1
Wireless networking	1
LTE and 4G Wireless	3
Wireless systems and standards	1
Exams	2

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies (Suggested): The faculty member teaching the course will provide the student with the evaluation strategy he/she will be using throughout the semester. This will be done within the first week of classes.

	Quantity	Percent
☒ **Exams**	**2**	**60**
☒ **Final Exam**	**1**	**35**
☐ **Short Quizzes**		
☒**Oral Reports**	**1**	**2.5**
☐ **Monographies**		
☐ **Portfolio**		
☐ **Projects**		
☐**Journals**		
☒**Other, specify: Assigned problems**	**2-4**	**2.5**
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Molisch, A. F.; *Wireless Communications*. 2nd ed.; John Wiley & Sons; 2011.

Additional References:

(2) Wong, K. D.; *Fundamentals of Wireless Communication Engineering Technologies*. Wiley & Sons; 2012.
(3) Stalling, W.; *Wireless Communications and Networks*. 2nd Ed.; Prentice Hall; 2004. (Classical textbook).
(4) Liu, R.; Trappe W.; *Securing Wireless Communications at the Physical Layer*. Springer; 2010. http://dx.doi.org/10.1007/978-1-4419-1385-2. [Available via Springer eBooks, UPRM Library Databases]
(5) Kocaoglu, M.; Akan O.B.; *Minimum Energy Channel Codes for Nanoscale Wireless* Communications. *IEEE Transactions on Wireless Communications*; Vol.12, no.4, 2013, pp. 1492-1500. http://dx.doi.org/10.1109/TWC.2013.022113.2190. [Available via IEEE Xplore, UPRM Library Databases]

12. Contribution of Course to meeting the requirements of Criterion 5:

Math	Basic Science	General	Engineering Topic
			√

11. According to Law 51

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13. Course Outcomes	**MAP to ABET Outcomes**
1. Describe the evolution toward modern wireless communications systems	d, g, j
2. Describe and justify the cellular concept	a, e, k
3. Analyze mobile radio propagation large-scale path loss	a, e
4. Analyze mobile radio-propagation small-scale fading and multipath	a, e
5. Analyze modulation techniques for mobile radio	a, e
6. Evaluation of engineering practice on quality of life, ethics	h, f
7. Describe different wireless communication standards	I

Person who prepared this description and date of preparation: Electromagnetics Committee, March, 12, 2008. Submitted by: Dr. Rafael Rodríguez, Committee Coordinator, March, 12, 2008
Updated by Henrick-Mario Ierkic, April 25, 2013.

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachellor of Science in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 5629
Course Title: TELECOMMUNICATIONS ELECTRONICS
Number of credits: 3
Contact Period: Two hours of lecture per week and one two-hour laboratory per week
Electives in INEL

2. Course Description:

English: Study of the theory of operation of radio frequency (RF) and microwave devices and components and fundamentals of RF design, with the purpose of understanding the operation of the different components of telecommunications systems

Spanish: Estudio de la teoría de operación de dispositivos y componentes de radio frecuencia (RF) y de microondas y los fundamentos de las técnicas de diseño de sistemas de RF con el propósito de entender la operación de los diversos componentes de sistemas de

3. Pre/Co-requisites and other requirements:

Prerequisites: INEL 4301, INEL 4201, INEL 4152

4. Course Objectives:

After completing the course, the students should be able to use telecommunications theory principles, examine different applications and apply Fourier transforms, convolution, filtering, sampling, noise, modulation and demodulation, to solve communications electronics problems.

5. Instructional Strategies:

☒conference ☐discussion ☐computation ☒laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

7. Course time frame and thematic outline

Outline	Contact Hours
Radio communication systems	1
Two-port networks	5
Impedance matching	8
Noise in linear systems	2
RF filters	7
RF amplifiers	6
Oscillator circuits	4
Phase Lock loops	8
Mixer Circuits	7
Frequency Synthesizers Modulators and Demodulators	5 4
Exams	3
Total hours: (equivalent to contact period)	60

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies (Suggested): The faculty member teaching the course will provide the student with the evaluation strategy he/she will be using throughout the semester. This will be done within the first week of classes.

	Quantity	Percent
☒ **Exams**	**3**	**60**
☒ **Final Exam**	**1**	**20**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☐ **Projects**		
☐ **Journals**		
☒ **Other, specify: Lab work**		**20**
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Bogdanov, G.; *RF Circuit Design: Theory and Applications*, 2 ed. Prentice Hall, 2009.

Additional References:

(2) Steer, M.; *Microwave and RF Design: A Systems Approach*; SciTech Publishing; 2010

(3) *IEEE Microwave Magazine*; http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6668

(4) Sivakumar, S.; Eroglu, A.; Analysis of Class-E Based RF Power Amplifiers Using Harmonic Modeling; *IEEE Transactions on Circuits and Systems I: Regular Papers*; Vol.57, no.1, 2010, pp.299-311. http://dx.doi.org/10.1109/TCSI.2009.2016169. [Available via IEEE Xplore, UPRM General Library Databases]

11. According to Law 51

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12. Contribution of Course to meeting the requirements of Criterion 5:

Math	Basic Science	General	Engineering Topic
			√

13. Course Outcomes **Map to Program Outcomes**

1. Describe the components of a communication system and explain the purpose of each component in the system (b)
2. Calculate the impedance, admittance, hybrid and scattering matrices for two-port networks (a)
3. Design impedance matching networks (c)
4. Calculate the noise parameters and the signal to noise ratio of communication systems (a)
5. Design lumped element RF filters and RF amplifiers (c)
6. Describe the operation of phase locked loops, frequency synthesizers, mixers and modulator and demodulator circuits (b)
7. Design simple mixers and oscillator circuits (c)
8. Design telecommunication electronics circuits using RF circuit simulators (k)
9.

Person(s) who prepared this description and date of preparation: Rafael Rodríguez, September, 2012.
Submitted by: Rafael Rodríguez.

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6000
Course Title: INTRODUCTION TO NONLINEAR CONTROL SYSTEMS
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: Analysis and synthesis of nonlinear control systems; phase plane and describing function techniques; Lyapunov's second method and its application in the design and stability determination of nonlinear systems.

Spanish: Analisis y sintesis de sistemas de control no lineal; técnicas del plano de fase y funciones descriptivas; segundo método de Lyapunov y su aplicación en el diseño y el analisis de estabilidad de sistemas no lineales.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

This course introduces theory and techniques for the analysis of nonlinear dynamical systems and the design of nonlinear control. It emphasizes rigorous analysis supplemented with computer simulation.

5. Instructional Strategies:

☒conference ☐discussion ☒computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☒other, please specify: Literature review

6. Minimum or Required Resources Available:

MATLAB Software with linear and nonlinear control system toolboxes.

7. Course time frame and thematic outline

Outline	Contact Hours
Introduction to Nonlinear Systems	1
Second order systems and analysis in the phase plane	6
Fundamental properties of ordinary differential equations	3
Lyapunov Stability (first and second method)	12
Frequency domain analysis of nonlinear systems (describing functions)	3
Introduction to nonlinear feedback control systems	2
Design of nonlinear control systems using linearization	6
Input/State and Input/Output Feedback linearization	6

Research topics in nonlinear systems and control	3
Tests	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**3**	**40**
☒ **Final Exam**	**1**	**20**
☐ **Short Quizzes**		
☒ **Oral Reports**	**1**	**5**
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**20**
☐ **Journals**		
☒ **Homework**	**2-4**	**10**
☒ **Other, specify: Paper review**	**1**	**5**
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Khalil, H. *Nonlinear Systems*; 3rd ed.; Prentice Hall, 2001. (Classical textbook).

Additional References:

(2) Cheng, D.; Hu, X.; Shen, T.; *Nonlinear Systems: Analysis, Stability, and Control*; 1srt ed.; Springer-Verlag; 2011.

(3) Jarzebowska, E. *Model-Based Tracking Control of Nonlinear Systems*; CRC Press, 2012. http://dx.doi.org/10.1201/b12262. [Available via ElectricalENGINEERINGnetBASE, UPRM General Library Databases]

(4) Vidyasagar, M.; *Nonlinear Systems Analysis*; 2. ed.; Prentice Hall, 1993. (Classical textbook). [Available at the Circulation Collection (QA402 .V53 1993), UPRM General Library]

11. According to Law 51

Students will identify themselves with the Institution and the instructor of the course for purposes of assessment (exams) accommodations. For more information please call the Student with Disabilities Office which is part of the Dean of Students office (Office #4) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258 or by email at virgen.aponte@upr.edu .

Person who prepared this description and date of preparation:

Eduardo I. Ortiz-Rivera, October 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6001
Course Title: FEEDBACK CONTROL SYSTEMS I
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: The Z-transform and its application to sampled-data control systems; analysis of automatic control systems, using state variable concepts; stability criteria; introduction to parameter optimization techniques.

Spanish: Regimen transitorio y regimen constante de sistemas lineales de control con retorno. Análisis en los dominios de tiempo y frecuencia. Diagramas de flujo de señales y teoría de la estabilidad. Solucion de Problemas Lineales Mediante el Uso de Variables de Estado

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

After completion of the course the student should be able to analyze design and control linear systems using state variable methods and optimal control techniques.

5. Instructional Strategies:

☒conference ☐discussion ☐computation ☒laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Standard lecturing facilities, Control Systems Laboratory in S-214 for demonstrations and projects.

7. Course time frame and thematic outline

Outline	Contact Hours
1. Introduction to state-variable representation of systems	3
2. Static Optimization	3
3. Optimal Control of Discrete-Time Systems	8
4. Linear Quadratic Regulator for Discrete-Time Systems	8
5. Discretization of Continuous-Time Systems	1
6. Steady-State Sub-Optimal Control	3
7. Calculus of Variations	2
8. Linear Quadratic Regulator for Continuous-Time Systems	8
9. The Tracking Problem	3

10. Final-Time-Free and Constrained Input Control	3
11. Output Feedback and Structured Control	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**2**	**40**
☒ **Final Exam**	**1**	**25**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**20**
☐ **Journals**		
☒ **Other, specify: Homework Sets**	**4**	**15**
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Lewis, F.L.; Vrabie, D.; Syrmos, V.L.; *Optimal Control*, 3rd ed.; Wiley-Interscience, 2012.

Additional References:

(2) Tarunraj, S. *Optimal Reference Shaping for Dynamical Systems Theory and Applications*; CRC Press; 2009.
(3) Weber, A.V.; Kryazhumskiy, T.; *Optimal Control Theory with Applications in Economics*; MIT Press; 2011.
(4) Gazi, V.; *Swarm Stability and Optimization*; Springer; 2011. http://dx.doi.org/10.1007/978-3-642-18041-5. [Available via Springer eBooks, UPRM General Library Databases]

Classical textbooks still among the best in the subject:

(1) Chen, C.T.; *Linear System Theory and Design*, 3rd ed.; Oxford University Press; 1999. [Available at the Circulation Collection (QA402 .C44 1999), UPRM General Library]
(2) Williams, R.L. II; Lawrence, D. A. *Linear State-Space Control Systems*; John Wiley: 2007. [Available at the Circulation Collection (QA402 .W547 2007), UPRM General Library]
(3) Anderson, B.D.O.; Moore, J.B.; *Optimal Control: Linear Quadratic Methods*; Dover Publications; 2007.

11. According to Law 51

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Person who prepared this description and date of preparation:

Eduardo. I. Ortiz-Rivera, April, 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6007
Course Title: INTRODUCTION TO REMOTE SENSING
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: History, principles and applications of remote sensing: electromagnetic radiation, aerial photography, land observation satellite system. airborne and spaceborne sensors, data and image analysis/interpretation, pattern recognition, applications on subsurface sensing.

Spanish: Este curso es una introducción a conceptos básicos, historia, métodos, tópicos y aplicaciones en Sensores Remotos. Se estudiarán principios de radiación electromagnética, fotografía aérea, interpretación de imágenes, sistema de satélites para la observación de la tierra, resolución de imágenes, preprocesamiento y clasificación de imágenes.

3. Pre/Co-requisites and other requirements:

Pre-Requisite Topics:

1. Probabilities
2. Linear Algebra
3. Physics
4. Calculus
5. Signals and systems
6. Basic programming skills in MATLAB
7. Basic optics

4. Course Objectives:

At the end of the course the student should be able to

- Describe different modalities and sensor platforms for active and passive remote sensing in different regions of the electromagnetic spectrum
- Describe limitations and degradations of remote sensing platform
- Describe all processing stages for remote sensing imagery from acquisition to final information product
- Combine different signal and image processing algorithms to enhance and extract information from remote sensing imagery
- Apply pattern recognition algorithms for image classification, evaluate their performance and assess the accuracy of the derived thematic maps
- Use the internet to search for remote sensing imagery
- Use the ENVI or MATLAB environments for remote sensing image analysis

5. Instructional Strategies:

☒conference ☒discussion ☒computation ☒laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

MATLAB or ENVI/IDL to perform computer analysis of remote sensing imagery and computer aided homework.

7. Course time frame and thematic outline

Outline	Contact Hours
1. History and principles of remote sensing	2
2. Introduction to Radiative Transfer and the physics of remote sensing	6
3. Remote sensing using passive and active modalities	6
4. Information extraction from remote sensing imagery	12
5. Hyperspectral remote sensing and information extraction	12
6. Geographic information systems	3
7. Future trends and research presentations	2
Exams	2
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**2**	**40**
☒ **Final Exam**	**1**	**30**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**20**
☐ **Journals**		
☒ **Other, specify: homework**	**1**	**10**
TOTAL:		**100%**

10. Bibliography:

Textbook:
(1) Richards, J.A.; Jia, X. *Remote Sensing Digital Image Analysis*; 5th ed. Spring-Verlag; 2013.

Additional References:
(2) Rees, W. G.; *Physical Principles of Remote Sensing*, 3rd ed. Cambridge University Press; 2013.
(3) Mather, P.; Tso, B. *Classification Methods for Remotely Sensed Data*, 2nd ed.; CRC Press, 2009. http://dx.doi.org/10.1201/9781420090741. [Available via ElectricalENGINEERINGnetBASE, UPRM General Library Databases]
(4) Schott, J.R.; *Remote Sensing: The Image Chain Approach*; 2nd ed.; Oxford; 2007. [Available at the Circulation Collection (G70.4 .S36 2007), UPRM General Library]
(5) Wang, W.Q.; *Near-Space Remote Sensing: Potential and Challenges*; Springer; 2011. http://dx.doi.org/10.1007/978-3-642-22188-0. [Available via Springer eBooks, UPRM General Library Databases]

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Person who prepared this description and date of preparation:
Miguel Vélez-Reyes, August 2007. Revised by Luis O. Jiménez-Rodríguez, February 2013.

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6009
Course Title: Computer Systems Architecture
Number of credits: 3
Contact Period: 3 contact hours per week

2. Course Description:

English: Basics in computer architecture and organization. High level language concepts. Architectural aid to the operating systems and to the compilation process

Spanish: Fundamentos de la arquitectura y organización de computadoras. Conceptos de lenguaje de alto nivel. Apoyo arquitectural al proceso de compilación y a los sistemas operativos.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

Gain Fundamental knowledge of Computer architecture old and contemporary

5. Instructional Strategies:

☒conference ☒discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☒research ☐other, please specify:

6. Minimum or Required Resources Available:

Jounals and other serial publications available in the library in Computer Engineering (IEEE & ACM)

7. Course time frame and thematic outline

Outline	**Contact Hours**
RISC and CISC ARchitectures Definición de arquitectura Distinción Entre Arquitectura y Organización Conjunto de Instrucciones Tipos de Data Registros Acceso a Memoria Efecto de la Arquitectura en la Implementación Ejemplos de Arquitecturas RISC	8
Apoyo Arquitectural a Lenguajes de Alto Nivel Instrucciones de Brinco	5

Subrutinas Register Stack Register Coloring Compiladores Optimizadores	
Pipelining “Hazzards” Implementación Manejo de brincos e interrupcione	3
Paralelismo a Nivel de Instrucciones “Hazzards” “Scheduling” Predicción de hardware Especulación	4
Apoyo Arquitectural a Sistemas Operativos Protección Seguridad Interrupciones de sistema Input/Output Relocalización de Código	5
Sistema de Memoria Memoria Primaria Caches Memoria Virtual Análisis de rendimiento	4
Aritmética Aritmética de punto fijo Aritmética de punto flotante Estándar IEEE de punto flotante	3
Sistema I/O Polling Memory-mapped I/O Programmed I/O DMA	4
Conceptos de Organización Vias de datos ALU Unidad de control	3
Multiprocessors and Thread-Level Parallelism SMP Memoria compartida Memoria distribuida Consistencia de Memoria Sincronización Rendimiento Multithreading	7
Contemporary Commercial Architectures	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**		**67%**
☐ **Final Exam**		
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**		**33%**
☐ **Journals**		
☐ **Other, specify:**		
TOTAL:		**100%**

10. Bibliography:

Text Book:

1. William Stallings, Computer Organization and Architecture, (9th edition), Prentice Hall, 2012.

Other Resources:

2. Hamacher, C., et. al, Computer Organization and Embedded Systems (6^{th} edition), McGraw – Hill, 2011.
3. Soudris, D.; Scalable Multi-core Architectures: Design Methodologies; Springer; 2012
4. Vikram Arkalgud Chandrasetty; VLSI Design; A Practical Guide for FPGA and ASIC Implementations; Springer; 2011
5. Miles J. Murdocca & Vincent P. Heuring, Principles of Computer Architecture, Prentice Hall, 2007 (Classic Reference)

11. According to Law 51

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Person who prepared this description and date of preparation:
Nestor Rodríguez, August 2007. Updated by Emmanuel Arzuaga, October 2013.

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6025
Course Title: Advanced Energy Conversion
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: Theory and design of processes for direct energy conversion. Thermoelectric, thermionic, and photovoltaic conversion. Fuel cells. Introduction to irreversible thermodynamics and its application to describe operations. MHD equations and generators.

Spanish: Teoria y disenyo de procesos de conversion directa de energia. Conversión termoelectrica, termionica y fotovoltaica. Celdas de combustible. Introducción a termodinámica irreversible y su aplicacion para describir operaciones. Ecuaciones magnetohidronámicas (MHD) y generadores.

3. Pre/Co-requisites and other requirements:

Permission from the Director

4. Course Objectives:

Students will describe a variety of processes for direct energy conversion of energy in one form to electric energy. Describe and evaluate renewable electric energy sources and their associated energy conversion methods to obtain electrical energy as well as needed electric energy storage. Explain important technical and social considerations regarding use and application of renewable energy sources.

5. Instructional Strategies:

☒conference ☒discussion ☒computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Strong emphasis will be given to the use of professional journals available to UPRM students through internet in http://ieeexplore.ieee.org.

7. Course time frame and thematic outline

Outline	Contact Hours
Energy Sources and Technologies Solar, MHD, Wind, Hydrogen,and other sources, Storage technologies	18

Interconnection Issues Power electronics & power quality Net metering & DG Standards Economic analysis	15
Social Implications of Energy Energy Policy Public perception Environment and compliance technologies Life cycle analysis	10
Exams	2
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**2**	**40**
☐ **Final Exam**		
☐ **Short Quizzes**		
☐**Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**2**	**50**
☐**Journals**		
☒**Other, specify: Homework**	**varies**	**10**
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Bollen, M.; Hassan, F.; *Integration of Distributed Generation in the Power System*; Wiley & Sons; 2011.

Additional References:

(2) Khaligh, A.; Onar, O. C.; *Energy Harvesting: Solar, Wind, and Ocean Energy Conversion Systems*; CRC; 2010. [Available via ElectricalENGINEERINGnetBASE, UPRM General Library Databases]

(3) San Cristobal Mateo, J. R.; *Multi Criteria Analysis in the Renewable Energy Industry*; Springer; 2012. http://dx.doi.org/10.1007/978-1-4471-2346-0. [Available via Springer eBooks, UPRM General Library Databases]

(4) Michaelides, E.; *Alternative Energy Sources*; Springer; 2012. http://dx.doi.org/10.1007/978-3-642-20951-2. [Available via Springer eBooks, UPRM General Library Databases]

(5) *IET Journals, Renewable Power Generation*, URL: http://ieeexplore.ieee.org/servlet/opac?punumber=4159946

Classic References:

(6) Smil, V.; *Energy at the Crossroads: Global Perspectives and Uncertainties*, 2003. [Available at the Circulation Collection (HD9502 .A2 S543 2003), UPRM General Library]

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Person who prepared this description and date of preparation:

Agustín Irizarry, August 2007: Revised by Erick Aponte, March 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6026
Course Title: COMPUTATIONAL METHODS FOR POWER SYSTEMS ANALYSIS II
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: Application of Numerical Techiques and Computer Methods to The Solution of A Variety of Problems Related to The Planning, Design and Operation of Large Interconnected Electric Power Systems.

Spanish: La Aplicacion de Tecnicas de Analisis Numéricos y el Uso Decomputadoras Electrónicas en la Solución de Problemas Relacionados Con la Planificación, el Diseno y la Operación de Sistemas Eléctricos Interconectados.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

Apply different evolutionary computation (EC) techniques to the solution of a variety of problems related to the planning, design and operation of large interconnected electric power systems. Implement various evolutionary computation algorithms. Discuss tradeoffs between different evolutionary algorithms and other optimization methods. Discuss issues related to the application and performance evaluation of evolutionary algorithms.

5. Instructional Strategies:

☒conference ☒discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Standard lecturing facilities and MATLAB software.

7. Course time frame and thematic outline

Outline	Contact Hours
Overview of Optimization	3
Introduction to Evolutionary Computation	3
Evolutionary Programming	3
Evolution Strategies	3
Differential Evolution	3

Particle Swarm Optimization	3
Ant Colony Search	3
Constraint Handling Techniques	3
Multi-Objective Optimization	3
Design Considerations	3
Advanced Topics	9
Project Presentations	6
Total hours: (equivalent to contact period)	45

8. Grading System

☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**1**	**15%**
☐ **Final Exam**		
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**		**15%**
☐ **Journals**		
☒ **Other, specify: homework articles review and critiques, term paper**		**70%**
TOTAL:		**100%**

10. Bibliography:

Textbook:

1. Z. Stojkovic; Computer-Aided Design in Power Engineering; Springer; 2012

References:

2. L. Wang; Modeling and Control of Sustainable Power Systems; Springer; 2012
3. X. Wan; Electrical Power Systems and Computers; Springer; 2012
4. M. Cepin; Assessment of Power System Reliability; Springer; 2011

Classic References:

5. D. Dumitrescu, "Evolutionary Computation", CRC Press, 2000.(classical reference)IEEE Transactions on Evolutionary Comuputation. URL: http://ieeexplore.ieee.org/servlet/opac?punumber=4235
6. Evolutionary Computation 1: Basic Algorithms and Operators edited by T. Bäck, D. B. Fogel, Z. Michalewicz, 2000.(classical referemce)
7. Evolutionary Computation 2: Advanced Algorithms and Operators edited by T. Bäck, D. B. Fogel, Z. Michalewicz, 2000.(classical reference)

11. According to Law 51

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Person who prepared this description and date of preparation:

José R. Cedeño, August 2007, Revised by Eduardo I. Ortiz-Rivera, October 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Master of Science in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL6027
Course Title: Dynamics and Control of Integrated Power System
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: Discussion of a variety of transient and control problems associated with interconnected power systems, and techniques for their analysis and solution. Methods for dynamic analysis of large systems are stressed.

Spanish: Discusión de problemas transitorios y de control asociados a sistemas de potencia eléctrica interconectados y de técnicas para sus análisis y solución. Se enfatizan métodos para el análisis dinámico de sistemas grandes.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

This is a graduate level course where mathematical models of power system components are developed and used in varying degrees of detail to analyze the dynamic behavior of interconnected power systems in response to small and large disturbances.

5. Instructional Strategies:

☒conference ☒discussion ☒computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Students are required to use EPRI's PSAPAC software, available in the electrical engineering computing centers, to solve homework problems and projects.

7. Course time frame and thematic outline

Outline	Contact Hours
Basic concepts; definition of stability	4
System dynamic performance and criteria for system dynamic performance	4
Types of stability studies, The swing equation	4
The Equal Area Criterion; Synchronizing power	4
Multimachine dynamics and stability studies	5
Synchronous Machine, Two-axis model, Parameters	5

Synchronous Machine and Network Interaction, Interfase	6
Modeling of Controls and Loads, Turbines, Excitation Systems	5
Small Signal Stability, Linearization, Eigenvalues, Modes	5
Exams	3
Totla hours: (equivalent to contact period)	45
Total hours: (equivalent to contact period)	

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

Standard Curve:

100-90 A; 89-80 B; 79-70 C; 69-60 D; 59-0 F

9. Evaluation Strategies

	Quantity	**Percent**
☒ **Exams**	**1**	**20**
☐ **Final Exam**		
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**3**	**50**
☐ **Journals**		
☒ **Other, specify: Homework**	**varies**	**30**
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Kundur, P.; Balu, N. J.; Lauby, M. G.; Power System Stability and Control; McGraw-Hill; 1994. Classic Textbook [Available at the Circulation Collection (TK1005 .K86 1994), UPRM General Library]

Additional References:

(2) Eremia; M.; Shahidehpour, M.; Handbook of Electrical Power System Dynamics: Modeling, Stability, and Control; IEEE Press Series on Power Engineering (Book 92); 2013.

(3) Pourbeik, P.; Power systems (review of "Power System Dynamics--Stability and Control by Machowski, J. et al; [Book reviews]; IEEE Power and Energy Magazine; Vol.7, no.5, 2009, pp.72-74. http://dx.doi.org/10.1109/TCSI.2009.2016169. [Available via IEEE Xplore, UPRM General Library Databases]

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University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6028

Course Title: OPTIMIZATION AND ECONOMIC OPERATION OF INTEGRATED POWER SYSTEMS

Number of credits: 3

Contact Period: 3 hours of lecture per week

2. Course Description:

English: Theory of Optimization Under Equality and Inequality Constraints; computational Methods and Application to Generation Scheduling in Intergrated Power Systems.

Spanish: Teoría de Optimización Bajo Condiciones de Igualdad y Desigualdad; Métodos Computacionales y Su Aplicación Al itinerario de Generación en Sistemas Integrados de Potencia Eléctrica.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

Explain modern power system operation and control issues. Apply optimization methods to solve unit commitment, generation control, energy interchange, state estimation, optimal power flow, security assessment, and emergency operation problems in power systems.

5. Instructional Strategies:

☒conference ☒discussion ☒computation ☐laboratory

☒seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☒trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Standard lecturing facilities. Standard software for power systems analysis.

7. Course time frame and thematic outline

Outline	Contact Hours
Overview of Power Systems Operation and Control	3
Mathematical Background	4.5
Unit Commitment	4.5
Control of Generation	4.5
Interchange of Power and Energy	4.5
State Estimation	6
Optimal Power Flow	6
Power System Security	6
Emergency Operations	6

Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**2**	**50%**
☐**Final Exam**		
☒ **Short Quizzes**	**Several**	**15%**
☐**Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**20%**
☐**Journals**		
☒**Other, specify: homework**	**Several**	**15%**
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Wood, A. J.; Wollenberg, B. F. *Power Generation, Operation, and Control*; 3. ed.; John Wiley and Sons, 2013

Additional References:

(2) Crow, M.; *Computational Methods for Electric Power Systems*; 2. ed.; CRC Press; 2009.

(3) Bayon, L.; Grau, J.M.; Ruiz, M.M.; Suarez, P.M.; The Exact Solution of the Environmental/Economic Dispatch Problem; *IEEE Transactions on Power Systems*; Vol.27, no.2, 2012, pp.723-731. http://dx.doi.org/10.1109/TPWRS.2011.2179952. [Available via IEEE Xplore, UPRM General Library Databases]

(4) Gan, D.; Feng, D.; Xie, J. *Electricity Markets and Power System Economics*; CRC Press 2013. http://dx.doi.org/10.1201/b15550. [Available via ElectricalENGINEERINGnetBASE, UPRM General Library Databases]

(5) Droste-Franke, B; Paal, B.P.; (et.al) *Balancing Renewable Electricity*; Springer; 2012. http://dx.doi.org/10.1007/978-3-642-25157-3. [Available via Springer eBooks, UPRM General Library Databases]

11. According to Law 51

Students will identify themselves with the Institution and the instructor of the course for purposes of assessment (exams) accommodations. For more information please call the Student with Disabilities Office which is part of the Dean of Students office (Office #4) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258 or by email at virgen.aponte@upr.edu .

Person who prepared this description and date of preparation:

José R. Cedeño, August 2007; Revised by Eduardo I. Ortiz-Rivera, October 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6047
Course Title: ADVANCED CONTROL SYSTEM THEORY
Number of credits: 3 credit
Contact Period: 3 hours of lecture

2. Course Description:

English: Advanced Problems In Linear and Nonlinear Control Systems. The use of Linear Algebra for The Analysis and Design of Linear Systems Is Emphasized. The Implementation of Linear Systems Via Analog and Digital Simulation Diagrams Is Also Studied.

Spanish: Problemas Avanzados en Sistemas de Control Lineales y No-lineales. Se Enfatiza el Uso de Algebra Lineal Para el Analisis y Diseno de Sistemas de Control Lineales. Se Estudia, Ademas, la Implantacion de Sistemas Lineales Mediante Diagramas de Simulacion Analógicos y Digitales.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

Introduce students to advanced methodologies in control systems design.

5. Instructional Strategies:

☒conference ☐discussion ☒computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Access to MATLAB Software and standard lecture facilities.

7. Course time frame and thematic outline

Outline	**Contact Hours**
Introduction to multivariable control systems.	2
State variable representation of dynamic systems.	4
Solution of the state equation: time and frequency domain methods. Modes of dynamic systems.	6
Internal and Lyapunov stability. Poles of multivariable systems.	6
Controllability and Observability.	6
Realizability and minimal realization.	3
Multivariable transmission zeros. Multivariable pole-zero	3

cancellations.	
Introduction to feedback systems. Full-state and output feedback. Eigenstructure assignment.	12
Tests	3
Total hours: (equivalent to contact period)	

8. Grading System

☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**2**	**40**
☒ **Final Exam**	**1**	**30**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**20**
☐ **Journals**		
☒ **Other, specify: homework**	**3-5**	**10**
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Antsaklis, P.J. Michel, A.N.; *Linear Systems*; Birkhauser; 2006. (Classical textbook).

Additional References:

(2) Rajamani, R.; *Vehicle Dynamics and Control*; Springer; 2012. http://dx.doi.org/10.1007/978-1-4614-1433-9. [Available via Springer eBooks, UPRM General Library Databases]

(3) Deng, W.; *Future Control and Automation*; Springer; 2012. Vol. 1. http://dx.doi.org/10.1007/978-3-642-31006-5. [Available via Springer eBooks, UPRM General Library Databases]. Vol. 2. http://dx.doi.org/10.1007/978-3-642-31003-4. [Available via Springer eBooks, UPRM General Library Databases].

(4) Mahmoud, M.S.; Xia, Y.; *Applied Control Systems Design; Springer*; 2012. http://dx.doi.org/10.1007/978-1-4471-2879-3. [Available via Springer eBooks, UPRM General Library Databases]

Classic References:

(5) Williams, R.L. II; Lawrence, D. A. *Linear State-Space Control Systems*; John Wiley; 2007.

(6) Chen, C.T. *Linear System Theory and Design*; Oxford University Press; 1999.

11. According to Law 51

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Person who prepared this description and date of preparation:

Miguel Vélez-Reyes, August 2007; Revised by Eduardo I. Ortiz-Rivera, October 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6048
Course Title: ADVANCED MICROPROCESSOR INTERFACING
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: Architecture of 8, 16, and 32 bits microprocessors; bus, input/output and memory interfacing; parallel processing architecture; configuration and interfacing of multiprocessors; applications of the multiprocessor system.

Spanish: Arquitectura de microprocesadores de 8, 16 y 32 bits; interfase del bus, entrada/salida y memoria; arquitecturas de procesamiento en paralelo; configuración e interfase de multiprocesadores; aplicaciones de sistemas de multiprocesadores.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

Prepare students to work on the development of advance embedded and conventional computer systems by studying modern platforms and to describe the hardware and software aspects of system interfacing.

5. Instructional Strategies:

☒conference ☐discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Standard lecturing facilities. Microprocessors interfacing laboratory.

7. Course time frame and thematic outline

Outline	Contact Hours
1. Embedded system design process	2
2. Architecture and instruction sets	8
3. Hardware interfacing and FPGA's	10
4. Software interfacing and operating systems	8
5. Communication protocols	8
6. System design methods	6
7. Tests	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ Exams	2	30
☒ Final Exam	1	20
☐ Short Quizzes		
☐ Oral Reports		
☐ Monographies		
☐ Portfolio		
☒ Projects	1	25
☐ Journals		
☒ Other, specify: homework	2-3	25
TOTAL:		100%

10. Bibliography:

Text Book:

1. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design; MORGAN Kaufmann Publishers; Inc. 2001. (Classical Textbook)

References:

2. M. Jimenez; R.Palomer; I. Couvertier , "Introduction to Embedded Systems: Using Microcontrollers and the MSP430", Springer, 2013
3. Spartan-3 Generation FPGA Users Manual and ISE 9.2i Software Manuals, http://www.xilinx.com
4. G. Nicolescu; I. O'Connor; Design Technology for Heterogeneous Embedded Systems; Springer; 2012

Classic References:

4. S. Ball, Analog Interfacing to Embedded Microprocessor Systems, Second Edition (Embedded Technology Series) Newnes, 2004 (Classical Textbook)

5. R. Zurawski, Embedded Systems Handbook, CRC Press, 2005

11. According to Law 51

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Person who prepared this description and date of preparation:
Manuel Toledo, August 2007 Revised by Eduardo I. Ortiz-Rivera, October 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6049
Course Title: Multidimensional Signal Processing
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: Representation of multidimensional signals and systems; Fourier analysis of multidimensional signals; design and implementation of two-dimensional digital filters; applications of digital filtering techniques to beam forming and image analysis.

Spanish: Representacion de Senales y Sistemas Multidimensionales; Analisis de Fourier de Senales Multidimensionales; Diseno e Implantacion de Filtros Digitales Bidimensionales; Aplicaciones de Tecnicas de Filtrosdigitales A la Formacion de Haces y Analisis de Imagenes.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

After completing the course, the student should be able to: analyze discrete multidimensional signals and systems using the DFT, DTFT and Z transforms; design FIR and IIR discrete multidimensional filters; analyze discrete multidimensional signals using the DFT.

5. Instructional Strategies:

☒conference ☒discussion ☐computation ☒laboratory

☒seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

7. Course time frame and thematic outline

Outline	Contact Hours
1. Multidimensional Signals and Systems a. 2-D Discrete Signals. b. Multidimensional Systems. c. Frequency-domain characterization of signals and systems. d. Sampling continuous 2-D signals.	3
2. Discrete Fourier Analysis of Multidimensional Signals a. Multidimensional Discrete Fourier Transform.	6

b. Linear and Cyclic Convolution.	
3. Design and Implementation of 2-D FIR filters a. Implementation. b. Design using windows.	9
4. Multidimensional Recursive Systems a. Finite order difference equations. b. Multidimensional Z-transform and the concept of Stability.	6
5. Design and implementation of 2-D IIR filters a. Implementation. b. Design in state space and in the frequency domain	6
6. Applications in Image Processing a. Short-time Fourier Transform b. Beamforming c. Adaptive and Nonlinear Techniques d. Image Formation from Sensor Data	12
7. Exams	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**2**	**30**
☒ **Final Exam**	**1**	**15**
☒ **Short Quizzes**	**4**	**20**
☐ **Oral Reports**	**1**	**5**
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**3**	**20**
☐ **Journals**		
☐ **Other, specify: homework**	**10**	**10**
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Woods, J. *Multidimensional Signal, Image, and Video Processing and Coding*, Elsevier Science & Technology Books; 2011.

Additional References:

(2) Dudgeon, D. E.; Mersereau, R. M.; *Multidimensional Signal Processing*, 1984 (Classical textbook). [Available at the Circulation Collection (TK5102.5 .D83 1984), UPRM General Library]

(3) Keinert, J.; Teich, J.; *Design of Image Processing Embedded Systems Using Multidimensional Data Flow*; Springer; 2011. http://dx.doi.org/10.1007/978-1-4419-7182-1. [Available via Springer eBooks, UPRM General Library Databases]

(4) Bhattacharyya, S. S.; *Handbook of Signal Processing Systems*, Springer; 2010. http://dx.doi.org/10.1007/978-1-4419-6345-1 [Available via Springer eBooks, UPRM General Library Databases]

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Person who prepared this description and date of preparation:

Domingo Rodríguez, August 2007. Updated by Lizdabel Morales, May 2013.

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6050
Course Title: ADVANCED DIGITAL SIGNAL PROCESSING ALGORITHMS
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: Theoretical foundatins, fast algorighms for the Discrete Fourier Transform. Fast convolution algorithms, multidimensional techniques, fast filtering computations, architecture of filters and transforms, fast algorighms in VLSI. Application studies in transmission error controlling codes, sonal, radar, speech, image processing, and other engineering areas. Study of software implementations on vector and parallel architectures. Algorighms and symbolic computation.

Spanish: Fundamentos Teoricos, Algoritmos Rapidos Para la Transformada Discretade Fourier, Algoritmos Para Convoluciones Rapidas, Tecnicas Multidi- Mensionales, Computaciones Rapidas de Filtrado, Arquitecturas de Filtros y Transformads, Algoritmos Rapidos en Vlsi. Estudio de Aplica-ciones en Codigos Para Controlar Errores de Transmision, Procesamientode Senales de Sonar, Radar, el Habla, Imagenes, y Otras Areas de Ingenieria. Estudio de Implantaciones en Programados en Arquitecturas Vectoriales y Paralelas. Algoritmos y la Computacion Simbolica.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

The student will be able to apply advanced mathematical techniques and a theoretical framework for the analysis, design, and implementation of signal processing algorithms for diverse applications and to develop system-level algorithm with the assitance of MATLAB

5. Instructional Strategies:

☒conference ☒discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☒special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

MATLAB software and standard lecturing facilities.

7. Course time frame and thematic outline

Outline	Contact Hours
1. Introduction to Digital Signal Processing and Digital	6

Communications a. Digital Signals and Systems b. Fundamental Concepts of Analog and Digital Communications Systems c. Fundamental Concepts of Discrete-time Signal Processing d. Cyclic Convolution Operations and Fast Unitary Transforms	
2. Fundamental Algebraic Structures a. Sets, Relations, Cartesian Products, Number Functions b. Semi-groups, Groups, Fields, Vector Spaces, Linear Algebras	6
3. Finite Dimensional Linear Operators and Signal Algebras a. Matrix Representations b. Algorithm Implementations	3
4. Finite Impulse Response Filters and the Discrete Fourier Transform a. Linear and Cyclic Arithmetic Complexities b. Algorithm Implementations	6
5. Cyclic Codes a. Linear Codes vs. Convolutional Codes b. Algorithm Implementations	3
6. Fast Algorithms for Multidimensional Applications a. Fourier Transform b. Block Convolutions and Toeplitz Systems	6
7. Software and Hardware Algorithm Design and Development Techniques a. Source and Channel Coding Applications b. Digital Modulation Applications c. Time-frequency Signal Analysis Algorithm Applications d. Space-time Adaptive Processing Algorithm Applications	12
Exams	3
Total hours: (equivalent to contact period)	

8. Grading System

☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**1**	**10**
☒ **Final Exam**	**1**	**20**
☒ **Short Quizzes**	**2**	**10**
☐ **Oral Reports**	**2**	**10**
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**2**	**30**
☐ **Journals**		
☒ **Other, specify: homework**	**10**	**20**
TOTAL:		**100%**

10. Bibliography:

Text Book:

1. Bi, G.; Zeng, Y. *Transforms and Fast Algorithms for Signal Analysis and Representations*, Birkhäuser; 2004. (Classical textbook).

Additional References:

(2) Blahut, R. E.; *Algebraic Codes for Data Transmission*; Cambridge Press University; 2002. (Classical textbook). [Available via EBSCO eBooks, UPRM General Library Databases]

(3) Bhattacharyya, S.S.; *Handbook of Signal Processing Systems*; Springer; 2010. 10. http://dx.doi.org/1007/978-1-4419-6345-1 [Available via Springer eBooks, UPRM General Library Databases]

(4) Benesty, J. (et.al.); *Springer Handbook of Speech Processing*; Springer; 2008. http://dx.doi.org/10.1007/978-3-540-49127-9 [Available via Springer eBooks, UPRM General Library Databases]

(5) Pohl, V.; Boche, H.; *Advanced Topics in System and Signal Theory*; Springer; 2010. http://dx.doi.org/10.1007/978-3-642-03639-2 [Available via Springer eBooks, UPRM General Library Databases]

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Person who prepared this description and date of preparation:

Domingo Rodríguez, August 2007. Updated by Lizdabel Morales, April 2013.

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6055
Course Title: SOLID STATE ELECTRONICS
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: This course deals with solid-state electronic devices that utilize the conductive, dielectric, magnetic and optimal properties of materials. Some of the topics included are atomic structure, interatomic forces and crystal structures, and conduction mechanisms.

Spanish: Este curso trata con aparatos electrónicos de estado sólido que utilizan las propiedades de conducción, dieléctricas, magnéticas y ópticas de los materiales. Algunos temas incluidos son la estructura atómica, fuerzas interatómicas, estructuras cristalinas, y mecanismos de conducción.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

This course introduces theory and techniques for the analysis of nonlinear dynamical systems and the design of nonlinear control. It emphasizes rigorous analysis supplemented with computer simulation.

5. Instructional Strategies:

☒conference ☐discussion ☒computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☒other, please specify: Literature review

6. Minimum or Required Resources Available:

Standard lecturing facilities

7. Course time frame and thematic outline

Outline	Contact Hours
Introduction to semiconductor materials	4
Semiconductor physics and conductivity	9
Capacitance of reverse-biased PN junctions and MOS structures	7
Forward-biased PN juctions	5
MOSFETs	4
Bipolar transistors	6
IC Devices and technologies	4

Photonic devices	3
Tests	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**3**	**40**
☒ **Final Exam**	**1**	**20**
☐ **Short Quizzes**		
☒ **Oral Reports**	**1**	**5**
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**20**
☐ **Journals**		
☒ **Homework**	**2-4**	**10**
☒ **Other, specify: Paper review**	**1**	**5**
TOTAL:		**100%**

10. Bibliography:

Text Book:

1. S. Dimitrijev, Principles of Semiconductor Devices, Oxford University Press, 2012

Other Resources:

2. U. Mishra; J.Singh, “Semiconductor Device Physics and Design”,Springer, 2008

3. V.A. Vashchenko, V.F. Sinkevithch, “Physical Limitations of Semiconductor Devices”, Springer, 2008

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Person who prepared this description and date of preparation:
Guillermo Serrano, August 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6058
Course Title: High Frequency Power Converters
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: Simulation, analysis, modeling, design and control of high frequency power converters. Unidirectional and bidirectional soft-switching topologies for dc to dc and dc to single-phase or three-phase power converters and their applications in various industrial fields.

Spanish: Simulación, análisis, modelado, diseño y control de convertidores a alta frequencia. Topologías unidireccionales y bidireccionales con conmutación suave para convertidores de cd a cd y de cd a monofásico o a trifásico y sus applicaciones en varios campos industriales.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

The student will be able to analyze and design high frequency power conversion circuits for applications in different industrial fields using analytical and simulation tools.

5. Instructional Strategies:

☒conference ☒discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Matematical and circuit simulation software such as SABER, PSpice and MATLAB available in electrical engineering computing centers to solve projects.

7. Course time frame and thematic outline

Outline	Contact Hours
High frequency effects on power converter components, operation and electromagnetic interference	2
Soft-switching in power converters	2
Quasi-resonant, Resonant and Multi-resonant dc-dc power converters: Operation, analysis, design and applications	12
Simulation, modeling and control of soft-switched dc-dc power converters converters	4
Bidirectional soft-switched dc-dc converters: Operation, analysis,	2

design and applications	
Single-phase and three-phase to dc soft-switched rectifiers and inverters: Operation, analysis, design and applications	10
Bidirectional soft-switched single-phase and three-phase to dc power converters	6
Modeling of soft-switched dc-dc, single-phase and three-phase to dc bidirectional converters	6
One Exam	1
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☐ **Exams**		
☐ **Final Exam**		
☐ **Short Quizzes**		
☐**Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**5**	**100**
☐**Journals**		
☐**Other, specify:**		
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Hart, D.; *Power Electronics*; 1st ed.; McGraw-Hill; 2010.

Additional References:

(2) Jayant Baliga, B.; *Advanced High Voltage Power Device Concepts*; Springer; 2012. http://dx.doi.org/10.1007/978-1-4614-0269-5. [Available via Springer eBooks, UPRM General Library Databases]

(3) Liu, Y.; *Power Electronic Packaging*; Springer; 2012. http://dx.doi.org/10.1007/978-1-4614-1053-9 [Available via Springer eBooks, UPRM General Library Databases]

(4) Trzynnadlowski, A.; *Introduction to Modern Power Electronics*; 2nd ed.: Wiley; 2010.

Classical references still among the best in the subject:

(5) Buso, S.; *Digital Control in Power Electronics* (Synthesis Lectures in Power electronics): Morgan and Claypool; 2007. http://dx.doi.org/10.2200/S00047ED1V01Y200609PEL002 [Available via Morgan and Claypool eBooks, UPRM General Library Databases]

(6) Van den Bossche, A.; Valchev V. C.; *Inductors and transformers for Power Electronics*; CRC; 2005. http://dx.doi.org/10.1201/9781420027280. [Available via ElectricalENGINEERINGnetBASE, UPRM General Library Databases]

(7) Mohan, N.; Undeland, T.; Robbins, W. *Power Electronics-Converters, Applications and Design*. John Wiley & Sons Inc.; 2003. [Available at the Circulation Collection (TK7881.15 .M64 2003), UPRM General Library]

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Person who prepared this description and date of preparation:

Eduardo I. Ortiz-Rivera, February 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6059
Course Title: INTELLIGENT SYSTEMS AND CONTROL
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: Engineered intelligent systems and their application to complex decision, modeling, and control processes.

Spanish: Sistemas Inteligentes artificiales y su aplicación a procesos complejos de decisión, modelado y control.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

Upon completion of the course, students should be able to apply neural networks, fuzzy logic, and genetic algorithms to the design of artificial intelligent systems for different applications.

5. Instructional Strategies:

☒conference ☒discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Electrical measurement equipment, electronic components, personal computers, some with data acquisition boards and software.

7. Course time frame and thematic outline

Outline	Contact Hours
Introduction 1. What is intelligence and artificial intelligence? 2. Expert system characteristics. 3. Learning mechanisms. 4. Mathematical modeling for estimations and approximations.	6
Neural Networks 1. Biological neural systems 2. Artificial Neural Networks a. Perceptron b. Backpropagation c. Associate Memories d. HPP Network e. ART and ART II (optional)	12

3. Recurrent Neural Networks 4. Applications	
First Project: Oral Presentations	3
Fuzzy Controllers 1. Fuzzy numbers and arithmetic 2. Conditional fuzzy rules 3. De-fuzzyfication rules 4. Applications	12
Genetic Algorithms 1. Terms and definitions 2. Representation of generations 3. Genetic Operators 4. Optimization 5. Applications	8
Second Project: Oral Presentations	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☐ **Exams**		
☐ **Final Exam**		
☐ **Short Quizzes**		
☒**Oral Reports**	**2**	**25**
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**2**	**40**
☐**Journals**		
☒**Other, specify: Assignments**	**8**	**35**
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Irwin, J. D.; *Intelligent Systems*; CRC Press; 2011. http://dx.doi.org/10.1201/b10604. [Available via ElectricalENGINEERINGnetBASE, UPRM General Library Databases]

Additional References:

(2) Hopgood, A. *Intelligent Systems for Engineers and Scientists*; 3rd ed.; CRC Press;2011. [Available via ElectricalENGINEERINGnetBASE, UPRM General Library Databases]

(3) Ponce-Cruz, P.; Ramirez-Figueroa, F. *Intelligent Control Systems with Labview*; Springer; 2010. http://dx.doi.org/10.1007/978-1-84882-684-7. [Available via Springer eBooks, UPRM General Library Databases]

(4) Liu, D.; Wang, L.; Tan, K.; *Design and Control of Intelligent Robotic Systems*; Springer; 2009. http://dx.doi.org/10.1007/978-3-540-89933-4. [Available via Springer eBooks, UPRM General Library Databases]

(5) Valavanis, K.; *Applications of Intelligent Control to Engineering Systems*; Springer, 2009 http://dx.doi.org/10.1007/978-90-481-3018-4. [Available via Springer eBooks, UPRM Library

11. According to Law 51

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Person who prepared this description and date of preparation:

Raul E. Torres, May 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6066
Course Title: CONTROL OF ELECTRIC DRIVE SYSTEMS
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: Theory and operation of phase and chopper controlled direct current (DC) drives, closed loop d.c. drives and their analysis, phase locked loop d.c. drives; Speed control and control schemes for induction and synchronous motors; inverters and cycloconverters; closed loop alternating current (a.c.) drives; stability and performance analysis.

Spanish: Teoría y operación de accionadores de corriente directa (CD) controlados por fase, accionadores c.d. de lazo cerrado y su análisis, accionadores de corriente directa de fase cerrada; Control de velodidad y esquemas de control para motores de inducción y sincrónicos; inversores y cicloconvertidores; accionadores de corriente alterna (c.a.); estabilidad y análisis de desempeño.

3. Pre/Co-requisites and other requirements:

1. DC motors: torque vs speed characteristics, dynamic model, closed loop control.
2. Induction and synchronous motors: torque vs speed characteristics, basic control using variable voltage or variable frequency operation.
3. Basic concepts in power converters
4. Feedback control systems

4. Course Objectives:

Explain basic concepts of AC and DC electric drives. Analyze the basic configurations, and design speed control schemes for the most common industrial applications. Students will also be able to perform advanced studies and research in electric drives.

5. Instructional Strategies:

☒conference ☒discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

This course will have a significant use of computers for problem sets and projects. Two software packages will be used in the course: MATLAB and PSPICE.

7. Course time frame and thematic outline

Outline	Contact Hours
1- Review of torque vs speed steady-state characteristics for	1

induction and dc motors.	
2- Review of power converters for electric drives.	2
3- Closed loop control of DC motor drives.	6
4- Space vector modeling of AC machines.	6
5- Vector and field oriented control of AC machines.	6
6- Modeling and control of induction motor drives.	4
7- Modeling and control of permanent magnet and brushless dc motors.	3
8- Modeling and control of switched reluctance motors.	3
9- Sensors and transducers used in electric drive systems	3
10- Hardware for controller implementation.	4
11- Power quality issues in electric drives. 12- Exams	3 4
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	**Percent**
☒ **Exams**	**3**	**50%**
☒ **Final Exam**	**1**	**20%**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**20%**
☐ **Journals**		
☒ **Other, specify: homework**	**1**	**10%**
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Novotny, D.W. ; Lipo, T.A.; *Vector Control and Dynamics of AC Drives*; Oxford University Press: 1998. (Classic textbook). [Available at the Circulation Collection (TK2744 .N68 1997), UPRM General Library]

Additional References:

(2) Mohan, N. *Electric Machines and Drives*; 1st ed.; Wiley; 2012.

(3) Donker, R.D.; Pulle, D.W.J.; Veltman, A.; *Advanced Electrical Drives*; Springer; 2011. http://dx.doi.org/10.1007/978-94-007-0181-6. [Available via Springer eBooks, UPRM General Library Databases]

(4) Marino, R.; Tomei, P.; *Induction Motor Control Design*; Springer; 2010. http://dx.doi.org/10.1007/978-1-84996-284-1. [Available via Springer eBooks, UPRM General Library Databases]

(5) Emadi, A.; Gao, Y.; Ehsan, M.; *Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design;* 2nd ed.; CRC Press; 2009. http://dx.doi.org/10.1201/9781420054002. [Available via ElectricalENGINEERINGnet BASE, UPRM General Library Databases]

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Person who prepared this description and date of preparation: Andres J. Diaz, May 2009

Revised by Eduardo I. Ortiz-Rivera, February, 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6075
Course Title: Integrated Circuits Fabrication
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: Basic principles underlying the fabrication of circuits with emphasis in very large scale integrated systems (VLSI). Properties of materials like silicon and gallium arsenide; phase diagrams; solid solubility; crystal growth; doping; evaporation; sputtering epitaxy; diffusion; ion implantation; oxidation; lithographic process; device and circuit fabrication. Thin and thick film circuits, assembly, packaging processing, yield and reliability.

Spanish: Principios básicos de la fabricación de circuitos con énfasis en sistemas integrados de gran escala (VLSI). Propiedades de materiales como silicio, arsenuro de galio; diagramas de fase; solubilidad sólida, crecimiento de cristales, dopaje, evaporación; deposición epitaxial, difusión, implante de iones, oxidación, proceso litográfico, fabricaron de dispositivos y circuitos. Circuitos de lamina delgada y gruesa, procesamiento de empaque, producción y confiabilidad.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

Students should be able to describe integrated circuit fabrication technologies and apply these technologies in the design of integrated circuits.

5. Instructional Strategies:

☒conference ☐discussion ☒computation ☐laboratory

☒seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☒special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Standard lecturing facilities and computer aided design tools available in ICDL.

7. Course time frame and thematic outline

Outline	Contact Hours
1. Thermal Oxidation	4
2. Photolithography	8
3. Etching (Dry and wet)	6
4. Dopant Diffusion	6
5. Metal Evaporation	7
6. Device Electrical Testing	4

7. System Integration	7
8. Tests	3
Total hours: (equivalent to contact period)	45

8. Grading System

☐ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**3**	**60**
☒ **Final Exam**	**1**	**30**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☐ **Projects**		
☐ **Journals**		
☒ **Other, specify: Homework**	**3-4**	**10**
TOTAL:		**100%**

10. Bibliography:

Textbook:

1. Ai-Qun Liu; RF MEMS Switches and Integrated Switching Circuits; Springer; 2010

References:

1. Ioannis Kymissis; Organic Field Effect Transistors; Springer; 2009
2. Manfred Dietrich; Process Variations and Probabilistic Integrated Circuit Design; Springer; 2012

Classic References:

1. Richard C Jaeger and Travis Blalock, Microelectronic Circuit Design, McGraw Hill, 2007
2. David A. Hodges, Analysis and Design of Digital Integrated Circuits, McGraw Hill, 2003
3. S.A. Campbell, The Science and Engineering of Microelectronic Fabrication, Oxford University Press, 2nd edition, 2001
4. Peter Van Zant, Microchip Fabrication: A Practical Guide to Semiconductor Processing, McGraw Hill, 2000
5. Richard C. Jaeger, Introduction to Microelectronic Fabrication, Second Edition, Prentice Hall 2001

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Person who prepared this description and date of preparation:

Nelson Sepulveda, August 2007. Updated by Guillermo Serrano, October 2013.

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Ph.D. in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6076
Course Title: Adaptive and Optimal Signal Processing
Number of credits: 3
Contact Period: 3 hours of lecture

2. Course Description:

English: Signal and system modeling, spectrum estimation, linear optimum filtering, linear and nonlinear adaptive filtering.

Spanish: Modelaje de señales y sistemas, estimación del espectro de potencia, filtraje lineal óptimo, filtraje adaptivo lineal y alineal.

3. Pre/Co-requisites and other requirements:

INEL 6078

4. Course Objectives:

After completing the course, the student should be able to model stochstic signals and linear systems, be able to estimate power spectral densities, be able to design and implement optimal and adaptive filters based on various algorithms including Kalman, Wiener, RLS, LMS, and Neural Networks.

5. Instructional Strategies:

☒conference ☐discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Access to MATLAB software and standard lecturing facilities

7. Course time frame and thematic outline

Outline	Contact Hours
Review of Stochastic Processes	3
Linear System Models	3
FIR Wiener Filters	5
IIR Wiener Filters	5
Steepest Descent Algorithm	3
LMS Algorithm	5
Systems based on Least Squares	3
Computing the LS solution	5
Recursive Least Squares	3
Kalman Filters	5

Non-linear Adaptive Filters	2
Exams	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**3**	**60**
☒ **Final Exam**	**1**	**30**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☐ **Projects**		
☐ **Journals**		
☒ **Other, specify: homework**	**3 or more**	**10**
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Haykin, S.; *Adaptive Filter Theory*; 5th ed.; Prentice Hall; 2013.

Additional References:

(2) Adali, T.; Haykin, S.; *Adaptive signal processing: Next generation solutions*. Wiley-IEEE Press; 2010.

(3) Bertein, J.C.; Ceschi, R. *Discrete Stochastic Processes and Optimal Filtering*, 2nd ed.; ISTE Publishing Company; 2010.

(4) Sayed, A. H. *Adaptive Filters*; Wiley-IEEE Press; 2008.

(5) D. Manolakis, V. Ingle, S. Kogon, Statistical and Adaptive Signal Processing, Artech House 2005

(6) L.C. Ludeman, Random Processes: Filtering, Estimation, and Detection, John Wiley & Sons, 2003.

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Person who prepared this description and date of preparation:

Shawn D. Hunt, August 2007. Revised by Nayda Santiago and Luis Jiménez, March 2013.

University of Puerto Rico
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Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6077
Course Title: Surge Phenomena in Power Systems
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: Transient surge phenomena in electric systems: generation, propagation, analysis, modeling, and protection.

Spanish: Fenómenos transitorios de sobrevoltaje en sistemas de potencia eléctrica: generación, propagación, análisis, modelaje y protección.

3. Pre/Co-requisites and other requirements:

INEL 4103 or equivalent

4. Course Objectives:

After completing the course, the student should be able to describe transient phenomena in power systems caused by switching and lightning surges. Also, the student will be able to design protection schemes to mitigate the impact of transients on the power system and apparatus.

5. Instructional Strategies:

☒conference ☒discussion ☒computation ☐laboratory

☒seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☒special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

EMTP and ATP software packages.

7. Course time frame and thematic outline

Outline	Contact Hours
1. Review of circuit elements characteristics, basic laws	3.0
2. Review of Laplace transform and its application to circuit analysis	6.0
3. RC, RL, and LC circuit transients	3.0
4. RLC circuit measurements	6.0
5. Single and multiple switching transients	3.0
6. Three phase and abnormal switching transients	6.0
7. Travelling waves on transmission lines	6.0
8. Lighting surge phenomena	6.0
9. Modeling of power apparatus for transient analysis	3.0
10. Selection of protective devices for transient events	3.0

	Total hours: (equivalent to contact period)		

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	**Percent**
☒ **Exams**	**2**	**70**
☐ **Final Exam**		
☐ **Short Quizzes**		
☐**Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**30**
☐**Journals**		
☐**Other, specify:**		
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Greenwood, A. *Electrical Transients in Power Systems*, 2nd. ed.; John Willey; 1991. (Classical textbook).

Additional References:

(2) Martinez-Velasco, J. A.; *Power System Transients: Parameter Determination*; CRC; 2010. http://dx.doi.org/10.1201/9781420065305. [Available via ElectricalENGINEERINGnet BASE, UPRM General Library Databases]

(3) Khaparde, S.A.; *Transformer Engineering*; 3rd ed.; CRC Press; 2012. http://dx.doi.org/10.1201/b12110. [Available via ElectricalENGINEERINGnetBASE, UPRM General Library Databases]

(4) *IEEE Transactions on Power Delivery*. http://ieeexplore.ieee.org/servlet/opac?punumber=61. [Available via IEEE Xplore, UPRM General Library Databases]

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Person who prepared this description and date of preparation:

Lionel Orama, August 2007; Updated by Eduardo I. Ortiz-Rivera, October 2013

University of Puerto Rico
Mayagüez Campus
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Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6078
Course Title: ESTIMATION, DETECTION, AND STOCHASTIC PROCESSES
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: Fundamentals of detection, estimation, and random process theory relevant for signal processing, communications, and control. Random processes and sequences. Linear systems driven by random processes. Bayesian and nonrandom parameter estimation. Signal detection and estimation from waveform observations. Wiener and Kalman filters.

Spanish: Fundamentos de las teorías de estimación, detección, y procesos estocásticos relevantes a procesamiento de señales, comunicaciones, y control. Procesos y secuencias aleatorias. Sistemas lineales excitados por procesos estocásticos. Estimación de parámetros Bayesiana y no aleatoria. Estimación y detección de señales a partir de observaciones de la forma de onda. Filtros de Wiener y Kalman.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

The student should be able to apply probabilistic methods to model signals and systems. To apply these models in the design of algorithms for estimation and detection. To determine the effect of linear systems in the statistical properties of signals throught them. To interpret technical literature in electrical engineering where these models are applied.

5. Instructional Strategies:

☒conference ☐discussion ☒computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Standard lecturing facilities and MATLAB software.

7. Course time frame and thematic outline

Outline	Contact Hours
1. Probability Review, Random Vectors	4
2. Random Processes and Sequences	10
3. Random Processes and Linear Systems	4
4. Hypothesis Testing and Signal Detection	6
5. Parameter Estimation	7
6. Estimation from Waveform Observations	4
7. Kalman and Wiener Filtering	7

8. Tests	3	
Total hours: (equivalent to contact period)	45	

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**3**	**60**
☒ **Final Exam**	**1**	**30**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☐ **Projects**		
☐ **Journals**		
☒ **Other, specify: Homework**	**3-4**	**10**
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Poor, H.V.; *An Introduction to Signal Detection and Estimation*, Springer-Verlag; 2010.

Additional References:

(2) Gray; R.M.; Davisson, L.D.; *An Introduction to Statistical Signal Processing*; Cambridge University Press; 2010.

(3) Leon-Garcia, A.; *Probability, Statistics and Random Processes, for Electrical Engineering*, 3rd ed.; Prentice Hall; 2008.

Classical references still among the best in the subject:

(4) Krishnan, V.; *Probability and Random Processes*; John Wiley; 2006.

(5) Gubner, J.A. *Probability and Random Processes for Electrical and Computer Engineers*; Cambridge University Press; 2006. [Available at the Circulation Collection (QA273 .G78 2006), UPRM General Library]

(6) Yates, R.D.; Goodman, D.J. *Probability and Stochastic Processes: An Friendly Introduction for Electrical and Computer Engineers*; John Wiley; 2005.

(7) Barkat, M.; *Signal Detection and Estimation*; 2nd ed.; Artech House Inc; 2005.

(8) Ludeman, L.C. *Random Processes: Filtering, Estimation, and Detection*; John Wiley & Sons; 2003.

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Person who prepared this description and date of preparation:

Miguel Vélez-Reyes, August 2007. Revised by Luis O. Jiménez-Rodríguez, February 2013.

University of Puerto Rico
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Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6079
Course Title: ADVANCED INTEGRATED CIRCUIT DESIGN TECHNIQUES
Number of credits: 3
Contact Period: 3 hours of lecture

2. Course Description:

English: Study of contemporary circuit optimization techniques with emphasis in noise analysis, power estimation, and power reduction topics in the design of both analog and digital systems. Coverage of performance optimization and noise reduction issues.

Spanish: Estudio de técnicas contemporáneas de optimización en el diseño de circuitos con énfasis en el análisis de ruido, mecanismos para la estimación y reducción de potencia en circuitos integrados analógicos y digitales. Discusión de tópicos sobre la optimización de la velocidad de operación de circuitos y técnicas de reducción de ruido.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

This course is intended to provide students an understanding of various contemporary techniques for optimizing analog and digital circuits in terms of area, speed, power, and reliability. Students will get in touch with current research in these areas at the same time that use state of the art CAD tools for evaluating, and analyzing diverse circuit optimization techniques studied throughout the class.

5. Instructional Strategies:

☒conference ☐discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

7. Course time frame and thematic outline

Outline	Contact Hours
MODELING AND ANALYSIS OF NOISE IN ANALOG CIRCUITS	16
MODELING AND ANALYSIS OF NOISE IN DIGITAL CIRCUITS	12

POWER ESTIMATION AND REDUCTION TECHNIQUES	12
STUDENT PRESENTATIONS	4
TEST	1
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**1**	**25**
☒ **Final Exam**	**1**	**25**
☐ **Short Quizzes**		
☒**Oral Reports**	**1**	**10**
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**20**
☒**Journals**	**1**	**20**
☐**Other, specify:**		
TOTAL:		**100%**

10. Bibliography:

Text Book:

1- A. Srivastava, D. Sylvester, and D. Blaauw, Statistical Analysis and Optimization for VLSI: Timing and Power, Springer, 2005.

Other Resources:

2- P.R. Grey, PJ Hurst, S H Lewis, RG Meyer, Analysis and Design of Analog Integrated Circuits, 4th Edition, John Wiley and Sons, 2003 (Classic)

3 - Technical papers from journals and conferences in Circuits and Systems and Computer Aided Design of Electronic Circuits. http://ieeexplore.ieee.org/Xplore/home.jsp

4 - M. Dietrich, J. Haase;Process Variations and Probabilistic Integrated Circuit Design, Springer New York, 2012

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Person who prepared this description and date of preparation:

Manuel Jiménez, August 2007; Revised by Guillermo Serrano, April 2013

University of Puerto Rico
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Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6080
Course Title: VLSI SYSTEMS DESIGN
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: MOS (Metal-Oxide-Semiconductor) devices and circuits. Design, implementation, and fabrication of very large scale integration (VLSI) circuits. System timing analysis. Physical implementation of computational systems.

Spanish: Diseño, Análisis, implementación y fabricación de circuitos de alto número de compuertas (VLSI). Analysis transiente del sistema. Implementación física de sistemas computacionales

3. Pre/Co-requisites and other requirements:

Graduate Level or professor authorization for advanced undergraduates.

4. Course Objectives:

This course is intended to provide students an understanding of various contemporary techniques for the design, simulation, and fabrication of CMOS VLSI Digital circuits. Students will get in touch with current research in these areas at the same time that use state of the art CAD tools for evaluating, and analyzing practical circuits developed as part of the class.

5. Instructional Strategies:

☒conference ☐discussion ☐computation ☒laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☒special problems ☐tutoring

☒research ☐other, please specify:

6. Minimum or Required Resources Available:

ICDL provides the required CAD resources needed for the course

7. Course time frame and thematic outline

Outline	Contact Hours
1. Introduction	1.5
2. Logic Design with MOSFETS	1.5
3. Introduction to HDLs	3
4. Physical Structure of CMOS ICs	1.5
5. Fabrication Process CMOS ICs	1.5
6. Elements of Physical Design	1.5
7. Review of MOS Transistor Theory	3

8.	Analysis of CMOS Logic Gates	4.5
9.	Design of High-speed CMOS Gates	4.5
10.	Advanced CMOS Techniques	4.5
11.	VLSI System Components	3
12.	CMOS VLSI Arithmetic Components	4.5
13.	System-level VLSI Design	4.5
14.	Reliability and Testing of VLSI Circuits	3
15.	Tests	3
Total hours: (equivalent to contact period)		45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**2**	**40%**
☐ **Final Exam**		
☒ **Short Quizzes**	**1**	**10%**
☒ **Oral Reports**	**1**	**25%**
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**25%**
☐ **Journals**		
☐ **Other, specify:**		
TOTAL:		**100%**

10. Bibliography:

Textbook:

J. P. Uyemura, "Introduction to VLSI Circuits and Systems", John Wiley & Sons, Inc., New York, NY 10158-0012, 2002

References:

1. R. Garg, "Analysis and Design of Resilient VLSI Circuits", Springer, 2010
2. B. Leung, "VLSI for Wireless Communications", Springer, 2011
3. S. Churiwala, S. Garg; "Principles of VLSI RTL Design", Springer, 2011
6. Technical papers from journals and conferences in Circuits and Systems and Computer Aided Design of Electronic Circuits. http://ieeexplore.ieee.org/Xplore/home.jsp

11. According to Law 51

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Person who prepared this description and date of preparation:

Manuel Jiménez, August 2007; Revised by Guillermo Serrano, April 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6085
Course Title: Analysis and Design of Power Semiconductor Circuits
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: Analysis and design of single-phase and three-phase controlled rectifiers, dual converters, A.C. voltage controllers, PWM converters for power supplies, four quadrant choppers, voltage and current source inverters with modulations techniques, A.C to A.C. converters.

Spanish: Análisis y diseño de rectificadores monofásicos y trifásicos, convertidores duales, controladores de tensión A.C., convetidores PWM para fuentes de potencia, troceadores de cuatro cuadrantes, inversores de tensión y de corriente con técnicas de modulación, convertidores de A.C. a A.C.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

The student will be able to use analytical an simulation tools to analize and design power conversion circuits for applications in different industrial fields.

5. Instructional Strategies:

☒conference ☒discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Matematical and circuit simulation software such as SABER, PSpice, and MATLAB

7. Course time frame and thematic outline

Outline	Contact Hours
Common dc-dc PWM converter configurations, analysis, design, basic modeling and control.	8
Transformer isolated dc-dc PWM converter configurations, analysis, design, basic modeling and control, power supply applications.	10
Inverter basic concepts, configurations, modulation techniques, voltage and harmonic control	8

Analysis, basic modeling and design of single-phase and three-phase voltage source and current source inverters	10
Single-phase and three-phase PWM ciclo-converter basic concepts, analysis and design	8
One exam	1
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☐ **Exams**		
☒ **Final Exam**	**1**	**25**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**3**	**75**
☐ **Journals**		
☐ **Other, specify:**		
TOTAL:		**100%**

10. Bibliography:

Text Book:

(1) Mohan, N.; Undeland, T.; Robbins, W.; *Power Electronics: Converters, Applications, and Design*; 3rd ed.; John Wiley & Sons; 2003. [Available at the Circulation Collection (TK7881.15 .M64 2003), UPRM General Library]

Additional References:

(2) Hart, D.; *Power Electronics*; 1st ed.; McGraw-Hill, 2010.
(3) Strzelecki, R.M. *Power Electronics in Smart Electrical Energy Networks*; Springer; 2008.
(4) Lutz, J.; Schlangenotto, H. *Semiconductor Power Devices*; Springer; 2011.

Classical references still among the best in the subject:

(5) Sira-Ramirez, H.J.; Silva-Ortigoza, R. *Control Design Techniques in Power Electronics Devices*; Springer-Verlag; 2006. http://dx.doi.org/10.1007/1-84628-459-7. [Available via Springer eBooks, UPRM General Library Databases]
(6) Kassakian, J.; Schlecht, M. Verghese, G.; *Principles of Power Electronics*; Prentice Hall; 1991.

11. According to Law 51

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Person who prepared this description and date of preparation:
Eduardo I. Ortiz-Rivera, October 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6088
Course Title: Computer Vision
Number of credits: 3
Contact Period: 3 hours per week

2. Course Description:

English: Introduction to Computer Vision. Computer Vision Systems. Biological Vision System and Biological Signal Processing; Early Image Processingboundary Detection; Region Growing; Texture and Shape Analysis.

Spanish: Introduccion A la Vision Por Computadoras. Sistemas Para la Vision Porcomputadoras. Sistema de la Vision Biologica y el Procesamiento Biologico de Senales. Procesamiento de Los Atributos Primarios de Una Imagen; Deteccion de Contornos; Crecimiento de Regiones; Analisis de Texturas y Formas.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

After completing this course the student should: Explain basic concepts and techniques of machine vision; Be able to develop a prototype of machine vision algorithms using MATLAB; Describe machine and computer vision applications.

5. Instructional Strategies:

☒conference ☒discussion ☐computation ☒laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☒other, please specify: perform design exercises and projects , class design project presentation

6. Minimum or Required Resources Available:

Materials, equipment, and physical facilities needed to fulfill the course objectives.

7. Course time frame and thematic outline

Outline	**Contact Hours**
Course Introduction	1
Machine vision systems: Illumination, Camera and lenses selection, and positioning devices.	4
Introduction to Geometrical Optics	3
Binary Image Processing	4
Regions	5
Image Filtering	6

Edge detection	6
Contours and region representation	4
Shading	3
Stereo Vision Photometric stereo	3
Camera calibration	4
Total hours: (equivalent to contact period)	

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**1**	**15%**
☒ **Final Exam**	**1**	**15%**
☐ **Short Quizzes**		
☒**Oral Reports**	**1**	**10%**
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**30%**
☐**Journals**		
☒**Other, specify: Laboratory Exercises and Homework**		**30%**
TOTAL:		**100%**

10. Bibliography:

Textbook:

1. S.J.D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012.

References:

2. E. R. Davies, Computer and Machine Vision, 4rd Edition, Academic Press, 2012.
3. D. A. Forsyth and J. Ponce, Computer Vision: A Modern Approach, Prentice Hall, 2011.
4. R. Szeliski, Computer Vision: Algorithms and Applications, Springer, 2010.

Classic references:

5. M. Sonka, V. Hlavac, R. Boyle, Image Processing, Analysis, and Machine Vision, Engineering- Nelson, 2007.
6. W.E. Snyder, H. Qi, Machine Vision, Cambridge University Press, 2004.
7. L.G. Shapiro, and G. Stockman, Computer Vision, Prentice Hall 2001.
8. Jain, R., Kasturi R. and Schunck, B.G., Machine Vision, McGraw-Hill, Inc. 1995.

11. According to Law 51

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Person who prepared this description and date of preparation:

Raul Torres, August 2007. Revised by Luis. O. Jiménez-Rodriguez, February 2013.

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6096
Course Title: Electric Power Quality
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: Analysis, modeling and mitigation of the difficulties related to the distortion of voltages and currents in power systems. Special emphasis on harmonics and sources of power quality problems. Voltage sags and swells, impulses and other transient events.

Spanish: Análisis, modelaje y mitigación de las dificultades relacionadas a la distorción de voltajes y corrientes en sistemas de potencia. Enfasis en armónicas y fuentes de problemas de calidad de potencia. Caídas y aumentos en voltaje, impulsos y otros fenómenos transitorios.

3. Pre/Co-requisites and other requirements:

Graduate standing or Permission from the Director

4. Course Objectives:

After completing the course, students will have a sound background on the main power quality issues, their causes and effects; explain industry standards and modeling techniques. Students will be able to analyze power systems accounting for the power quality impact of non-linear devices.

5. Instructional Strategies:

☒conference ☒discussion ☒computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Strong emphasis will be given to the use of professional journals available to UPRM students through internet in http://ieeexplore.ieee.org.

7. Course time frame and thematic outline

Outline	**Contact Hours**
Introduction to Electric Power Quality 1	1
Indices of distortion and interference, industry standards	4
Analysis methods: transient and steady state	6
Measurements: voltage, current, power, energy and power factor. Instrumentation	4
Modeling under nonsinusoidal conditions	6
Review of power electronics	3

Sources of power quality problems	3
Harmonics	6
Transient	3
Mitigation of power quality problems	6
Exams	3
Total hours: (equivalent to contact period)	

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**2**	**40**
☐ **Final Exam**		
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**2**	**50**
☐ **Journals**		
☒ **Other, specify: Homework**	**varies**	**10**
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Dugan, R. C.; McGranaghan, M. F.; Santoso, S.; Wayne Beaty, H.; *Electrical Power Systems Quality*; 3rd ed.; McGraw-Hill; 2013.

Additional References:

(2) Saint, B.; Update on IEEE 1547 Series of Standards for distributed resources interconnection, *IEEE PES Transmission and Distribution Conference and Exposition (T&D)2012*; pp.1-5, 7-10; 2012. http://dx.doi.org/10.1109/TDC.2012.6281696. [Available via IEEE Xplore, UPRM General Library Databases]

(3) *IEEE Transactions on Power Delivery, Power Electronics and Power Systems*; Articles on Power Quality, Policy Issues, and Power Electronics. http://ieeexplore.ieee.org/servlet/opac?punumber=61. [Available via IEEE Xplore, UPRM General Library Databases]

(4) Benysek, G.; Pasko, M.; *Power Theories for Improved Power Quality*; Springer; 2012. http://dx.doi.org/10.1007/978-1-4471-2786-4. [Available via Springer eBooks, UPRM General Library Databases]

(5) Chattopadhyay, S.; Mitra, M.; Sengupta, S.; *Electric Power Quality*; Springer; 2011. http://dx.doi.org/10.1007/978-94-007-0635-4. [Available via Springer eBooks, UPRM General Library Databases]

(6) Čepin, M.; *Assessment of Power System Reliability*; Springer; 2011. http://dx.doi.org/10.1007/978-0-85729-688-7. [Available via Springer eBooks, UPRM General Library Databases]

11. According to Law 51

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Person who prepared this description and date of preparation:

Efrain O'Neill, August 2007; Revised by Eduardo Ortiz, October 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6601
Course Title: Advanced Electromagnetics
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: Advanced theory and techniques for the analysis of electromagnetic systems applied to electrical engineering problems. Advanced study of Maxwell's Equations. Construction of solutions and study of the wave equation, with emphasis in propagation, scattering and radiation. Study of the electrical properties of matter and propagation, polarization, reflection and transmission of waves in diverse media. Use of Green's functions in the solution of electromagnetics problems.

Spanish: Teoría y técnicas avanzadas de análisis de sistemas electromagnéticos aplicados a problemas de ingeniería eléctrica. Estudio avanzado de las ecuaciones de Maxwell. Construcción de soluciones y estudio de la ecuación de onda, con énfasis en propagación, dispersión y radiación. Estudio de las propiedades eléctricas de la materia y propagación, polarización, reflexión y transmisión de ondas en diversos medios. Uso de funciones de Green en la solución de problemas en electromagnética

3. Pre/Co-requisites and other requirements:

authorization of the Director of the Department

4. Course Objectives:

At the end of the course, the students, will have to apply the theoretical foundations of electromagnetism in research work and to analyze and solve advanced problems in electromagnetism.

5. Instructional Strategies:

☒conference ☒discussion ☐computation ☒laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Standard lecturing facilities and applied electromagnetic laboratory.

7. Course time frame and thematic outline

Outline	Contact Hours
Introducción y Discusión del Prontuario: Discusión del prontuario, dinámica de la clase y métodos de evaluación; Motivación del curso	1 hour
Campos Electromagnéticos (Repaso): Ecuaciones de Maxwell; Parámetros consti¬tutivos; Condiciones de frontera; Potencia y energía; Variación armónica en tiempo.	2 hour
Propiedades Eléctricas de la Materia (Repaso): Permitividad, permeabilidad y conductividad; Semiconductores y superconductores; Medios lineales, isotrópicos y homogéneos; Variación a.c.; Ecuación de Debye*; Medios anisotrópicos*; Rota¬ción de Faraday*; Ferritas*; Teorema de reciprocidad de Lorentz en medios aniso¬trópicos*.	3 hour
Ecuación de Onda y sus Soluciones (Repaso): Coordenadas cartesianas; Coordena¬das cilíndricas*, Coordenadas esféricas*.	3 hours
Propagación y Polarización (Repaso): Modos TEM; Modos TEM en medios con pérdidas; Polarización.	2 hour
Reflexión y Transmisión: Incidencia normal; Incidencia oblicua, Medios con pér¬didas; Características de polarización en reflexión; Ondas en medios multicapas, Ondas de superficie; Ondas en medios no homogéneos; Estructuras periódicas y modos de Floquet.	8 hour
Potenciales Auxiliares Vectoriales, Construcción de Soluciones y Ecuaciones de Dispersión y Radiación: Potenciales vectoriales magnético y eléctrico; Vector de Hertz; Construcción de soluciones TEM, TE y TM en coordenadas rectangulares, cilíndricas y esféricas; Ecuaciones de radiación y dispersión	3 hours
Teoremas y Principios Electromagnéticos: Dualidad; Teorema de unicidad; Teoría de imágenes; Teorema de reciprocidad; Teorema de equivalencia de volumen y superficie.	3 hours
Guías de Onda y Cavidades: Guías de onda rectangulares y cilíndricas; Guías de onda parcialmente rellenas; Cavidades rectangulares, cilíndricas y esféricas; Líneas de transmisión esféricas.	8 hours
Dispersión: Dispersión por superficies planas, cilindros circulares, cuñas conduc¬toras y esferas conductoras	6 hours
Funciones de Green: Problemas Sturm-Liouville, Identidades	5 clases
Total hours: (equivalent to contact period)	45 clases

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**2**	**50%**
☒ **Final Exam**	**1**	**25%**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		

☐ **Portfolio**			
☒ **Projects**	**1**	**25%**	
☐ **Journals**			
☐ **Other, specify:**			
TOTAL:		**100%**	

10. Bibliography:

Textbook:

(1) Balanis, C. A.; *Advanced Engineering Electromagnetics*; 2nd ed.; Wiley; 2012.

Additional References:

(1) Sadiku, M. N. O.; *Numerical techniques in electromagnetics*;3rd ed.; CRC Press; 2009.
(2) Saez de Adana, F.; Gutierrez, O.; González, I.; *Practical Applications of Asymptotic Techniques in Electromagnetics*; Artech House; 2012.
(3) Gok, G., Grbic, A.; Tensor Transmission-Line Metamaterials," *IEEE Transactions on Antennas and Propagation*; Vol.58, no.5, 2010, pp.1559-1566. http://dx.doi.org/10.1109/TAP.2010.2044351. [Available via IEEE Xplore, UPRM General Library Databases]
(4) *IEEE Transactions on Antennas and Propagation*. http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=8
(5) *IEEE Transactions on Microwave Theory and Techniques*. http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=22
(6) *IEEE Transactions on Electromagnetic Compatibility*. http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=15 [Available via IEEE Xplore, UPRM General Library Databases]

11. According to Law 51

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Person who prepared this description and date of preparation:

Sandra Cruz, August 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6605
Course Title: Active remote sensing techniques
Number of credits: 3
Contact Period: 3

2. Course Description:

English: The course develops the theory underlying the radar and lidar techniques. The topics addressed include: wave propagation and polarization, cross section of targets, matched filters and ambiguity function, coded radar signals, signal processing and interpretation of the radar and lidar returns. Applications usually discussed are: weather radar, synthetic aperture radar, and lidar.

Spanish: El curso desarrolla la teoría detrás de las técnicas de radar y de lidar. Los tópicos que se estudian son: propagacion y polarización de ondas, sección transversal de los blancos, filtros acoplados y function de ambiguedad, señales de radar codificadas, procesamiento de señales, interpretación de los ecos de radar y lidar. Las aplicaciones usualmente discutidas son: radar de clima, radar de aperture sintética,

3. Pre/Co-requisites and other requirements:

Theory of Communications (INEL 4301), Electromagnetics II (INEL 4152).

4. Course Objectives:

To acquaint the student with the basic theory of active sensors (radar and lidar): a.) Principles of high-resolution polarimetric Doppler radar, b.) Principle of Optical radars. Apply processing methods to retrieve physical parameters. Explain examples of deployed systems. Interpret physical characteristics of active sensing systems.

5. Instructional Strategies:

☒conference ☐discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Lecturing facilities.

7. Course time frame and thematic outline

Outline	Contact Hours
Radar measurements	4
Cross-section of radar targets	3
Propagation and polarization	4
The matched filter	2

The ambiguity function	4
Coded radar signals	4
Synthetic aperture radar	8
Optical radar (Lidar)	5
Weather radar	8
Exams and Seminar/Visit	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**2**	**60**
☒ **Final Exam**	**1**	**30**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**10**
☐ **Journals**		
☐ **Other, specify:**		
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Bringi, V.N.; Chandrasekar, V. *Polarimetric Doppler weather radar*; Cambridge; 2001. (Classical textbook). [Available via EBSCO eBooks, UPRM General Library Databases and also at the Circulation Collection (QC973.5.B75 2001)]

Additional References:

(2) Doviak, R.J.; Zrnic, D. S.; *Doppler radar and weather observations*, 2nd ed., Academic Press;1993. (Classical textbook). [Available at the Circulation Collection (QC973.5 .D68 1993), UPRM General Library]
(3) Richards, J. A. *Remote Sensing with Imaging Radar*; Springer; 2009. http://dx.doi.org/10.1007/978-3-642-02020-9. [Available via Springer eBooks, UPRM General Library Databases]
(4) Van Zyl, J.J. ; *Synthetic Aperture Radar Polarimetry*; Wiley; 2011.
(5) Cao, Q.; Yeary, M.B.; Zhang, G.; Efficient Ways to Learn Weather Radar Polarimetry. *IEEE Transactions on Education*; Vol.55, no.1, 2012, pp.58-68. http://dx.doi.org/10.1109/TE.2011.2118211. [Available via IEEE Xplore, UPRM General Library Databases]
(6) *IEEE Transactions in Geoscience and Remote Sensing*. [Available via IEEE Xplore, UPRM General Library Databases]

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Person who prepared this description and date of preparation:

Rafael Rodríguez, April 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6606
Course Title: Introduction to Radar Sytems
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: The course aims to develop the basic theory underlying the radar system, focusing in the hardware. The students will learn basic radar concepts including the radar equation for different applications. Different types of radars such as FM, FM-CW, Pulse, etc., are discussed. Strengths and weaknesses are addressed as well as applications for different types of radars. Calibration techniques are also discussed. Detection of signals in noise. Typical radar transmitters and receivers.

Spanish: Desarrollo de teoria basica de sistemas de radares, enfocado en la parte de fabricacion. El estudiante aprndera conceptos basicos como lo son la ecuacion de radar para diferentes aplicaciones. Tipos de radares tales como FM, FM-CW, Pulso, etc. son discutidos. Se enfatiza tambien en ventajas y desventajas de diferentes tipos de radares. Tecnicas de calibracion, deteccion de señal en ruido, transmisores y recibidores son tambien discutidos.

3. Pre/Co-requisites and other requirements:

1. Electromagnetics II (INEL 4152)

4. Course Objectives:

The student will learn basic concepts used in the design of radar systems; describe important parameters used for the characterization of radar systems; derive of radar range equation and applications to extract desired information from target through calibration methods. Describe different radar systems and typical transmitters and receivers.

5. Instructional Strategies:

☒conference ☒discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

7. Course time frame and thematic outline

Outline	Contact Hours
Introduction to Radar Systems.	4
Radar Equation	6

Types of Radars (FM-CW, FM, Pulse, etc.)	9
Tracking Radar	6
Detection in Noise	5
Calibration	4
Transmitters	4
Receivers	4
Exams	3
Total hours: (equivalent to contact period)	

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**3**	**60%**
☒ **Final Exam**	**1**	**20%**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☐ **Projects**		
☐ **Journals**		
☒ **Other, specify: homework**	**6-8**	**20%**
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Skolnik, M. I.; *Introduction to Radar Systems*; 3rd ed.; McGraw-Hill; 2001. (Classical textbook).

Additional References:

(2) Richards, M. A. *Principles of Modern Radar: Basic Principles*; SciTech; 2010.
(3) Skolnik, M. I.; *Radar Handbook*, 3rd ed.; McGraw Hill; 2008.
(4) Deng, Hai; Orthogonal netted radar systems; *IEEE Aerospace and Electronic Systems Magazine*; Vol.27, no.5, 2012, pp.28-35. http://dx.doi.org/10.1109/MAES.2012.6226692. [Available via IEEE Xplore, UPRM General Library Databases]
(5) *IEEE Transactions on Geoscience and Remote Sensing*. [Available via IEEE Xplore, UPRM General Library Databases]
(6) *IEEE Transactions on Antennas and Propagation*. http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=8
(7) *IEEE Transactions on Microwave Theory and Techniques*. http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=22

11. According to Law 51

Students will identify themselves with the Institution and the instructor of the course for purposes of assessment (exams) accommodations. For more information please call the Student with Disabilities Office which is part of the Dean of Students office (Office #4) at (787) 265-3862 or (787) 832-4040 extensions 3250 or 3258 or by email at virgen.aponte@upr.edu.

Person who prepared this description and date of preparation:
Rafael Rodríguez, April 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6615
Course Title: Microwave Active Circuits
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: This course deals with the design of microwave transistor amplifiers and oscillators using S parameters. Different transistor amplifiers such as broadband, low noise, and power amplifiers are discussed. The course also covers the design of microwave oscillators using dielectric resonators. Circuit simulations using HP-ADS are required

Spanish: Este curso discute el diseño de amplificadores y osciladores usando parametros-S. Diferentes tipos de amplificadores tales como bajo en ruido, de potencia, y ancho de banda amplio se discuten en detalle. El curso tambien cubre el diseño de osciladores usando resonadores dielectricos. Simulacion de los circuitos usando HP-ADS es requerido.

3. Pre/Co-requisites and other requirements:

1. INEL 5306 Microwave Engineering or Approval of Department Head

4. Course Objectives:

After completing the course the student should know how to analyze and design different types of microwave amplifiers taking into account parameters such as gain, output power, noise figure, VSWR and bandwidth. The student should be able to design a microwave oscillator using a dielectric resonator. The students should be able to simulate any of the circuits using commercially available microwave simulators.

5. Instructional Strategies:

☒conference ☒discussion ☒computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

7. Course time frame and thematic outline

Outline	**Contact Hours**
Two port circuits.	3
Matching Networks, S Parameters, Microstrip, Smith Chart	4
Max Gain Amplifier design, stability, DC bias, power gain circles, unilateral case, bilateral case	6

Noise, noise circles, low noise amplifier design	6
Broadband amplifier design, balanced amplifier, feedback	6
Power Amplifier design, Class A, B and C	6
Two-stage amplifiers	5
Oscillator design using dielectric resonator	6
Exams	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**3**	**60%**
☒ **Final Exam**	**1**	**20%**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☐ **Projects**		
☐ **Journals**		
☒ **Other, specify: homework**	**6-8**	**20%**
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Gonzalez, G. *Microwave Transistor Amplifiers Analysis and Design*; Prentice Hall; 1997.

Additional References:

(2) Pozar, D. M.; *Microwave Engineering*. John Wiley and Sons. 4th ed, 2012.
(3) Vandelin, G.D.; Pavio, A.M.; Rohde, U.L. *Microwave Circuit Design Using Linear and Nonlinear Techniques*; Springer-Verlag; 2nd ed.; 2005. (Classical textbook).
(5) Rogers, J. W. M.; Plett, C. *Radio Frequency Integrated Circuit Design*; Artech House; 2nd ed; 2010.
(6) Otegi, N.; Anakabe, A.; Pelaz, J.; Collantes, J.; Soubercaze-Pun, G.; Experimental Characterization of Stability Margins in Microwave Amplifiers; *IEEE Transactions on Microwave Theory and Techniques*; Vol.60, no.12, 2012, pp. 4145-4156. http://dx.doi.org/10.1109/TMTT.2012.2221736. [Available via IEEE Xplore, UPRM General Library Databases]
(7) *IEEE Transactions on Microwave Theory and Techniques*. http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=22
(8) *IEEE Microwave and Wireless Components Letters*. http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=7260

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Person who prepared this description and date of preparation:

José Colom, Jan 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6668
Course Title: MICROWAVE ANTENNA ENGINEERING
Number of credits: 3
Contact Period: Three hours of lecture per week

2. Course Description:

English: Analysis and design of microwave and milimeter-wave antennas.

Spanish: Análisis y diseño de antenas de microondas y ondas milimétricas

3. Pre/Co-requisites and other requirements:

Prerequisites: INEL 5605 or Permission of the Department Head

4. Course Objectives:

After completing the course, the students should be able to analyze and design various types of printed circuit antennas, apply different techniques to provide circular polarization and increase the bandwidth of printed circuit antennas, analyze and design antenna arrays, apply different methods to synthesize the desired radiation pattern in arrays and understand the principles of adaptive array systems.

5. Instructional Strategies:

☒conference ☐discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Standard lecturing facilities. Radiation laboratory and Applied electromagnetics laboratory.

7. Course time frame and thematic outline

Outline	**Contact Hours**
Printed antenna elements: microstrip patches, slots and dipoles	9
Techniques for circular polarization	3
Band broadening and tuning	3
Design and analysis of microstrip arrays	11
Array pattern synthesis	11
Adaptive antennas	6
Exams	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**2**	**50**
☒ **Final Exam**	**1**	**25**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**25**
☐ **Journals**		
☐ **Other, specify:**		
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Fujimoto, K.; James, J.R. *Mobile Antenna Systems Handbook*, 2nd ed.; Artech House; 2008.

Additional References:

(2) Sanchez-Hernandez, D. A. *Multiband Integrated Antennas for 4G Terminals*, Artech House, 2008. [Available at the Circulation Collection (TK5102.5 .D83 1985), UPRM General Library]

(3) Hall, P. S.; Hao, Y. *Antennas and Propagation for Body-Centric Wireless Communications*; 2nd ed.; Artech House; 2012.

(4) Mailloux, R.; *Phased Array Antenna Handbook*, 2nd ed.; Artech House; 2005. (Classical textbook). [Available via EBSCO eBooks, UPRM General Library Databases]

(5) Balanis, C. A. *Antenna Theory, Analysis and Design*; 3rd ed.; John Wiley and Sons; 2006. (Classical textbook).

(6) Deshmukh, A.A.; Ray, K.P.; Formulation of Resonance Frequencies for Dual-Band Slotted Rectangular Microstrip Antennas; *IEEE Transactions on Antennas and Propagation*; Vol.54, no.4, 2012, pp.78-97. http://dx.doi.org/10.1109/MAP.2012.6309159. [Available via IEEE Xplore, UPRM General Library Databases]

(7) Ghorbani, A.; Ansarizadeh, M.; Abd-Alhameed, R.A.; Bandwidth Limitations on Linearly Polarized Microstrip Antennas; *IEEE Transactions on Antennas and Propagation*; Vol.58, no.2, 2012, pp.250-257. http://dx.doi.org/10.1109/TAP.2009.2037768. [Available via IEEE Xplore, UPRM General Library Databases]

(8) *IEEE Transactions on Antennas and Propagation*. http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=8

(9) *IEEE Antennas and Wireless Propagation Letters*: http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=7727

11. According to Law 51

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Person who prepared this description and date of preparation:

Rafael A. Rodriguez Solis, Jan 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6669
Course Title: MICROWAVE REMOTE SENSING
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: This course deals with the interaction of electromagnetic waves with natural (clouds, rain, snow) and artificial targets. In addition, it provides with an introduction to radiometry principles (e.g. Planck's Law) and to active and passive instrumentation used in remote sensing such as radiometers, radars and altimeters, with emphasis on passive systems.

Spanish: Este curso estudia la interacción de ondas electromagnéticas con objetos naturales (e.g., nubes, nieve, lluvia) y artificiales. Provee una introducción a teoría de radiometría (ley de Planck), y principios de operación de instrumentos activos (radares) y pasivos (radiómetros) usados para la percepción remota, dándole mayor énfasis a los sistemas pasivos.

3. Pre/Co-requisites and other requirements:

1. Prerequisites: Electromagnetics II or equivalent

4. Course Objectives:

After completion of the course the students will be able to explain the basic concepts of microwave remote sensing used to measure natural targets such as rain, clouds, storms, and others. Student will be able to describe and analyze data from sensors such as altimeters, radiometers and precipitacion radars, and design different types of radiometers such as the Dicke radiometer for several applications. Students will also be able to engage in advanced studies and research in remote sensing with atmospheric/meteorological applications.

5. Instructional Strategies:

☒conference ☒discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

This course will have a significant use of computers for problem sets and projects. They can use either Matlab, Fortran or any basic programing language.

7. Course time frame and thematic outline

Outline	Contact Hours
1- Importancia de las microondas para percepción remota.	1
2- Repaso teoría de antenas	2

3- Teoría de radiometría: Radiación termal, Radiación de Cuerpo Oscuro, Ley de Planck Radiación de cuerpo no oscuro	6
Teoría de Transferencia de radiación ,Temperatura aparente, Emisión y reflexión	7
5-Interacción de las microondas con componentes de la atmósfera	7
6-Propiedades físicas de la atmósfera Absorción y emisión por gases; oxígeno, vapor de agua Extinción debido a nubes, nieve, lluvia y otros cuerpos naturales.	5
7-Sistemas de radiómetros, Temperatura de Ruido, Figura de Ruido	4
8-Ruido para un sistema en cascada	3
9-Temperatura de Ruido equivalente para un Receptor Super-heterodino	3
10-Calibración de Radiómetros	4
12-Exams	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**3**	**75%**
☐ **Final Exam**		
☒ **Short Quizzes**	**5**	**10**
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**5%**
☐ **Journals**		
☒ **Other, specify: homework**	**6**	**10%**
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Ulaby, F. T., R.K. Moore, and A. K. Fung, Microwave Remote Sensing: Active and Passive, Vol. 1, Addison-Wesley, 1986. (Classical textbook). [Available at the Circulation Collection (G70.6 .U4 1981 V.1-3), UPRM General Library]

Additional References:

(2) Doviak, R.J.; Zrnic, D. S.; *Doppler radar and weather observations*, 2nd ed., Academic Press;1993. (Classical textbook). [Available at the Circulation Collection (QC973.5 .D68 1993), UPRM General Library]

(3) Nanzer, J.; *Microwave and Millimeter-Wave Remote Sensing for Security Applics*; Artech House; 2012.

(4) Saakian, A. *Radio Wave Propagation Fundamentals*; Arthech House; 2011.

(5) Hwang, P.A.; Foam and Roughness Effects on Passive Microwave Remote Sensing of the Ocean; *IEEE Transactions on Geoscience and Remote Sensing;* Vol.50, no.8, 2012, pp.2978-2985. http://dx.doi.org/10.1109/TGRS.2011.2177666. [Available via IEEE Xplore, UPRM Library Databases]

(6) Yang, H.; Weng; F.; Error Sources in Remote Sensing of Microwave Land Surface Emissivity; *IEEE Transactions on Geoscience and Remote Sensing*; Vol.49, no.9, 2011, pp.3437-3442. http://dx.doi.org/10.1109/TGRS.2011.2177666. [Available via IEEE Xplore, UPRM Library Databases]

11. According to Law 51

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Person who prepared this description and date of preparation:

Sandra Cruz-Pol, August 2012

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Master of Science in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 6995
Course Title: SPECIAL TOPICS ELECTRICAL ENGINEERING
Number of credits: 1 to 6
Contact Period: Variable

2. Course Description:

English: Study of Selected Topics in Electrical Engineering

Spanish: Estudio de Temas Selectos en Ingeniería Eléctrica

3. Pre/Co-requisites and other requirements:

Permission od the Director

4. Course Objectives:

Depend on the topics

5. Instructional Strategies:

☒conference ☒discussion ☒computation ☒laboratory

☒seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Journals and other serial publications available at the UPRM library. Other resources depend on the topics.

7. Course time frame and thematic outline

Outline	Contact Hours
Depend on the topic	
Total hours: (equivalent to contact period)	

8. Grading System

☒ Quantifiable (letters) ☐ Not Quantifiable

Depend on the topics

9. Evaluation Strategies

	Quantity	Percent
☐ **Exams**		
☐ **Final Exam**		
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☐ **Projects**		
☐ **Journals**		
☐ **Other, specify:** **Depends on the topics.**		
TOTAL:		**100%**

10. Bibliography:

(1) Electronic resources available through the UPRM Library's website: http://www.uprm.edu/library/cre/listdbsp.php?l=1&st=0&topic=63.

(2) Other references, depending on topic

11. According to Law 51

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University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 8295
Course Title: Advanced Topics in Electronics
Number of credits: 3
Contact Period: Three hours of lecture per week

2. Course Description:

English: Advanced analysis and design techniques of analog, digital, mixed-signal circuits and systems using theoretical analysis and advanced cad tools; physical layout level design of circuits and circuit testing.

Spanish: Técnicas avanzadas de análisis y diseño de circuitos análogos, digitales, de señales mixtas, y sistemas usando análisis teórico y herramientas avanzadas de diseño; diseño de circuitos a nivel del plano físico y prueba de circuitos.

3. Pre/Co-requisites and other requirements:

Prerequisites: INEL 6005

4. Course Objectives:

After completing the course, the students should be able to analyze, design, and implement advanced analog, digital, mixed-signals circuits and systems.

5. Instructional Strategies:

☒ conference ☐ discussion ☐ computation ☐ laboratory

☐ seminar with formal presentation ☐ seminar without formal presentation ☐ workshop

☐ art workshop ☐ practice ☐ trip ☐ thesis ☐ special problems ☐ tutoring

☐ research ☐ other, please specify:

6. Minimum or Required Resources Available:

Standard lecturing facilities; the Integrated Circuit Design Laboratory (ICDL)

7. Course time frame and thematic outline

Outline	**Contact Hours**
Semiconductor Devices	4
CAD Circuit Simulation and Physical Design	3
Design of Advanced Analog Circuits	12
Design of Advanced Digital Circuits	12
Design of Mixed Signal Systems	11
Exams	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**2**	**50**
☒ **Final Exam**	**1**	**25**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**25**
☐ **Journals**		
☐ **Other, specify:**		
TOTAL:		**100%**

10. Bibliography:

Textbook:

(1) Hu, W. *Advances in Electric and Electronics*; Springer; 2012. http://dx.doi.org/10.1007/978-3-642-28744-2. [Available via Springer eBooks, UPRM General Library Databases]

Additional References:

(2) Grey, P.R.; Hurst, P.J.; Lewis, S.H.; Meyer, R.G. *Analysis and Design on Analog Integrated Circuits*; 5th ed.; John Wiley and Sons; 2009. [Available at the Circulation Collection (TK7874 .A588 2009), UPRM General Library]

(3) Allen, P. E.; Holberg, D. R.; *CMOS Analog Circuit Design*; 3rd ed.; Oxford Univ. Press; 2012. [Available at the Circulation Collection (TK7874 .A428 2012), UPRM General Library]

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Person who prepared this description and date of preparation:

Guillermo J Serrano, Mar 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 8395
Course Title: Advanced Topics in Signal Processing: Image Analysis and Remote Sensing of Coastal Shallow Waters
Number of credits: 3
Contact Period: Three hours of lecture per week

2. Course Description:

English: Image analysis of the water column and benthic mapping of coastal shallow waters by means of remotely sensed signals and imagery.

Spanish: Análisis de imágenes de la columna de agua y mapas bénticos de aguas costeras por medio de señales e imágenes detectadas por sensores remotos.

3. Pre/Co-requisites and other requirements:

Prerequisites: INEL 6007

4. Course Objectives:

After completing the course, the students should be able to design and implement an algorithm for signal analysis and subsurface detection applied to coastal shallos waters remote sensing.

5. Instructional Strategies:

☒conference ☐discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Standard lecturing facilities. Radiation laboratory and Applied electromagnetics laboratory.

7. Course time frame and thematic outline

Outline	**Contact Hours**
Radiative transfer equation	9
Inverse models and atmospheric correction	9
Composition of coastal shallow waters	6
Inverse models and bathimetry	9
Estimation of optical parameters from the water column	9
Exams	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ Exams	2	50
☒ Final Exam	1	25
☐ Short Quizzes		
☐ Oral Reports		
☐ Monographies		
☐ Portfolio		
☒ Projects	1	25
☐ Journals		
☐ Other, specify:		
TOTAL:		100%

10. Bibliography:

Textbook:

(1) Wang, Y. (Ed.); *Remote Sensing of Coastal Environments*; CRC Press; 2010. http://dx.doi.org/10.1201/9781420094428. [Available via CRCnetBASE, UPRM General Library Databases]

Additional References:

(2) Yang, X.; *Remote Sensing and Geospatial Technologies for Coastal Ecosystem Assessment and Management*; Springer; 2009.
(3) Zhao, Y.; Yongchao, P.; Ruiliang, B.; Susan, S.; Meyer, C.; Bagget, L.; Lesley, P.; Geng, X. (2013). Hyperion Image Optimization in Coastal Waters, *IEEE Transactions on Geoscience and Remote Sensing*, Vol. 51, no.2, 2012, pp. 1025-1036. http://dx.doi.org/10.1109/TGRS.2012.2205262. [Available via IEEE Xplore, UPRM General Library Databases]
(4) González Trilla, G.; Pratolongo, P.; Beget, M.E.; Kandus, P.; Marcovecchio, J.; Di Bella, C. Relating Biophysical Parameters of Coastal Marshes to Hyperspectral Reflectance Data in the Bahia Blanca Estuary, Argentina; *Journal of Coastal Research*; Vol. 29, no.1, 2013, pp. 231-238 . http://dx.doi.org/10.2112/JCOASTRES-D-11-00214.1. [Available via Academic Search Complete, UPRM General Library Databases]
(5) Shanmugan, P.; Sundarabalan, B.; Ahn, Y.H.; Ryu, J.H.; A New Inversion Model to Retrieve the Particulate Backskattering in Coastal/Ocean Waters; *IEEE Transactions on Geoscience and Remote Sensing*; Vol. 49, No. 6, 2011, pp. 2463-2475. http://dx.doi.org/10.1109/TGRS.2010.2103947. [Available via IEEE Xplore, UPRM General Library Databases]
(6) Klemas, V.; Remote Sensing of Coastal Plumes and Ocean Fronts: Overview and Case Study; *Journal of Coastal Research*; Vol.28, no.1A: p. 1 – 7. http://dx.doi.org/10.2112/JCOASTRES-D-11-00025.1. [Available via Academic Search Complete, UPRM General Library Databases]

Classic textbooks:

(7) Richardson, L.L.; LeDrew, E.F. (Eds.); *Remote Sensing of Aquatic Coastal Ecosystem Processes: Science and Management Applications*, Springer, 2006.
(8) Bukata, R.; Jerome, J.H.; Kondratyev, A.S.; Pozdnyakov, D.V. *Optical Properties and Remote Sensing of Inland and Coastal Waters*, CRC Press, 1995. [Available at the Marine Sciences Collection (GC178.2 .O66 1995), UPRM General Library]

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Person who prepared this description and date of preparation:

Luis O. Jiménez-Rodríguez, Mar 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 8397
Course Title: Advanced Topics in Communications: Software Defined Radio, Cognitive Radio and Cognitive Networks
Number of credits: 3
Contact Period: Three hours of lecture per week

2. Course Description:

English: This course examines the emergent technologies of Software Defined Radio, Cognitive Radio and Cognitive Networks while exploring Dynamic Spectrum Access, a major motivating application of these technologies.

Spanish: Análisis y diseño de tecnologías emergentes como radio definido en "software", radio cognitivo y redes cognitivas mientras explora el acceso dinámico del espectro.

3. Pre/Co-requisites and other requirements:

None

4. Course Objectives:

After completing the course, the students should be able to analyze and design various types of cognitive radio systems and networks.

5. Instructional Strategies:

☒conference ☒discussion ☒computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Standard lecturing facilities. Digital Signal Processing laboratory.

7. Course time frame and thematic outline

Outline	**Contact Hours**
Dynamic Spectrum Access	3
Introduction to SDR	6
Introduction to CR	3
The Cognition Cycle	3
Introduction to Cognitive Networks	12
Artificial Intelligence for Communication Networks	3
Hardware Platforms	3
Software Platforms	3
Spectrum Policy	3
Future Challenges	3
Exams	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ Exams	2	50
☒ Final Exam	1	25
☐ Short Quizzes		
☐ Oral Reports		
☐ Monographies		
☐ Portfolio		
☒ Projects	1	25
☐ Journals		
☐ Other, specify:		
TOTAL:		100%

10. Bibliography:

Textbook:

1. Zeng, D.; Advances in Control and Communication; Springer; 2012

References:

2. Wu, Y.; Advances in Computer, Communication, Control and Automation; Springer; 2012
3. Zhang, T.; Future Computer, Communication, Control and Automation; Springer; 2012
4. Khodakarami, H.; Shieh, W.; On the Energy Efficiency of Modulation Formats for Optical Communications; IEEE Photonics Technology Letters; Vol. 25 Issue 3; 2013; pp. 275-278 http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6387262&tag=1
5. IEEE Journal on Selected Areas in Communications
6. IEEE Communications Magazine
7. IEEE Transactions on Wireless Communications
8. IEEE Transactions on Mobile Computing

11. According to Law 51

Students will identify themselves with the Institution and the instructor of the course for purposes of assessment (exams) accommodations. For more information please call the Student with Disabilities Office which is part of the Dean of Students office (Office #4) at (787) 265-3862 or (787) 832-4040 extensions 3250 or 3258 or by email at virgen.aponte@upr.edu.

Person who prepared this description and date of preparation:

Lizdabel Morales Tirado, June 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL8495
Course Title: Advanced Topics In Electric Power Engineering: Power Engineering Analysis
Number of credits: 3
Contact Period: Three hours of lecture per week

2. Course Description:

English: Development of mathematical models for the main components of the power system based on their properties and physical aspects.

Spanish: Desarrollo de modelos matemáticos para los componentes principales del sistema de potencia a partir de las propiedades y comportamiento físico de los mismos.

3. Pre/Co-requisites and other requirements:

Prerequisites:

4. Course Objectives:

After completing the course, the students should be able to understand the interaction between major components of a power system and predict their behavior.

5. Instructional Strategies:

☒ conference ☐ discussion ☐ computation ☐ laboratory

☐ seminar with formal presentation ☐ seminar without formal presentation ☐ workshop

☐ art workshop ☐ practice ☐ trip ☐ thesis ☐ special problems ☐ tutoring

☐ research ☐ other, please specify:

6. Minimum or Required Resources Available:

Standard lecturing facilities.

7. Course time frame and thematic outline

Outline	**Contact Hours**
Transmission Lines	9
Single Phase Transformers	9
Balanced Three Phase systems	6
Unbalanced Three Phase Systems	9
Symmetrical Components	9
Exams	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ Exams	2	50
☒ FinalExam	1	25
☐ ShortQuizzes		
☐ OralReports		
☐ Monographies		
☐ Portfolio		
☒ Projects	1	25
☐ Journals		
☐ Other, specify:		
TOTAL:		100%

10.Bibliography:

Textbook:

(1) Degeneff, R.C.; Hesse, M.J.; *Principles of Power Engineering Analysis*; CRC; 2011.

Additional References:

(2) *IEEE Transaction on Power Delivery*. http://ieeexplore.ieee.org/servlet/opac?punumber=61. [Available via IEEE Xplore, UPRM General Library Databases]

(3) *IEEE Transactions on Power Systems*. http://ieeexplore.ieee.org/servlet/opac?punumber=59. [Available via IEEE Xplore, UPRM General Library Databases]

(4) Stojkovic, Z.; *Computer-Aided Design in Power Engineering*; Springer; 2012. http://dx.doi.org/10.1007/978-3-642-30206-0. [Available via Springer eBooks, UPRM General Library Databases]

(5) Panigrahi, B.K.; Abraham, A.; Das, S.; *Computational Intelligence in Power Engineering*; Springer; 2010. http://dx.doi.org/10.1007/978-3-642-14013-6. [Available via Springer eBooks, UPRM General Library Databases]

(6) Zelinka, I.; Vasant, P.; Barsoum.; *Power, Control and Optimization*; Springer; 2013

11.According to Law51

Students will identify themselves with the Institution and the instructor of the course for purposes of assessment (exams) accommodations. For more information please call the Student with Disabilities Office which is part of the Dean of Students office (Office #4) at (787) 265-3862 or (787) 832-4040 extensions 3250 or 3258 or by email at virgen.aponte@upr.edu.

Personwho prepared thisdescription and date ofpreparation:

Erick E. Aponte Bezares, Mar 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 8496
Course Title: Advanced Topics in Power Electronics
Number of credits: 3
Contact Period: Three hours of lecture per week

2. Course Description:

English: Advanced analysis power semiconductor devices and circuits; design and implementation of power converters and DSP controlled system with emphasis in renewable energy, automotive, aerospace, and utility applications.

Spanish: Análisis avanzado de semiconductores y circuitos de alta potencia; desino e implementación de convertidores de potencia y sistemas de control digital con énfasis en aplicaciones de energía renovable, automotriz, aeroespacial y uitilidades.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

After completing the course, the students should be able to design and implement advanced power electronic circuits and systems.

5. Instructional Strategies:

☒conference ☐discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Standard lecturing facilities; the Power Electronics Laboratory.

7. Course time frame and thematic outline

Outline	**Contact Hours**
Power semiconductor devices, circuit control, and applications	9
Power converter and inverter analysis and design	9
Wavelet inverters analysis and design	6
DSP control and implementation.	9
Renewable energy, automotive, aerospace, and utility applications.	9
Exams	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ Exams	2	50
☒ Final Exam	1	25
☐ Short Quizzes		
☐ Oral Reports		
☐ Monographies		
☐ Portfolio		
☒ Projects	1	25
☐ Journals		
☐ Other, specify:		
TOTAL:		100%

10. Bibliography:

Textbook:

(1) Baliga, B. J. *Advanced High Voltage Power Device Concepts*; 2012; Springer. http://dx.doi.org/10.1007/978-1-4614-0269-5. [Available via Springer eBooks, UPRM General Library Databases]

Additional References:

(2) Rashid, M. H.; *Power Electronics Handbook*; 3rd ed.; Butterworth-Heinemann Publications; 2010. [Available at the Circulation Collection (TK7881.15 .P6733 2011), UPRM General Library]

(3) Pressman, A.; Billings, K.; Taylor, M. *Switching Power Supply Design*; 3rd ed.; McGraw-Hill; 2009.

(4) Wilamowski, B.; *Power Electronics and Motor Drives*; 2nd ed.; CRC Press; 2011. http://dx.doi.org/10.1201/b10643. [Available via ElectricalENGINEERINGnetBASE, UPRM General Library Databases]

(5) Liu, Y.; *Power Electronic Packaging: Design, Assembly Process, Reliability and Modeling*; 1rst ed.; Springer. 2012. http://dx.doi.org/10.1007/978-1-4614-1053-9. [Available via Springer eBooks, UPRM General Library Databases]

(6) Hart, D.; *Power Electronics*; 1st ed.; McGraw-Hill; 2010.

11. According to Law 51

Students will identify themselves with the Institution and the instructor of the course for purposes of assessment (exams) accommodations. For more information please call the Student with Disabilities Office which is part of the Dean of Students office (Office #4) at (787) 265-3862 or (787) 832-4040 extensions 3250 or 3258 or by email at virgen.aponte@upr.edu.

Person who prepared this description and date of preparation:

Eduardo Ortiz, Mar 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 8595
Course Title: Advanced Topics in Control Systems: Adaptive Control
Number of credits: 3
Contact Period: Three hours of lecture per week

2. Course Description:

English: Advanced analysis and design of control systems using model reference adaptive control in continuous and discrete time, Lyapunov and hyperstability techniques, adaptive observers, self-tuning regulators, minimum variance and LQG control.

Spanish: Análisis avanzado y diseño de sistemas de control usando control de modelo de referencia adaptiva en tiempo continuo y discreto, técnicas de Lyapunov e hiperestabilidad, obsevadores adaptivos, reguladores automodificables, variancia minima y control LQG.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

After completing the course, the students should be able to design and implement advanced control systems.

5. Instructional Strategies:

☒conference ☐discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Standard lecturing facilities; Control Systems Laboratory.

7. Course time frame and thematic outline

Outline	**Contact Hours**
Model reference adaptive control in continuous and discrete time.	9
Lyapunov and hyperstability approaches, adaptive observers.	9
Design using pole zero assignments.	6
Self-tuning regulators	9
Minimum variance and LQG control.	9
Exams	3
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ Exams	2	50
☒ Final Exam	1	25
☐ Short Quizzes		
☐ Oral Reports		
☐ Monographies		
☐ Portfolio		
☒ Projects	1	25
☐ Journals		
☐ Other, specify:		
TOTAL:		100%

10. Bibliography:

Textbook:

(1) Åström, K.; Wittenmark , B.; *Adaptive Control*; 2nd ed.; Dover Publications; 2008.

Additional References:

(2) Sastry, S.; Bodson, M.; *Adaptive Control: Stability, Convergence, and Robustness*; Dover Publications; 2011.

(3) Lavrestsky, E.; Wise, A. *Robust and Adaptive Control with Aerospace Applications*; Springer; 2012.

(4) Ioaonnou, P.; Sun, J.; *Robust Adaptive Control*; Dover Publications; 2012.

(5) Landau, I.; Lozano, R.; M'Saad, M.; Karimi A.; *Adaptive Control: Algorithm, Analysis, and Applications*; Springer; 2011. http://dx.doi.org/10.1007/978-0-85729-664-1. [Available via Springer eBooks, UPRM General Library Databases]

(6) Astolfi, A.; Karagiannis, D.; Ortega, R.; *Nonlinear and Adaptive Control with Applications*; Springer; 2008. http://dx.doi.org/10.1007/978-1-84800-066-7. [Available via Springer eBooks, UPRM General Library Databases]

11. According to Law 51

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Person who prepared this description and date of preparation:

Eduardo Ortiz, October 2013

UniversityofPuertoRico
MayagüezCampus
College ofEngineering
Departmentof Electricaland ComputerEngineering
Graduate Programin ElectricalEngineering

CourseSyllabus

1. GeneralInformation:

Alpha-numeric codification:INEL8695
CourseTitle:Advanced Topics in Applied Electromagnetics: Printed Microwave and Millimeter-Wave Antennas
Numberofcredits:3
ContactPeriod: Threehours oflecture perweek

2. CourseDescription:

English: Analysis anddesign ofprinted microwave and milimeter-wave antennas.

Spanish: Análisis ydiseñode antenasimpresasdemicroondas yondasmilimétricas

3. Pre/Co-requisitesand otherrequirements:

Prerequisites:INEL6668

4. CourseObjectives:

Aftercompletingthecourse, thestudentsshould beable toanalyze and design varioustypesof printedcircuitantennas for microwave and millimeter wave frequencies.

5. InstructionalStrategies:

☒conference ☐discussion ☐computation ☐laboratory

☐seminarwith formalpresentation ☐seminarwithoutformalpresentation ☐workshop

☐artworkshop ☐practice ☐trip ☐thesis ☐specialproblems ☐tutoring

☐research ☐other, please specify:

6. Minimumor Required Resources Available:

Standardlecturingfacilities. Radiation laboratoryandApplied electromagnetics laboratory.

7. Coursetimeframe andthematicoutline

Outline	**ContactHours**
Printedantennaelements:microstrip patches,slotsand dipoles	15
Cavity backing	6
Techniquesforcircularpolarization	6
Band broadeningandtuning	9
Fabrication techniques	6
Exams	3
Totalhours: (equivalentto contactperiod)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ Exams	2	50
☒ FinalExam	1	25
☐ ShortQuizzes		
☐ OralReports		
☐ Monographies		
☐ Portfolio		
☒ Projects	1	25
☐ Journals		
☐ Other, specify:		
TOTAL:		100%

10.Bibliography:

Textbook:

(1) Fujimoto, K.; James, J.R. *Mobile Antenna Systems Handbook*, 2nd ed.; Artech House; 2008.

Additional References:

(2) Sanchez-Hernandez, D. A. *Multiband Integrated Antennas for 4G Terminals*, Artech House, 2008. [Available at the Circulation Collection (TK5102.5 .D83 1985), UPRM General Library]

(3) Rabinovich, V.; Alexandrov, N.; *Antenna*; *Arrays and Automotive Applications*; Springer; 2013. http://dx.doi.org/10.1007/978-1-4614-1074-4. [Available via Springer eBooks, UPRM General Library Databases]

(4) Yarman, B. S.; *Design of Ultra Wideband Antenna Matching Networks*; Springer; 2008. http://dx.doi.org/10.1007/978-1-4020-8418-8. [Available via Springer eBooks, UPRM General Library Databases]

(5) Minin, I.V.; Minin, O.; *Basic Principles of Fresnel Antenna Arrays*; Springer; 2008. http://dx.doi.org/10.1007/978-3-540-79559-9. [Available via Springer eBooks, UPRM General Library Databases]

(6) *IEEE Transactions on Antennas and Propagation*. http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=8

(7) *IEEE Antennas and Wireless Propagation Letters*: http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=7727

(8) Deshmukh, A.A.; Ray, K.P.; Formulation of Resonance Frequencies for Dual-Band Slotted Rectangular Microstrip Antennas; *IEEE Antennas and Propagation Magazine*; Vol.54, no.4, 2012, pp.78-97. http://dx.doi.org/10.1109/MAP.2012.6309159. [Available via IEEE Xplore, UPRM General Library Databases]

(9) Ghorbani, A., Ansarizadeh, M., Abd-Alhameed, R.A.; Bandwidth Limitations on Linearly Polarized Microstrip Antennas; *IEEE Transactions on Antennas and Propagation*; Vol.58, no.2, 2010, pp.250-257. http://dx.doi.org/10.1109/TAP.2009.2037768. [Available via IEEE Xplore, UPRM General Library

11.According to Law51

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Personwho prepared thisdescription and date ofpreparation:

Rafael A. Rodriguez Solis, Jan2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachellor of Science in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 8995
Course Title: ADVANCED TOPICS
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: Advance Topics and Research Works In Electrical Engineering Or Related Fileds. Open to Doctoral Students and Outstanding Electrical Engineering Students.

Spanish: Temas Avanzados y Trabajos de Investigación de Ingeniería Eléctrica y Ramas Afines. Abierto a estudiantes doctorales y a estudiantes sobresalientes de Ingeniería Eléctrica.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

Students will compare and contrast the theoretical aspects of electrical engineering with the real world practice. They will apply the fundamental concepts taught in the classroom and recognize their value in real practice. Students will experience and be exposed to advance topics and state-of-the-art research works on electrical engineering.

5. Instructional Strategies:

☒conference ☒discussion ☒computation ☐laboratory

☒seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☒special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Materials, equipment, and physical facilities needed to fulfill the course objectives.

7. Course time frame and thematic outline

Outline	Contact Hours
Varies with assignment	15-45
Total hours: (equivalent to contact period)	15-45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**varies**	**40**
☐ **Final Exam**		
☐ **Short Quizzes**		
☐**Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**varies**	**20**
☐**Journals**		
☒**Other, specify: Reports**	**varies**	**40**
TOTAL:		**100%**

(Suggested): The faculty member teaching the course will provide the student with the evaluation strategy he/she will be using throughout the semester. This will be done within the first week of classes.

10. **Bibliography:**
1. Selected articles from various databases available online the UPRM General Library. http://www.uprm.edu/library *2. IEEE Xplore*. http://ieeexplore.ieee.org (Electronic Publications of the IEEE) *3. ScienceDirect.* http://www.sciencedirect.org (Additional references are determined by the faculty member teaching the course.)
11. **According to Law 51**
Students will identify themselves with the Institution and the instructor of the course for purposes of assessment (exams) accommodations. For more information please call the Student with Disabilities Office which is part of the Dean of Students office (Office #4) at (787) 265-3862 or (787) 832-4040 extensions 3250 or 3258 or by email at virgen.aponte@upr.edu. .

Person(s) who prepared this description and date of preparation: Eduardo I. Ortiz-Rivera, June 15, 2013
Revision: Eduardo I. Ortiz-Rivera, October 11, 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Graduate Program in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 8997
Course Title: INDEPENDENT STUDY
Number of credits: 3
Contact Period: Independent studies

2. Course Description:

English: Individualized study advance projects in electrical engineering and/or related areas under supervision of a member of the faculty. The student develops a plan including faculty consultation, learning objectives, progress, and evaluation.

Spanish: Estudios avanzados individualizados en ingeniería eléctrica y/o áreas relacionadas bajo la supervisión de un miembro de la facultad. El estudiante desarrollará un plan que incluirá consultas con la facultad, objetivos de aprendizaje, progreso, y evaluación.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

Evaluate the state of the art and identify gaps in the current state of knowledge in a particular topic in Electrical Engineering. Select and construct a well-organized bibliography on specific Electrical Engineering topics using library resources and the internet.

5. Instructional Strategies:

☒conference ☐discussion ☒computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☒other, please specify: Independent studies

6. Minimum or Required Resources Available:

Campus library. Other resources dependent on the particular topics being studied.

7. Course time frame and thematic outline

Dependent on the particular topics being studied

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

(Suggested): The faculty member teaching the course will provide the student with the evaluation strategy.

	Quantity	Percent
☒ **Exams**	**TBD**	**0-100**
☒ **Final Exam**	TBD	**0-100**
☐ **Short Quizzes**		
☒**Oral Reports**	TBD	**0-100**
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	TBD	**0-100**
☐**Journals**		
☒**Homework**	TBD	**0-100**
☒**Other, specify: Papers review**	TBD	**0-100**
TOTAL:		**100%**

10. Bibliography:

1. *Selected articles from various databases available online the UPRM General Library*. http://www.uprm.edu/library

2. *IEEE Xplore*. http://ieeexplore.ieee.org (Electronic Publications of the IEEE)

3. *ScienceDirect.* http://www.sciencedirect.org

(Additional references are determined by the faculty member teaching the course.)

11. According to Law 51

Students will identify themselves with the Institution and the instructor of the course for purposes of assessment (exams) accommodations. For more information please call the Student with Disabilities Office which is part of the Dean of Students office (Office #4) at (787) 265-3862 or (787) 832-4040 extensions 3250 or 3258 or by email at virgen.aponte@upr.edu.

Person who prepared this description and date of preparation:

Eduardo I. Ortiz-Rivera, November 24, 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachellor of Science in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 8998
Course Title: DOCTORAL SEMINAR
Number of credits: Zero to One Credit hours
Contact Period: 1 hour of lecture per week

2. Course Description:

English: Study and dissemination of current research topics in electrical engineering and related areas. Forum to provide professional and academic advice to students participating in the doctoral program.

Spanish: Estudio y diseminación de tópicos actualizados de investigación en ingeniería eléctrica y áreas afines. Foro para proveer orientación profesional y académica a los estudiantes participantes en el programa doctoral.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

Expose students to a wide range of research activities in electrical engineering. Improve communication skills. Provide orientation about professional and academic careers in electrical engineering. Provide orientation to students about the process of proposal preparation and research funding. Discuss ethical issues in research, publications and intellectual property. Provide orientation about the doctoral program: academic progress, qualifying exam, comprehensive exam, proposal and thesis preparation, and research expectations. Train the student to conduct research in electrical engineering.

5. Instructional Strategies:

☐conference ☐discussion ☐computation ☐laboratory

☒seminar with formal presentation ☒seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Materials, equipment, and physical facilities needed to fulfill the course objectives.

7. Course time frame and thematic outline

Outline	**Contact Hours**
Topics vary with faculty interests but examples of topics might include:	
How to give effective oral presentations.	2
Proposal preparation.	2
Thesis preparation.	2
How to present and publish your research work.	2
Academic careers in electrical engineering.	2
How to use electronic resources and the WEB to conduct literature searches.	2
How to conduct research.	1
Requirements for the doctoral program: Qualifying exam, Comprehensive exam	1
Academic Progress	1
Total hours: (equivalent to contact period)	15

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☐ Exams		
☐ Final Exam		
☐ Short Quizzes		
☒ Oral Reports	varies	40
☐ Monographies		
☐ Portfolio		
☒ Projects	varies	20
☐ Journals		
☒ Other, specify: Reports	varies	40
TOTAL:		100%

(Suggested): The faculty member teaching the course will provide the student with the evaluation strategy he/she will be using throughout the semester. This will be done within the first week of classes.

10. Bibliography:

Textbook:

(1) Blaxter, L.; Hughes, C.; Tight, M.; *How to Research*; Open University Press, 4th ed.; 2010.

(2) Davis, G. B.; Parker, C. A.; Straub, D. W.; *Writing the Doctoral Dissertation: A Systematic Approach*, Barron's Educational Series, 3rd ed., 2012.

(3) Gustavii, B.; *How to Prepare a Scientific Doctoral Dissertation Based on Research Articles*; Cambridge University Press; 2012.

(4) *UPRM-Redacción de Tesis*. http://grad.uprm.edu/oeg/RecursosDocumentos/#reda

(Additional references are determined by the faculty member teaching the course. The UPRM's library offers several online databases for the use of the faculty and students. http://www.uprm.edu/library)

IEEE Xplore. http://ieeexplore.ieee.org (Electronic Publications of the IEEE)

ScienceDirect. http://www.sciencedirect.org

Annual Reviews [Available online via Annual Reviews, UPRM General Library]

ProQuest Dissertations & Theses Database [Available online via ProQuest, UPRM General Library]

(Additional references are determined by the faculty member teaching the course.)

11. According to Law 51

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Person(s) who prepared this description and date of preparation: Eduardo I. Ortiz-Rivera, August 21, 2013

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Ph.D. in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INEL 8999
Course Title: DOCTORAL DISSETATION
Number of credits: Zero to twelve credit hours.
Contact Period: Variable (based on the amount of enrolled academic credits)

2. Course Description:

English: Development, preparation and defense of a dissertation based on an original research project which represents a significant contribution to the state of knowledge in Electrical Engineering.

Spanish: Desarrollo, preparación y defensa de una disertación basada en un proyecto de investigación original que representa una contribución significativa al conocimiento en Ingeniería Eléctrica.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

To develop a dissertation that represents a novel and significant contribution to the state knowledge in Electrical Engineering. To present a report documenting the findings of the research.

5. Instructional Strategies:

☐conference ☐discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☒thesis ☐special problems ☐tutoring

☒research ☐other, please specify:

6. Minimum or Required Resources Available:

Materials, equipment, and physical facilities needed to fulfill the course objectives.

7. Course time frame and thematic outline

This is not a lecture based course. Students will meet with faculty advisor and faculty in their graduate committee as needed to advance the research project. Note that the contact hours will vary depending on the enrolled credit hours (i.e. 1 credit is equivalent to 15 contact hours).

Outline	**Contact Hours**
Dissertation research topics vary with faculty and student interests.	Varies
Total hours: (equivalent to contact period)	Varies

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	**Percent**
☒ **Exams**	**1**	**15**
☒ **Final Exam**	**1**	**15**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☒ **Research Reports**	**1**	**10**
☐ **Portfolio**		
☐ **Projects**		
☒ **Journals**	**3**	**60**
☐ **Other, specify:**		
TOTAL:		**100%**

10. Bibliography:

References:

(1) Levin, P.; *Excellent Dissertations!; Student-friendly Guides*. 2nd ed.; McGraw-Hill. 2011. [Available via EBSCO eBooks, UPRM General Library Databases]

(2) Gustavii, B.; *How to Prepare a Scientific Doctoral Dissertation Based on Research Articles*; Cambridge University Press; 2012.B. Gustavii, How to Prepare a Scientific Doctoral Dissertation Based on Research Articles, Cambridge University Press, 2012

(3) Blaxter, L.; Hughes, C.; Tight, M.; *How to Research*; Open University Press, 4th ed.; 2010.

(4) Davis, G. B.; Parker, C. A.; Straub, D. W.; *Writing the Doctoral Dissertation: A Systematic Approach*, Barron's Educational Series, 3rd ed., 2012.

(5) *UPRM-Redacción de Tesis*. http://grad.uprm.edu/oeg/RecursosDocumentos/#reda

(Additional references are determined by the faculty member teaching the course. The UPRM's library offers several online databases for the use of the faculty and students. http://www.uprm.edu/library)

IEEE Xplore. http://ieeexplore.ieee.org (Electronic Publications of the IEEE)

ScienceDirect. http://www.sciencedirect.org

Annual Reviews [Available online via Annual Reviews, UPRM General Library]

ProQuest Dissertations & Theses Database [Available online via ProQuest, UPRM General Library]

11. According to Law 51

Students will identify themselves with the Institution and the instructor of the course for purposes of assessment (exams) accommodations. For more information please call the Student with Disabilities Office which is part of the Dean of Students office (Office #4) at (787) 265-3862 or (787) 832-4040 extensions 3250 or 3258 or by email at virgen.aponte@upr.edu.

Person(s) who prepared this description and date of preparation: Eduardo I. Ortiz-Rivera, August 21, 2013

Appendix G:
Description of Courses that can be used to satisfy the Mathematics Requirement

Sample Courses to Satisfy the Mathematics Requirement

This is a list of potential courses that can be used to meet the mathematics requirement in the EE Ph.D. program. It includes courses in Mathematical Sciences and related courses with applied mathematics content offered at the college of engineering. The list will be revised by the ECE Graduate Committee yearly and updated according to course offers in mathematical sciences and related fields and interests of the faculty.

Courses from the Mathematical Sciences Department

MATE 5016. GAME THEORY (On demand). Three credit hours. Three hours of lecture per week. Mathematical theory and solution of different classes of games, such as two-person, rectangular or matrix, and multipersonal games.

MATE 5047. INTERMEDIATE DIFFERENTIAL EQUATIONS (I) (Odd numbered years). Three credit hours. Three hours of lecture per week. Prerequisites: MATE 4009 and MATE 4031 or its equivalent. Existence, continuity and differentiability of solutions; stability and Lyapunov’s theorem.

MATE 5049. CALCULUS OF VARIATIONS (On demand). Three credit hours. Three hours of lecture per week. Prerequisite: MATE 4009. Origin and historical development of the calculus of variations; first variation of a functional; canonical forms of Euler's equations; second variation: sufficient conditions for weak and strong extremals; applications to problems in geometry, mechanisms and physics.

MATE 5055. VECTOR ANALYSIS (On demand). Three credit hours. Three hours of lecture per week. Prerequisite: MATE 3063 or MATE 3185. Introduction to vector analysis as a tool for mathematicians. The algebra and calculus of vectors, including gradient, divergence and curl, Stokes' and Green's theorems, curvilinear coordinates, and simple n-dimensional space. Applications in physics and geometry.

MATE 5056. TENSOR ANALYSIS (On demand). Three credit hours. Three hours of lecture per week. Prerequisite: MATE 3063 or MATE 3185. Cartesian tensors, Cartesian tensor fields, gradient vector, Laplacian, covariant and contravariant tensor fields, the differential line-element and the fundamental tensors, covariant differentiation and the Riemann-Christoffel tensor.

MATE 5150. LINEAR ALGEBRA (I). Three credit hours. Three hours of lecture per week. Prerequisite: MATE 4008. Study of the essentials of linear algebra, including finite dimensional vector spaces, linear equations, matrices, determinants, bilinear forms, inner products, spectral theorem for normal operators, and linear transformations.

MATE 6005. COMBINATORICS (On demand). Three credit hours. Three hours of lecture per week. Enumerative analysis and optimization techniques: permutations and combinations, generating functions, recurrence relations, the principle of inclusion and exclusion, rudiments of graph theory, transport network, and linear programming.

MATE 6025. NUMERICAL LINEAR ALGEBRA. Three credit hours. Three hours of lecture per week. Matrix analysis techniques fundamental to problem solving and the development of optimization methods and numerical solution of differential equations. Topics include: eigenvalue and eigenvector problems, numerical methods, singular value decomposition, special problems, and applications.
MATE 6026. NUMERICAL OPTIMIZATION. Three credit hours. Three hours of lecture per week. Modern optimization methods and their application to various problems in science and engineering. Topics include: optimization on convex sets, minimization methods of nonlinear problems, nonlinear equations, conjugate methods, and special structure problems.

MATE 6045. OPTIMIZATION THEORY (II) (Odd numbered years). Three credit hours. Three hours of lecture per week. Classical optimization techniques: linear, nonlinear, geometric programming, dynamic programming, the path method.

MATE 6201-6202. ABSTRACT ALGEBRA (II)- (I). Three credit hours per semester. Three hours of lecture per week each semester. Prerequisite: authorization of Director of the Department. A survey of abstract algebra. Algebraic systems studied include groups, ring, fields, Galois theory, modules over rings, partially ordered algebraic systems and theory of categories.

MATE 6261. THEORY OF FUNCTIONS OF A REAL VARIABLE I (I). Three credit hours. Three hours of lecture per week. Set theory, the axiom of choice and Zorn's lemma, structure of the real number system, metric and topological spaces, Borel sets and Baire functions, limit theorems, properties of continuous and semicontinuous functions, derivatives and sequences of functions, functions of bounded variation, Riemann-Stieltjes integration.

MATE 6262. THEORY OF FUNCTIONS OF A REAL VARIABLE II (II). Three credit hours. Three hours of lecture per week. An introduction to measure theory and Lebesque integration, covering the following topics: inner and outer measure, measurable sets, Lebesque measurable sets, Vitali's covering theorem, measurable functions, convergence in measure, the Lebesque integral for real functions of a real variable, the Radon-Nykodym theorem, multiple integrals, Fubini's theorem, L spaces, convergence in the mean.

MATE 6301. THEORY OF FUNCTIONS OF A COMPLEX VARIABLE (II) (Even numbered years). Three credit hours. Three hours of lecture per week. This course provides a rigorous foundation in the theory of functions of a complex variable. Topics include theory of analytic functions, contour integration and infinite series.

MATE 6530. DIFFERENTIAL GEOMETRY I (II) (Even numbered years). Three credit hours. Three hours of lecture per week. Prerequisite: MATE 6670. Study of Riemannian metrics, affine and Riemannian connections, geodesics, curvatures, Jacobi fields, immersions.

MATE 6531. DIFFERENTIAL GEOMETRY II (On demand). Three credit hours. Three hours of lecture per week. Prerequisite: MATE 6530. Study of complete manifolds, spaces of constant curvature, variations of energy, Rauch comparison theorem, Morse index theorem, fundamental group of manifolds of negative curvature, sphere theorem.

MATE 6540. TOPOLOGY (II). Three credit hours. Three hours of lecture per week. An introductory course devoted to set-theoretic topology. Properties of topological spaces, including connectedness, compactness, bases, subbases, product spaces, quotient spaces, and the separation axioms.

MATE 6551. ALGEBRAIC TOPOLOGY (On demand). Three credit hours. Three hours of lecture per week. Homotopy and homology groups associated with a topological space.

MATE 6622. TOPICS IN THE THEORY OF FUNCTIONS OF A COMPLEX VARIABLE (I) (Even numbered years). Three credit hours. Three hours of lecture per week. Prerequisite: ATE 6301. Conformal mapping. Riemann surfaces, harmonic functions, the Dirichlet problem.

MATE 6651-6652. INTRODUCTION TO HIGHER GEOMETRY (I, Even numbered years)- (On demand). Three credit hours per semester. Three hours of lecture per week each semester. Homogeneous Cartesian coordinates, linear dependence of points and lines, harmonic division, line coordinates, cross-ratio; transformation; metric, affine, and projective geometries; points and line curves, space geometry.

MATE 6670. DIFFERENTIABLE MANIFOLDS (I, Every two years) (On demand). Three credit hours. Three hours of lecture per week. Differentiable manifolds, vector fields, the Frobenius theorem, differential forms and tensor fields, Lie groups, homogeneous spaces, integration on manifolds.

MATE 6672. NUMERICAL MATHEMATICAL ANALYSIS (I). Three credit hours. Three hours of lecture per week. Mathematical methods of computation applicable to automatic digital computers, choice and use of tables, finite differences, roots of equations, numerical differentiation and integration, curve fitting, least squares, harmonic analysis.

MATE 6674. NUMERICAL METHODS FOR DIFFERENTIAL EQUATIONS. Three credit hours. Three hours of lecture per week. Fundamentals of mathematical modeling with partial differential equations and numerical methods for their solution with the computer. Convergence and stability of distinct schemes of finite differences or finite elements for various types of partial differential equations.

MATE 6675. MATHEMATICS OF MODERN SCIENCE I (I). Three credit hours. Three hours of lecture per week. A more advanced study of some topics covered in Mathematics of Modern Science. Complex variables, partial differential equations, special functions, and transform calculus.

MATE 6676. MATHEMATICS OF MODERN SCIENCE II (II). Three credit hours. Three lectures per week. Prerequisite: MATE 6675. A more advanced study of some topics covered in MATE 4071-4072. Sturm-Liouville systems, calculus variations, integral equations, tensors, and finite differences.

MATE 6677. ELEMENTARY PARTIAL DIFFERENTIAL EQUATIONS (I) (Even numbered years). Three credit hours. Three hours of lecture per week. Prerequisite: MATE 4009.

General theory of partial differential equations of the first and second order, linear partial differential equations, study of some of the important types of differential equations of mathematical physics.

COMP 6785. ANALYSIS OF ALGORITHMS (II). Three credit hours. Three hours of lecture per week. Prerequisite: authorization of the Director of the Department. Analysis of algorithms: graph algorithms, algorithms for classical problems in linear algebra. Integer and polynomial arithmetic, complexity, and NP-completeness.

ESMA 5015. STOCHASTIC SIMULATION (I) (Even numbered years). Three credit hours. Three hours of lecture per week. Prerequisite: ESMA 4001 or MATE 4001. Basic methods of simulation, modeling of complex systems, simulation languages, generation of random numbers, model validity, analysis of solutions, variance reduction techniques, and the design of experiments.

ESMA 6205. APPLIED REGRESSION (II). Three credit hours. Three hours of lecture per week. Simple linear regression, multiple linear regression, robust regression methods and analysis of residuals. Problems and remedial measures in the design of regression models. Selection of independent variables. Non-linear regression.

ESMA 6305. STATISTICAL METHODS (I). Three credit hours. Three hours of lecture per week. Populations and samples, probability distributions, sampling distributions, statistical inference, linear and multiple regression and correlation, analysis of variance and covariance. Use of statistical computer package.

ESMA 6600. PROBABILITY THEORY (I). Three credit hours. Three hours of lecture per week. Sample spaces and events, conditional probability and independence, discrete and continuous random variables, moment generating functions, and limit theorems.

ESMA 6607. ADVANCED SAMPLING THEORY (II) (Even numbered years). Three credit hours. Three hours of lecture per week. Advanced theory and techniques of statistical sampling, including simple, stratified, systematic, and conglomerate sampling; comparison among these and corresponding problems of estimation; allocation problems.

ESMA 6616. LINEAR MODELS (I) (Odd numbered years). Three credit hours. Three hours of lecture per week. Prerequisite: authorization of the Director of the Department. Multivariate normal distribution; distribution of quadratic forms; theory of least squares; estimation and hypothesis testing in the general linear model, analysis of multiple classifications; components of variance models.

ESMA 6660. BIOSTATISTICAL ANALYSIS (On demand). Three credit hours. Three hours of lecture per week. Prerequisite: authorization of the Director of the Department. Descriptive and inferential statistical techniques, design of experiments, construction of biomathematical models, bio-essays and probit analysis.

ESMA 6661. THEORY OF STATISTICS I (II). Three credit hours. Three hours of lecture per week. Sampling distributions, point and interval estimation, optimal properties of estimators, tests of simple and composite hypotheses, likelihood ratio tests, tests of goodness of fit, and analysis of contingency tables.

ESMA 6662. THEORY OF STATISTICS II (I). Three credit hours. Three hours of lecture per week. Prerequisite: ESMA 6661. Nonparametric tests, multivariate distributions, introduction to linear models, estimation and hypothesis testing in linear models, Bayesian methods, and statistical decision theory.

ESMA 6787. EXPERIMENTAL DESIGN (I) (Even numbered years). Three credit hours. Three hours of lecture per week. Principles of experimental design and hypothesis testing: randomized blocks, latin squares, 2n, 3n, and other factorial experiments; confounding, fractional factorials, response surface methodology, split plot and incomplete block designs.

ESMA 6788. ADVANCED PROBABILITY THEORY (On demand). Three credit hours. Three hours of lecture per week. Fundamentals of integration and measure theory; basic concepts of probability in the context of measure theory; conditional probability and conditional expectation; strong law of large numbers; theory of martingales and central limit theorem.

ESMA 6789. STOCHASTIC PROCESSES (II) (Odd numbered years). Three credit hours. Three hours of lecture per week. Probability spaces and convergence concepts; random walk; Markov chains; Poisson processes and purely discontinuous Markov processes; stationary processes; martingales; Brownian motion and diffusion stochastic processes.

Courses from the College of Engineering

ININ 6005. EXPERIMENTAL STATISTICS. Three credit hours. Three hours of lecture and/or discussion per week. Prerequisite: authorization of the Director of the Department. Applications of multiple regression to analysis of variance and experimental designs. Analysis of multiple classifications involving fixed, random, and mixed effects, including crossed and nested variables of classification. Emphasis on computer model applications.

ININ 6008. NETWORK FLOWS AND GRAPHS IN MANAGEMENT SCIENCE. Three credit hours. Three hours of lecture and discussion per week. Prerequisite: authorization of the Director of the Department. Principles of network flows and graphs theory and their applications in management science. Classical network flow problem formulations including maximal flow-minimal cut, assignment, transportation and others. Representation of optimization problems as network formulations, and the use of the out of kilter algorithm for their solution. Single versus multicommodity flow, as well as the relation of graphs and networks to combination problems.

ININ 6010. MULTIPLE REGRESSION ANALYSIS. Three credit hours. Three hours of lecture per week. Prerequisite: authorization of the Director of the Department. Analysis of unplanned experimental data to develop models for predicting complex systems behavior. Topics include: matrix formulation and properties of least squares estimators in multiple linear regression; analysis of residuals; diagnostics for influential data; strategies for variable selection;

diagnostics, effects, and corrective measures for problems with correlated predictor variables; biased regression and other estimation criteria; autocorrelated residuals; simultaneous inference, model validation; use of computer programs to analyze real data and to develop a model.

ININ 6020. QUEUEING THEORY AND APPLICATIONS. Three credit hours. Three hours of lecture per week. Prerequisite: authorization of the Director of the Department. Development and use of analytical models for the design of queuing systems. Introduction to stochastic-process models. Applications to analysis, design, and optimization of queuing systems in service and manufacturing organizations.

ININ 6025. LINEAR AND DISCRETE OPTIMIZATION. Three credit hours. Three hours of lecture and discussion per week. Prerequisite: authorization of the Director of the Department. Basic theory and development of the simplex method for solving linear programming problems with discrete variables. Dual problems and sensitivity analysis. Formulation of problems with discrete variables. Developments of implicit enumeration and related methods for integer problems. Application of linear and discrete optimization methods to problems of industry and government. Use of computer programs.

ININ 6036. INTRODUCTION TO TIME SERIES ANALYSIS. Three credit hours. Three hours of lecture per week. Prerequisite: authorization of the Director of the Department. Univariate and bivariate time series in frequency and time domain, use of autocorrelation and spectral analysis for model identification. Uses of model diagnostic and forecasting techniques, dynamic systems modeling and stochasting estimation by means of the Kalman filter.

CIIC 6005. COMPUTING FOUNDATIONS.
Three credit hours. Three hours of lecture per week.
Concepts and formal definitions of algorithmically solvable problems. Classification of problems by their computability in terms of the time and space required to solve them.

Appendix H: Doctoral Qualifying Examination for the Electrical Engineering Doctoral Program

Purpose and General Information

The purpose of the doctoral qualifying examination is to evaluate the candidate's ability to organize for doing research at the doctoral level, to write a technical paper, to speak from a prepared talk and in response to live questioning, and to think logically and clearly, under some pressure. The assessment is based on the student's performance in a written examination and an oral examination. The exams will be prepared, supervised and evaluated by the program's Graduate Studies Committee in coordination with its faculty.

The qualifying examination is offered each semester, during the first month of classes. Students entering the program with a M.S. must take the qualifying examination the semester immediately after their first year of study, and students entering the program with a B.S. degree must take the exam the semester immediately after their second year of study. Students who are required to take deficiency courses must complete the all the deficiencies before taking the qualifying exam. The Graduate Studies Committee may, under well justified circumstances, offer extensions to these time requirements. Failure to take the examination within the established periods will count as a failed attempt, except in the case of extenuating circumstances. According to UPRM's regulations, each student has two opportunities to pass the exam.

Format

The doctoral qualifying examination consists of a written exam and an oral exam. The Graduate Committee, in coordination with the department faculty, will pose an open question to each candidate during the first week of classes, and will assign an Evaluation Committee for each student. The Evaluation Committee will consist of two faculty selected from the ECE Department, and one representative from the Graduate Committee. The candidates must complete a research paper on the assigned question in two weeks, and turn them in to their Evaluation Committee. The oral exam will take place two weeks after the completion of the research paper. In the oral exam, the candidates will present their papers to the Evaluation Committee.

The candidates will work on both the oral and written exam without any external consultation.

Assessments of Results

The result of the qualifying examination is determined as follows:

1. Each evaluator submits numerical evaluations of the student's performance in the written and oral examinations. Each exam will have a maximum score of 100 points.
2. The Graduate Studies Committee will tabulate the results of the individual exams. The results of the examination will then be compared and evaluated and a consensus vote will be made to decide the passing grade for that particular exam offering. If a student fails the exam and feels that additional information is needed, he/she may request a meeting with the president of the program Graduate Studies Committee.

3. The Graduate Studies Committee will inform the program's Director of the results of the examination, who will in turn inform the student and the Office of Graduate Studies no later than two weeks after the qualifying exam.

A student who has passed the examination will be allowed to register in INEL 8999 – Doctoral Dissertation. This student is henceforth regarded as a doctoral degree candidate in the Electrical Engineering Program at UPRM.

A student who has failed the qualifying examination the first time may retake it a second and final time within one semester of the first attempt. According to UPRM regulations, a second failure will result in the student's dismissal from the graduate program. If the student does not hold a Master's degree in Electrical Engineering, the student will be given the opportunity to transfer to the Electrical Engineering's Master of Science or Master of Engineering programs. If none of these options is selected, the student will be suspended from the Electrical Engineering graduate program. After one year of suspension, the student may apply for a second and final admission to the same program or to another UPRM graduate program.

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CONDICIONADO

28,882	112-1-13
NUMERO DE CONTROL	NÚMERO DE CASO
EDIFICIO LUIS STEFANI	UNIVERSIDAD DE PUERTO RICO RUM
Nombre del Establecimiento	Dueño del Establecimiento
BOULEVARD ALFONSO VALDES # 253, MAYAGUEZ	SALONES DE CLASES, LABORATORIOS Y OFICINAS
Dirección del Establecimiento	*Tipo de Uso*
Pies Cuadrados: 103,972 p/c	

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14 DE OCTUBRE DE 2013	14 DE ENERO DE 2014
FECHA DE EXPEDICION	FECHA DE EXPIRACION

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REGION: MAYAGÜEZ EXPEDIDA: 29 DE OCTUBRE DE 2013

POR LA PRESENTE SE AUTORIZA A UPR RECINTO UNIVERSITARIO DE MAYAGUEZ

A OPERAR UN EDIFICIO LUIS STEFANI (SALONES DE CLASES, LAB Y OFICINAS) EN ESTA CIUDAD,
(CLASE DE ESTABLECIMIENTO, NEGOCIO O INSTITUCION)

DIRECCION: RECINTO UNIVERSITARIO DE MAYAGUEZ, MAYAGÜEZ, PR

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ESTA LICENCIA VENCE EL 29 DE OCTUBRE DE 2016.

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OFICIAL O SUPERVISOR DE SALUD AMBIENTAL

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PUERTO RICO

15 de octubre de 2013

Sr. William Hernández
Decano Asociado asuntos
Administrativos de Ingeniería

Universidad de Puerto Rico
Interamericana de San German
Edificio Stefani
Boulevard Alfonso Valdez #253
San German

CASO # 112-1-13

Saludos cordiales,

Por la presente le doy conocimiento referente a la petición de tiempo adicional y endoso condicionado para el edificio Stefani. Se le aprueba la petición de otorgarle tiempo adicional para el cumplimiento de los requerimientos señalados. A la vez se le otorga endoso condicionado con fecha de 14 de octubre del 2013 hasta el 14 de enero del 2014.

Para esta fecha deberá haber cumplido con los requerimientos señalados en el informe de inspección #48828 del 2 de octubre del 2013. Luego que haya cumplido a cabalidad con los requerimientos aquí estipulado se le otorgara el endoso correspondiente para los últimos 9 meses equivalente al año.

Se le informa que de no cumplir con los acuerdos estipulados en el informe y esta carta normativa, se expone a la revocación de las licencias, multas y permisos expedidos por el Negociado de Prevención de Incendios según Ley 43 del 21 junio del 1988

Insp. III, Israel Martínez Pagan
Director,
Oficina de Prevención Mayagüez

Calle Loíza Esq. Doncella
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San Juan, PR 00936
P.O. Box 13325 San Juan P.R. 00908-3325
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PUEBLO: **MAYAGUEZ** LICENCIA NUMERO: **4267**

REGION: **MAYAGÜEZ** EXPEDIDA: **11 DE DICIEMBRE 2012**

POR LA PRESENTE SE AUTORIZA A **UNIVERSIDAD DE PR RECINTO UNIVERSITARIO DE MAYAGUEZ**

A OPERAR UN **EDIFICIO INVERNADERO (SALONES DE CLASES,LABORATORIOS Y OFICINAS)CENTRO NUCLEAR** EN ESTA CIUDAD,

(CLASE DE ESTABLECIMIENTO, NEGOCIO O INSTITUCION)

DIRECCION: **RECINTO UNIVERSITARIO DE MAYAGUEZ MAYAGUEZ PR**

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ESTA LICENCIA VENCE EL **11** DE **DICIEMBRE** DE **2015**.

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Eduardo P. ... [signature]

CARLOS J. MERCADO RUIZ, MS
OFICIAL O SUPERVISOR DE SALUD AMBIENTAL

CBPR - NPREV - 004
MAYO - 2009

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398-2-12
NÚMERO DE CASO

CENTRO INVESTIGACION Y DESARROLLO
Nombre del Establecimiento

RECINTO UNIVERSITARIO MAYAGUEZ
Dueño del Establecimiento

CARR 108 KM 1.0, BO. MIRADERO MAYAGUEZ
Dirección del Establecimiento

ADMINISTRACION DE PROGRAMAS DE INVESTIGACION
Tipo de Uso

Pies Cuadrados: 74,938 p/c

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9 DE OCTUBRE DE 2013
FECHA DE EXPEDICION

9 DE OCTUBRE DE 2014
FECHA DE EXPIRACION

Inspeccionado por:

Jeffrey Hernández López

JEFFREY HERNANDEZ LOPEZ
Nombre y firma del Inspector

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DISTRITO MAYAGÜEZ

ÁNGEL A. CRESPO ORTÍZ
Jefe del Cuerpo de Bomberos

INSP. III ISRAEL MARTINEZ PAGAN
Nombre y firma del funcionario autorizado

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Consejo de Educación de Puerto Rico
CEPR

SOLICITUD DE ENMIENDA PARA
CREACIÓN DE NUEVOS OFRECIMIENTO ACADÉMICO
Sección 28.4
(Completar para cada ofrecimiento académico por separado)

INFORMACIÓN DE LA INSTITUCIÓN				
Nombre: Universidad de Puerto Rico				
Unidad: Recinto Universitario de Mayagüez				
INFORMACIÓN DEL OFRECIMIENTO ACADÉMICO				
Título del ofrecimiento	Doctoral Program in Electrical Engineering (Ph.D.), Programa Doctoral en Ingeniería Eléctrica (Ph.D.)			CIP CODE 14.1001
Modalidad	☒ Presencial	☐ En línea	☐ Otro (Describa)	
	☐ Acelerado	☐ Weekend College		
Término Académico	☒ Semestre (15 semanas) ☐ Trimestre (___ semanas)		☐ Cuatrimestre (__semanas) ☐ Bimestre (___ semanas)	☐ Otro (Describa)

Diseño Curricular	Cantidad de Créditos
Educación General	0
Cursos Medulares	3-9
Concentración/Especialidad	15-21
Electivas	12
Otro (Disertación y Seminario)	13
Total	49

Unidad de Equivalencia Horas/Crédito por término

1Crédito = __1hr__ horas lectivas
1Crédito = laboratorio/practica

Indicar si el ofrecimiento académico responde a una Ocupación o Profesión Reglamentada por Ley en Puerto Rico

☐ **SI** ☒ **NO**

De ser afirmativo, la institución certifica que los egresados cumplen con los requisitos establecidos por la ocupación o profesión.

DESCRIPCIÓN DEL OFRECIMIENTO ACADÉMICO

NCES CIP Code: 14.1001 Electrical, Electronics and Communications Engineering

The proposed program will provide the most advanced education in electrical engineering in Puerto Rico. Graduates of this program will utilize their knowledge and training to think critically and creatively to significantly contribute to the social and economic development of Puerto Rico and its hemisphere in the areas of research, development, and education. The proposed program emerges from the natural evolution of research and graduate studies at the Master level in the Department of Electrical and Computer Engineering, and addresses the need for advanced studies and research in electrical engineering.

The program will neither include specialty nor concentration areas. Instead, it will utilize internal areas of emphasis in order to guide students in their curriculum and research. This is done in order to maintain a flexible structure which will allow the program to adapt itself to the rapid technological changes in electrical engineering and related areas while permitting the development of non-traditional interdisciplinary research areas that do not fit into the traditional electrical engineering mold. The doctoral program will have an initial emphasis towards the areas of 1) energy systems, 2) applied electromagnetic, 3) signal and systems, and 4) electronics. However, the program structure has enough flexibility to accommodate new efforts in bioengineering, aerospace systems, smart renewable energy systems, and microelectromechanical systems being developed at UPRM.

The proposed academic program will consist of a minimum of forty-nine credits, from which a minimum of twenty-four will be taken in one of the areas of emphasis. Of the forty-nine required credits, a minimum of six credits will be taken in advanced graduate or undergraduate level courses to satisfy a mathematical sciences requirement, of which at least three credits will be at the 6000 or higher level. The objective behind this requirement is to strengthen essential analytical skills required for state of the art research in electrical engineering. A list of sample courses to satisfy the mathematical sciences requirement is included in the appendix. In addition, six credits in electives outside the area of emphasis will be required. Each doctoral candidate will be required to participate in the doctoral seminar each semester for which he will receive one credit at the conclusion of his/her dissertation. Besides, students will be required to pass a qualifying exam and a comprehensive exam as part of the process of evaluating their ability to engage in doctoral level research. Finally, students will be required to approve 12 dissertation credits.

The dissertation will measure the scope of acquired knowledge and it will evidence the student’s degree of creativity. It will require an original contribution to the existing scientific and/or technological body of knowledge in the field of electrical engineering or related areas.

Título del Ofrecimiento Académico: Programa Doctoral en Ingeniería Eléctrica CIP Code: 14.1001

REQUISITOS DE ADMISIÓN (a la institución y al ofrecimiento académico)
Nota: indique cursos que sean pre requisitos para admisión al ofrecimiento académico General requirements necessary for admission into the graduate program appear in the section titled NORMS WHICH REGULATE GRADUATE STUDIES AT UPRM which at the moment of writing this proposal are established in Certification 09-09 issued by the UPRM Academic Senate. Specific program requirements are as follows: • Bachelor or Master's Degree in Electrical Engineering, Computer Engineering or their equivalents from an accredited institution of higher learning. The graduate departmental committee will evaluate each applicant's qualifications and the reputation of their graduating institution to determine if the applicant fulfills admission requirements of the doctoral program and decide on the type of admission to be awarded. • Applicants with a bachelor degree or a master's degree in other engineering fields, in science, in mathematics or in related areas may be considered for admission into the electrical engineering doctoral program. Depending on the applicant's academic background, admission may be granted with deficiency courses or a master degree in Electrical or Computer Engineering may be recommended before admission into the doctoral program. • A general grade point average of 3.3/4.0 or its equivalent if the applicant holds a BS degree • A general grade point average of 3.5/4.0 GPA or its equivalent if the applicant holds an MS degree or a higher degree. • A minimum mastery of both English and Spanish skills to understand technical literature, and to write technical documents in both languages. The norms established by the Office of Graduate Studies as well as all previously described admission guidelines to the doctoral program are applicable to transfer students.

REQUISITOS DE GRADUACIÓN
(a la institución y al ofrecimiento académico)

The general academic requirements for conferring the doctoral degree are specified in the "Norms that regulate graduate studies at UPRM". Specific requirements for the proposed doctoral program in Electrical Engineering are described below.

1) Total Credit-Hour Requirement

Students are required to approve a minimum of 49 credits distributed in the following manner:
• 24 credits in graduate or advanced undergraduate level courses within a particular area of emphasis
• 6 credits in graduate or advanced undergraduate level mathematics courses. At least one course must be at the graduate level (6000 or above).
• 6 credits in elective courses outside the area of specialization
• 1 credit in doctoral seminar
• 12 credits in doctoral dissertation
No more than 9 credits at the advanced undergraduate level can be used to complete doctoral degree course requirements. At least 6 credits in advanced graduate courses (8000 or higher) are required within the area of emphasis.

2) Minimal Academic Index Requirements
In order to obtain a doctoral degree, each student must approve a minimum of 49 credits (according to specifications stated in the previous section) with a 3.0 or higher GPA. Students enrolled in the doctoral program may repeat a course with an earned grade of C or lower only once. Courses with a final grade of A or B cannot be repeated. Students must approve all courses in their program of studies with a minimum grade of C.

3) Maximum Number of Transfer Credits to be Allowed
Courses taken at UPRM in fulfillment of requirements of another graduate program may be used to fulfill the requirements of the doctoral program. Courses taken at other institutions of higher learning may be used to fulfill doctoral program requirements but are subject to residency requirements specified in "Norms that Regulate Graduate Studies at UPRM" which at the moment of writing this proposal require that 60% of the courses to be taken at UPRM. The departmental graduate committee will evaluate and determine in all cases the courses to credit or convalidate. All transfer courses must have been approved with a minimum grade of B. Under no condition may thesis credits be transferred.

4) Residency
Residency requirements will be those established by Norms that Regulate Graduate Studies at UPRM which at the time of this proposal read as follows:
"Residency requirements at the Doctoral level – a minimum of four semesters for students entering with a Bachelors degree, and a minimum of two semesters for students entering with a Masters degree. In both cases the student will complete at least sixty percent of the course work for the program at UPRM."

5) Seminar
The seminars are a method to integrate in a coherent manner various research areas linked to the program. Doctoral candidates will be required to register for the Doctoral Seminar in EE for the duration of their doctoral program and will be awarded one credit the semester their dissertation is turned in.

6) Qualifying Exam

All students will be required to take a Qualifying Exam. This exam will serve to evaluate a candidate's competency in areas related to Electrical Engineering. The exam will be prepared by the department Graduate Committee. This committee will determine the minimum competencies required to pass the exam. Students admitted to the program with a Masters degree should take the exam at the end of the first year of studies. Those admitted with a Bachelors degree should take the exam at the end of the second year of studies. Students must have passed the qualifying exam in order to register for the doctoral dissertation course. Doctoral students who fail this exam will be allowed to repeat the exam only once, and will be suspended after failing twice. Students who fail the qualifying exam twice may not be re-admitted or given a new admission to the program. Once the qualifying exam is passed, the student becomes a doctoral candidate.

7) Comprehensive Exam

After passing the Qualifying Exam, the student must prepare a research thesis proposal and submit it to his Graduate Committee for approval. After receiving approval, the student will request the Comprehensive Exam. This application must be done no later than the semester following the submission of the proposal.

The student will present his research proposal during this exam and can be evaluated on any topics related to his area of emphasis or research. The exam will be prepared and administered by the members of the student's graduate committee and one representative of the departmental graduate committee appointed by the ECE Graduate Committee Chair. They will decide whether the student passes or fails the exam and will submit a report to the department. Doctoral students may repeat the comprehensive exam only once in case of failure and will be suspended after failing for the second time. Students who fail the comprehensive exam twice may not be re-admitted or given new admission to the program.

8) Dissertation

All Ph.D. candidates must undertake an independent research project that is a significant contribution to the advancement of knowledge in the area of specialization. All doctoral candidates must pass the oral exam in defense of his dissertation. Students must have passed the qualifying exam in order to register for the doctoral dissertation course, and must have passed the comprehensive exam before defending the thesis. Doctoral students may repeat the dissertation oral exam only in case of failure and will be suspended after failing for the second time. Students who fail the dissertation oral exam twice may not be re-admitted or given new admission to the program.

9) Language Requirements

This program has no language requirements

10) Time Limit for Program Completion

The time limit to complete the degree will be determined by the "Norms that Regulate Graduate Studies at UPRM" which at the time of the publication of this proposal are as follows:

- Ten years if the student initiates the program with a Bachelor's degree, even if the student is a transfer from another graduate program or if the student had temporarily suspended studies.
- Eight years if the student initiates the program with a Master's degree, even if the student is a transfer from another graduate program or if the student had temporarily suspended studies.

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Incluya los objetivos del ofrecimiento académico y el enunciado del perfil del egresado que corresponda. El perfil del egresado tiene que incluir las destrezas, conocimientos y actitudes que adquirirá el estudiante. En las últimas dos columnas indique los códigos y los cursos que propenden al logro del perfil que pretende desarrollar el ofrecimiento académico en sus egresados.

OBJETIVOS DEL OFRECIMIENTO ACADÉMICO	PERFIL DEL EGRESADO	CURSO(S)	
		Código	Título del curso
a, b, c	1,3,4,5,12	INEL 5046.	PATTERN RECOGNITION
a, b, c	1,3,4,5,12	INEL 5206.	DIGITAL SYSTEMS DESIGN
a, b, c	1,3,4,5,12	INEL 5265	ANALOG INTEGRATED CIRCUITS DESIGN
a, b, c	1,3,4,5,12	INEL 5307.	OPTICAL COMMUNICATIONS
a, b, c	1,3,4,5,12	INEL 5309.	DIGITAL SIGNAL PROCESSING
a, b, c	1,3,4,5,12	INEL 5315	THEORY OF COMMUNICATIONS II
a, b, c	1,3,4,5,12	INEL 5327.	IMAGE PROCESSING
a, b, c	1,3,4,5,12	INEL 5406.	DESIGN OF TRANSMISSION AND DISTRIBUTION SYSTEMS
a, b, c	1,3,4,5,12	INEL 5415	ELECTRICAL SYSTEMS PROTECTION DESIGN
a, b, c	1,3,4,5,12	INEL 5505.	LINEAR SYSTEM ANALYSIS
a, b, c	1,3,4,5,12	INEL 5506.	PROCESS INSTRUMENTATION AND CONTROL ENGINEERING
a, b, c	1,3,4,5,12	INEL 5508.	DIGITAL CONTROL SYSTEMS
a, b, c	1,3,4,5,12	INEL 5605.	ANTENNA THEORY AND DESIGN
a, b, c	1,3,4,5,12	INEL 5606.	MICROWAVE ENGINEERING
a, b, c	1,3,4,5,12	INEL 5616.	WIRELESS COMMUNICATIONS
a, b, c	1,3,4,5,12	INEL 5629.	TELECOMMUNICATION ELECTRONICS
a, b, c	1,3,4,5,12	INEL 6000.	INTRODUCTION TO NONLINEAR CONTROL SYSTEMS
a, b, c	1,3,4,5,12	INEL 6001.	FEEDBACK CONTROL SYSTEMS I
a, b, c	1,3,4,5,12	INEL 6007.	INTRODUCTION TO REMOTE SENSING
a, b, c	1,3,4,5,12	INEL 6025.	ADVANCED ENERGY CONVERSION
a, b, c	1,3,4,5,12	INEL 6027.	DYNAMICS AND CONTROL OF INTEGRATED POWER SYSTEMS
a, b, c	1,3,4,5,12	INEL 6028.	OPTIMIZATION AND ECONOMIC OPERATION OF INTEGRATED POWER SYSTEMS
a, b, c	1,3,4,5,12	INEL 6047	ADVANCED CONTROL SYSTEM THEORY
a, b, c	1,3,4,5,12	INEL 6049.	MULTIDIMENSIONAL DIGITAL SIGNAL PROCESSING
a, b, c	1,3,4,5,12	INEL 6050.	ADVANCED DIGITAL SIGNAL PROCESSING ALGORITHMS
a, b, c	1,3,4,5,12	INEL 6058.	HIGH FREQUENCY POWER CONVERTERS
a, b, c	1,3,4,5,12	INEL 6059.	INTELLIGENT SYSTEMS AND CONTROLS
a, b, c	1,3,4,5,12	INEL 6066.	CONTROL OF ELECTRIC DRIVE SYSTEMS
a, b, c	1,3,4,5,12	INEL 6076.	ADAPTIVE AND OPTIMAL SIGNAL PROCESSING
a, b, c	1,3,4,5,12	INEL 6077.	SURGE PHENOMENA IN POWER SYSTEMS
a, b, c	1,3,4,5,12	INEL 6078.	ESTIMATION, DETECTION AND STOCHASTIC PROCESSES
a, b, c	1,3,4,5,12	INEL 6085.	ANALYSIS AND DESIGN OF POWER SEMICONDUCTOR CIRCUITS
a, b, c	1,3,4,5,12	INEL 6096	ELECTRIC POWER QUALITY
a, b, c	1,3,4,5,12	INEL 6601	ADVANCED ELECTROMAGNETICS
a, b, c	1,3,4,5,12	INEL 6605	ACTIVE REMOTE SENSING TECHNIQUES
a, b, c	1,3,4,5,12	INEL 6606	INTRODUCTION TO RADAR SYSTEMS
a, b, c	1,3,4,5,12	INEL 6615	MICROWAVE ACTIVE CIRCUITS
a, b, c	1,3,4,5,12	INEL 6668	MICROWAVE ANTENNA ENGINEERING
a, b, c	1,3,4,5,12	INEL 6669	MICROWAVE REMOTE SENSING
a, b, c	1,3,4,5,12	INEL 6995.	SPECIAL TOPICS IN ELECTRICAL ENGINEERING
a, b, c	1,3,4,5,8,9,12	INEL 8295	ADVANCED TOPICS IN ELECTRONICS

a, b, c	1,3,4,5,8,9,12	INEL 8395	ADVANCED TOPICS IN SIGNAL PROCESSING
a, b, c	1,3,4,5,8,9,12	INEL 8495	ADVANCED TOPICS IN ELECTRIC POWER ENGINEERING
a, b, c	1,3,4,5,8,9,12	INEL 8496	ADVANCED TOPICS IN POWER ELECTRONICS
a, b, c	1,3,4,5,8,9,12	INEL 8595	ADVANCED TOPICS IN CONTROL SYSTEMS
a, b, c	1,3,4,5,8,9,12	INEL 8695	ADVANCED TOPICS IN APPLIED ELECTROMAGNETICS
a, b, c	1,3,4,5,8,9,12	INEL 8995	ADVANCED TOPICS
a, b, c	1,2,3,4,5,8,9,12	INEL 8997	INDEPENDENT STUDY
a, b, c	5,6,7,8,9,10,11	INEL 8998	DOCTORAL SEMINAR
a, b, c	1,2,4,5,6,8,9,12	INEL 8999	DOCTORAL DISSERTATION

Nota: *El perfil del egresado y objetivos del programa se incluyen en el documento.*

Program Objectives

The doctoral program's objectives are as follows:

a) Prepare the professional engineers at the highest level capable of contributing to the social and economic development of Puerto Rico and its hemisphere in government, industry, and academia.
b) Provide the highest level of Electrical Engineering education in Puerto Rico.
c) Develop close ties with industry and government in order to support graduate education and research relevant to the economic development of Puerto Rico and facilitate technology transfer.

Graduate Profile

Among the general skills of the professional profile for the graduates of the Doctoral Program in Electrical Engineering the following are the most outstanding:

1. Profound knowledge in the area of expertise. Knowledgeable of state of the art language, topics, and research problems in this area.
2. Capable of active participation in scientific research and application to their area of expertise.
3. Ample knowledge in electrical engineering, which allow for significant contributions to the academic milieu in institutions of higher learning.
4. Ability to creatively apply and integrate this knowledge to the development of scientific research, and engineering solutions.
5. Ability for oral and written communication in both Spanish and English.
6. Ability to clearly formulate short term, medium-range and long term objectives and to communicate ideas and results adequately with colleagues.
7. Ability to communicate effectively the essential aspects of a problem and its solution to the general public.
8. Ability to develop research proposals for public and private funding agencies.
9. Ability to present results in written form in technical papers and orally in technical presentations in the field.
10. Ability to lifelong learning, due to the changing nature of the discipline.
11. Awareness of an individual's professional impact on society's quality of life including a clear understanding and respect for the legal, ethical, social and cultural issues pertinent to the profession.
12. Appreciation of the relationship between theory and practice. The Ph.D. graduate should appreciate both the value of good design as well as the theoretical framework on which it is based. That is, she/he should understand the value of the relation between theory, experiment and results while being able to utilize this understanding effectively in his professional practice.

Nota: Los objetivos del programa y perfil del estudiante han sido pareados de acuerdo a los cursos graduados ofrecidos. Debido a la gran cantidad de cursos existentes y limitaciones de espacio en este documento se utiliza este tipo de estrategia de pareo entre perfil y objetivos para así poder optimizar el espacio y realizar un esfuerzo coherente entre objetivo, perfil, y curso. Este tipo de estrategia de pareo es utilizada por agencias acreditadoras como Middle States Commission on Higher Education (MS-CHE) y el Accreditation Board Engineering and Technology (ABET).

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CURSOS DEL OFRECIMIENTO ACADÉMICO					
CÓDIGO Y NÚM.	TÍTULO	HORAS CRÉDITO	HORAS LECTIVAS	HORAS DE LABORATORIO	NOMBRE DEL PROFESOR/ES QUE OFRECERÁ EL CURSO
INEL 5046.	PATTERN RECOGNITION	3	45	0	7, 13,
INEL 5206.	DIGITAL SYSTEMS DESIGN	3	45	0	16, 20,
INEL 5265	ANALOG INTEGRATED CIRCUITS DESIGN	3	45	0	16, 17, 20,
INEL 5307.	OPTICAL COMMUNICATIONS	3	45	0	12,
INEL 5309.	DIGITAL SIGNAL PROCESSING	3	45	0	9, 10, 11,14,
INEL 5315	THEORY OF COMMUNICATIONS II	3	45	0	8, 9,
INEL 5327.	IMAGE PROCESSING	3	45	0	7, 11, 12, 14,
INEL 5406.	DESIGN OF TRANSMISSION AND DISTRIBUTION SYSTEMS	3	45	0	5, 6,
INEL 5415	ELECTRICAL SYSTEMS PROTECTION DESIGN	3	45	0	1,
INEL 5505.	LINEAR SYSTEM ANALYSIS	3	45	0	3, 15, 18,
INEL 5506.	PROCESS INSTRUMENTATION AND CONTROL ENGINEERING	3	45	0	15, 18,
INEL 5508.	DIGITAL CONTROL SYSTEMS	3	45	0	3, 15, 18,
INEL 5605.	ANTENNA THEORY AND DESIGN	3	45	0	23,
INEL 5606.	MICROWAVE ENGINEERING	3	45	0	24,
INEL 5616.	WIRELESS COMMUNICATIONS	3	45	0	8, 9,
INEL 5629.	TELECOMMUNICATION ELECTRONICS	3	45	0	8, 9,
INEL 6000.	INTRODUCTION TO NONLINEAR CONTROL SYSTEMS	3	45	0	3, 11, 14,
INEL 6001.	FEEDBACK CONTROL SYSTEMS I	3	45	0	3, 15,
INEL 6007.	INTRODUCTION TO REMOTE SENSING	3	45	0	7, 10, 13,
INEL 6025.	ADVANCED ENERGY CONVERSION	3	45	0	1, 5, 6,
INEL 6027.	DYNAMICS AND CONTROL OF INTEGRATED POWER SYSTEMS	3	45	0	1, 5,
INEL 6028.	OPTIMIZATION AND ECONOMIC OPERATION OF INTEGRATED POWER SYS.	3	45	0	1, 5,
INEL 6047	ADVANCED CONTROL SYSTEM THEORY	3	45	0	3, 13,
INEL 6049.	MULTIDIMENSIONAL DIGITAL SIGNAL PROCESSING	3	45	0	10, 11, 13, 14,
INEL 6050.	ADVANCED DIGITAL SIGNAL PROCESSING	3	45	0	10, 13, 14,
INEL 6058.	HIGH FREQUENCY POWER CONVERTERS	3	45	0	3, 4,
INEL 6059.	INTELLIGENT SYSTEMS AND CONTROLS	3	45	0	2, 15,
INEL 6066.	CONTROL OF ELECTRIC DRIVE SYSTEMS	3	45	0	2, 4,
INEL 6076.	ADAPTIVE AND OPTIMAL SIGNAL PROCESSING	3	45	0	10, 11, 13, 14,
INEL 6077.	SURGE PHENOMENA IN POWER SYSTEMS	3	45	0	6,
INEL 6078.	ESTIMATION, DETECTION AND STOCHASTIC PROCESSES	3	45	0	9-14,
INEL 6085.	ANALYSIS AND DESIGN OF POWER	3	45	0	3, 4, 16,

	SEMICONDUCTOR CIRCUITS				
INEL 6096	ELECTRIC POWER QUALITY	3	45	0	6,
INEL 6601	ADVANCED ELECTROMAGNETICS	3	45	0	22,
INEL 6605	ACTIVE REMOTE SENSING TECHNIQUES	3	45	0	8, 10,
INEL 6606	INTRODUCTION TO RADAR SYSTEMS	3	45	0	22,
INEL 6615	MICROWAVE ACTIVE CIRCUITS	3	45	0	22, 24,
INEL 6668	MICROWAVE ANTENNA ENGINEERING	3	45	0	23, 24,
INEL 6669	MICROWAVE REMOTE SENSING	3	45	0	25,
INEL 6995.	SPECIAL TOPICS IN ELECTRICAL ENGINEERING	3	45	0	1-25
INEL 8295	ADVANCED TOPICS IN ELECTRONICS	3	45	0	16-21,
INEL 8395	ADVANCED TOPICS IN SIGNAL PROCESSING	3	45	0	7-15, 18, 19,
INEL 8495	ADVANCED TOPICS IN ELECTRIC POWER ENGINEERING	3	45	0	1, 3, 5, 6,
INEL 8496	ADVANCED TOPICS IN POWER ELECTRONICS	3	45	0	3, 4, 6, 16,
INEL 8595	ADVANCED TOPICS IN CONTROL SYSTEMS	3	45	0	3, 13, 15, 18,
INEL 8695	ADVANCED TOPICS IN APPLIED ELECTROMAGNETICS	3	45	0	22, 23, 24, 25,
INEL 8995	ADVANCED TOPICS	3	45	0	1-25
INEL 8997	INDEPENDENT STUDY	3	45	0	1-25
INEL 8998	DOCTORAL SEMINAR	3	45	0	1-25
INEL 8999	DOCTORAL DISSERTATION	3	45	0	1-25
Nota: Por limitaciones de espacio, la lista con nombres numerados se encuentra en la sección de **EXPERIENCIA Y CREDENCIALES ACADÉMICAS Y LA EXPERIENCIA PROFESIONAL DE LA FACULTAD**					
	TOTAL:				

Aneje el prontuario de cada curso incluido en la tabla. En caso de Cursos en Modalidad a Distancia, incluya acceso electrónico a los módulos de los cursos que propone ofrecer en el primer término académico

Código para acceso a módulos:	

Nota: Los prontuarios de cada curso incluido en la tabla, se incluyeron como parte de dos documentos adicionales en formato .pdf debido a limitaciones de espacio en esta solicitud.

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EXPERIENCIA Y CREDENCIALES ACADÉMICAS Y LA EXPERIENCIA PROFESIONAL DE LA FACULTAD

Favor de incluir todos los grados oficialmente otorgados y la institución que otorgó cada uno.

Apellidos y Nombre	Grados/Siglas (incluya todos los grados obtenidos)	Especialidad/ Concentración	Institución y Año donde obtuvo el grado	Carga Académica	Núm. de preparaciones
1) APONTE-BEZARES, ERICK	D.Eng.	Sistemas de Potencia	Rensselaer Polytecnic Institute/ 2005	6 créditos	2
2) CASTRO-SITIRICHE, MARCEL J.	Ph.D.	Tecnología Apropiada	Howard University/2007	6 créditos	2
3) ORTIZ-RIVERA, EDUARDO I.	Ph.D.	Control Sistemas Fotovoltaicos	Michigan State University/2006	6 créditos	2
4) DIAZ-CASTILLO, ANDRES J.	Ph.D.	Electrónica de Potencia/Motor	Michigan State University/2000	6 créditos	2
5) IRIZARRY- RIVERA, AGUSTIN A.	Ph.D.	Sistemas de Potencia	Iowa State University/1996	6 créditos	2
6) O'NEILL-CARRILLO, EFRAIN	Ph.D.	Calidad de Potencia	Arizona State University/1999	6 créditos	2
7) MANIAN, VIDYA	Ph.D.	Procesamiento de Señales	University of Puerto Rico-Mayaguez/2004	6 créditos	2
8) LU, KEJIE	Ph.D.	Redes de Computadoras	University of Texas – Dallas/2003	6 créditos	2
9) MORALES, LIZDABEL	Ph.D.	Comunicaciones, Radio Cognitiva	Virginia Tech./2009	6 créditos	2
10) ARZUAGA, EMMANUEL	Ph.D.	Sistemas Operativos	Northeastern University/2010	6 créditos	2
11) HUNT, SHAWN D.	Ph.D.	Procesamiento de Señales	Michigan State University/1992	9 créditos	3
12) PARSIANI, HAMED	Ph.D.	Procesamiento de Señales	Texas A&M University/1979	6 créditos	2
13) LUIS JIMENEZ	Ph.D.	Procesamiento de Señales	Purdue University/1996	6 créditos	2
14) VELEZ-REYEZ, MIGUEL	Ph.D.	Control Alineal de Motores	MIT/1992	6 créditos	2
15) TORRES MUÑIZ, RAUL E.	Ph.D.	Robótica Visión Computadoras	University of Virginia/1998	6 créditos	2
16) SERRANO-RIVERA, GUILLERMO	Ph.D.	Circuitos Integrado	Georgia Institute of Technology/2007	6 créditos	2
17) DUCOUDRAY, GLADYS O.	Ph.D.	Semiconductores Circuitos Análogo	New Mexico State University/2003	6 créditos	2
18) JUAN, EDUARDO J.	Ph.D.	Instrumentación Biomédica	Purdue University/2001	6 créditos	2
19) SANTIAGO, NAYDA G.	Ph.D.	Computación Multi-Paralela	Michigan State University/2003	6 créditos	2
20) JIMENEZ-CEDEÑO, MANUEL A.	Ph.D.	Micro-Sistemas Embebidos	Michigan State University/1999	6 créditos	2

21) COUVERTIER, ISIDORO	Ph.D.	Computación de Redes	Louisiana State University/1996	12 créditos	4
22) LEON, LEYDA	Ph.D.	Electromagnética Radares	Colorado State University/2009	6 créditos	2
23) RODRIGUEZ–SOLIS, RAFAEL A.	Ph.D.	Electromagnética Antenas	Pennsylvania State University/1997	6 créditos	2
24) COLOM-USTARIZ, JOSE G.	Ph.D.	Electromagnética Radares	Pennsylvania State University/1998	6 créditos	2
25) CRUZ-POL, SANDRA L.	Ph.D.	Electromagnética Radares	Pennsylvania State University/1998	6 créditos	2

Incluir además los siguientes documentos, según aplique:

1. Evidencia de cartas de acuerdos con los centros de práctica o internado (N/A)
2. Manual de Práctica o Internado (N/A)
3. Manual de Tesis o Disertación (Anejo A)
   Se incluyen copia del Manual de Tesis o Disertación según ofrecido por escuela graduado en Anejo A.
   http://grad.uprm.edu/oeg/EstudiantesActivos/Normas/guia.php
   http://grad.uprm.edu/oeg/EstudiantesActivos/#reda
4. Guías para Exámenes Comprensivos, Portafolios u otros requisitos del grado (Anejo B)
   Se incluyen las guías generales para los Exámenes Comprensivos en el Anejo B.
   http://grad.uprm.edu/oeg/EstudiantesActivos/#exam
   http://grad.uprm.edu/cert.pdf (Certificación 09-09)

Nota: Se incluyen enlaces actualizados el 21 de mayo de 2013

Título del Ofrecimiento Académico: Programa Doctoral en Ingeniería Eléctrica CIP Code: 14.1001

*Base de datos medular (Suscripción anual que se ha renovado periódicamente por años)

BASES DE DATOS QUE APOYAN EL OFRECIMIENTO ACADÉMICO	VIGENCIA DE LA LICENCIA O FECHA A SER ADQUIRIDA
Academic Search Complete (EBSCO)*	Suscripción en consocio con las Bibliotecas de la UPR hasta agosto 2013
ACM (Association for Computing Machinery) Digital Library*	Suscripción de UPR-Mayagüez hasta diciembre 2013
ACS (American Chemical Society) Journals*	Suscripción en consocio con las Bibliotecas de la UPR. Contrato por 3 años hasta marzo 2016
Annual Reviews	Suscripción de UPR-Mayagüez hasta diciembre 2013
Applied Science and Technology Full Text (EBSCO)	Suscripción en consocio con las Bibliotecas de la UPR hasta agosto 2013
Central (ProQuest)*	Suscripción en consocio con las Bibliotecas de la UPR hasta julio 2013
Computer Source (EBSCO)*	Suscripción en consocio con las Bibliotecas de la UPR hasta agosto 2013
Computing (ProQuest)*	Suscripción en consocio con las Bibliotecas de la UPR hasta julio 2013
CRCnetBASE (Handbooks)*	Suscripción en consocio con las Bibliotecas de la UPR hasta noviembre 2013
CRCnetBASE ElectricalEngineeringnetBASE	Suscripción de UPR-Mayagüez hasta noviembre 2013
CRCnetBASE ENGnetBASE*	Suscripción de UPR-Mayagüez hasta noviembre 2013
CRCnetBASE ENVIROnetBASE	Suscripción de UPR-Mayagüez hasta noviembre 2013
CRCnetBASE ITECHnetBASE	Suscripción de UPR-Mayagüez hasta noviembre 2013
CRCnetBASE MATERIALSnetBASE	Suscripción de UPR-Mayagüez hasta noviembre 2013
CRCnetBASE NANOnetBASE	Suscripción de UPR-Mayagüez hasta noviembre 2013
CRCnetBASE POLYMERSnetBASE	Suscripción de UPR-Mayagüez hasta noviembre 2013
CRCnetBASE POLYMERSnetBASE	Suscripción de UPR-Mayagüez hasta noviembre 2013
CRCnetBASE TELECOMMUNICATIONSnetBASE	Suscripción de UPR-Mayagüez hasta noviembre 2013
Dissertations & Theses (ProQuest)*	Suscripción en consocio con las Bibliotecas de la UPR hasta julio 2013
eBook Academic Collection (EBSCO)	Suscripción en consocio con las Bibliotecas de la UPR hasta agosto 2013
ECS (Electrochemical Society) Digital Library	Suscripción de UPR-Mayagüez hasta agosto 2013
Engineering Design Graphics Journal	Suscripción de UPR-Mayagüez hasta agosto 2013
Engineering Village (Elsevier IE)*	Suscripción en consocio con las Bibliotecas de la UPR hasta mayo 2014
Environment Index (EBSCO)	Suscripción en consocio con las Bibliotecas de la UPR hasta agosto 2013
GreenFILE (EBSCO)	Suscripción en consocio con las Bibliotecas de la UPR hasta agosto 2013
GREENR (Global Reference on the Environment, Energy, and Natural Resources)	Suscripción de UPR-Mayagüez hasta agosto 2013
IEEE Xplore*	Suscripción de UPR-Mayagüez hasta diciembre 2013
IGI Global (e-books)	Libros electrónicos con acceso perpetuos
Library, Information Science & Technology Full Text (EBSCO)	Suscripción en consocio con las Bibliotecas de la UPR hasta agosto 2013
MathScinet (American Mathematical Society)*	Suscripción por aportación del Departamento de Matemáticas Licencia hasta agosto 2014
Military Collection (ProQuest)*	Suscripción en consocio con las Bibliotecas de la UPR hasta julio 2013
Morgan and Claypool eBooks	Libros electrónicos con acceso perpetuos
National Academies Press (ebooks)	Acceso abierto
Research Library (ProQuest)*	Suscripción en consocio con las Bibliotecas de la UPR hasta julio 2013
Science Direct (Elsevier)*	Suscripción en consocio con las Bibliotecas de la UPR hasta agosto 2013 (contrato a 3 años)
SciFinder	Suscripción de UPR-Mayagüez hasta diciembre 2013
SpringerLink eBooks (2007-2012)	Libros electrónicos con acceso perpetuos
SpringerLink Online Journals (Suscripción a una lista selectiva de títulos)	Suscripción de UPR-Mayagüez hasta agosto 2013
Taylor and Francis Online (Suscripción a una lista selectiva de títulos)	Suscripción de UPR-Mayagüez hasta agosto 2013
Telecommunications (ProQuest)*	Suscripción de UPR-Mayagüez hasta julio 2013

DESCRIPCIÓN DE LA INFRAESTRUCTURA TECNOLÓGICA RELACIONADA CON LOS CURSOS Y LOS RECURSOS DISPONIBLES PARA APOYARLOS
The Department of Electrical and Computer Engineering has more than 200 computers, all connected to our network. The network provides full Internet access, e-mail service, Moodle, and share to local resources between laboratories and servers. Available software includes Pspice, Matlab, MS Office, Visual Studio, Project, Front Page, and FPGA design tools. Specialized software tools in ICDL include Cadence Tools, Mentor Graphics Design Suite, NI-LabView, Tanner Tools, Aldec ActiveHDL/Synplify, and Xilinx ISE 9.2. Additional, laboratory software consists of Logic Works, Texas Instruments Assembly and Floating Point tools including Code Composer, Microsoft Office, and Microsoft Visual C++. All students from our department have Internet access and the opportunity to use all these resources from their first year.

DESCRIPCIÓN DE LOS LABORATORIOS ASOCIADOS AL OFRECIMIENTO ACADÉMICO					
Identifique el tipo y naturaleza del laboratorio, el curso al que corresponde utilizando la siguiente clasificación: **AT - Apoyo tecnológico** **C - Ciencias** **P- Prácticas asociadas a los cursos** **DT - Desarrollo de destrezas Investigación**					
Nombre del laboratorio	**Clasificación**	**Inventario del Equipo**	**Cantidad**	**Breve descripción**	**Promedio de estudiantes**
Power Electronics Lab S101	P, DT, I	Convertidores, celdas solares, invertidores, rectificadores, CPUs	4 design stations 3 computers	Support laboratory courses INEL 4417, 4418, 4416, 5417, 6085, 6058	20
ElectroMechanical Conversion Lab S103a	P, DT	Motores, Maquinas eléctricas (DC y AC)		Support laboratory courses INEL 4417, 4416, 5417, 6066, 6085, 6058, 6995	30
Electric Energy Power Laboratory S103b	P, DT, I	Motores, maquinas eléctricas, thyristors,		Laboratorio para la enseñanza subgraduada y graduada, e investigación en sist. energía.	15
Radiation Lab S120	I	Equipo electromagnético, componentes eléctricos		Lab. para la investigación graduada en electromagnética	4
Proc. Instrumentation and Control Lab. S213	P, DT	Pendulos invertidos, PIDs, Computadoras, Giroscopios		Support laboratory courses INEL 4505, 5505, 5508, 5516	28
Robotics Lab S102	P, DT, I	Robots, Computers, PLC, pneumatic systems	10	Laboratorio para la enseñanza subgraduada en robótica.	25
General Purpose Computer Labs S-105D, S-105C	AT, DT, P, I	Computer workstations Windows	60	Support laboratory for general computing needs of INEL 3105, 4102, 4205, 4201, 4103, 4405, etc.	750
Amadeus S121	AT, P	Computer workstations Linux	30	Supports closed lab sessions for ICOM 4015, 4035, and 5007.	171
Graduate Students Office	AT	Computer workstations	5	Graduate Students Office	23
Electrical Measurements and Electronics Labs S-104A, S-104B	P, DT, I	Working stations, each consisting of: DC power supply, a digital multimeter, a 20MHz function/arbitrary waveform generator, a 2 Channel 100 MHz 1GSa/s Oscilloscope, digi-labs, and PC with acquisition boards. Each PC has LabView Express and Multisim software.	12 Stations	Support laboratory courses INEL 4077, 4115, 4211, 4212, and 4225	270
Microprocessors Laboratory S115a	AT, P, DT, I	Design stations, PCB stations, and Prototyping stations.	14 design	Supports design projects of ICOM 5217. Design stations are used to design entry, programming,	25

			stations 1 PCB station 2 prototyping stations	simulation, prototype debugging, and document preparation. The PCB station provides access to PCB construction tools. The prototyping stations provide access to mechanical assembly, soldering, and building equipment.	
Computer Engineering Capstone Lab. S122-S123	AT, P, DT	Computers: Pentium 4 3.2 GHz, 1 GB RAM, 80 GB HD), oscilloscopes, and signal generators. Available software includes Pspice, MS Office, Visual Studio, Project, and Front Page.	27 Computers 6 Oscilloscopes 4 Signal Generators	Supports ICOM5047 design projects	27
Rapid Systems Prototyping Lab S208	AT, P, DT, I	Working stations, each consisting of Pentium III-900, 128 MB RAM, 20 GB HD. A server (Sun Sparc Ultra Enterprise 450, 4 x 400 MHz, 1.6GB RAM, 54 GB HD, Solaris). Available software includes Pspice, MS Office, Visual Studio, Project, Front Page, and FPGA design tools.	11 working stations 1 server	Supports design projects in electronics	39
Integrated Circuits Design Lab S210B	P, DT, I	Several design workstations running industry-grade software tools for the design entry and design validation in bipolar and MOS technologies. In addition, the lab provides 4 testing stations with state-of-the-art test and measurement tools used by senior and graduate students in advanced undergraduate and graduate course projects in electronics, as well as graduate research students for their projects. Specialized software tools in ICDL include Cadence Tools, Mentor Graphics Design Suite, NI-LabView, Tanner Tools, Aldec ActiveHDL/Synplify, and Xilinx ISE 9.2. ICDL is served by a distributed processor network that includes one large application server, four compute nodes, and one backup	16 design stations 4 testing stations 1 application Server 4 compute nodes 1 backup server	Supports design projects in INEL 5065, INEL 4998, and INEL 5995. The lab is devoted to the tasks of designing and testing analog, digital, and mixed-signal integrated circuits and systems.	39

		server.			
ECE Computer Networking Laboratory S-122A	P, DT, I, AT	Routers, switches, PCs, and Access Servers.	30 routers 23 switches 16 PCs	Supports INEL / ICOM 4308 and INEL / ICOM 5318. The lab provides students the necessary infrastructure to put in practice their knowledge in design, testing, and troubleshooting of LANs, WANs, VLANs, VPNs, WLANs, and digital telephony. The lab supports two CISCO related courses in routing protocols such as RIP, OSPF, ISIS, and BGP4. The lab is also accessible via the Internet, and students could be CISCO certified after passing the CISCO examination.	15
Tools and Toys S222	P, DT	Demostraciones de las áreas de INEL/ICOM		Laboratorio para la enseñanza subgraduada en ingeniería	16
Communications and Digital Signal Processing S-222E	AT, P, DT, I	Several working stations, each consisting of a Dell Precision T3400 computer (Dual Core 2.66 GHz, 2 GB RAM, 250 GB HD, NVIDIA Quadro FX 570, DELL 1908FP LCD) with external DSP boards (TI TMS320C31 and TI TMS320C6711), and peripheral equipment (HP 54610B 500MHz Oscilloscope with HP 54659B module, HP 33120A Waveform Generator, and HP 34401A Multimeter). The lab also has four HP 8560E 2.3GHz Spectrum Analyzers. The laboratory software consists of Matlab, Texas Instruments Assembly and Floating Point tools including Code Composer, Microsoft Office, and Microsoft Visual C++.	14 working stations 4 spectrum analizers	Supports INEL 5309 demonstrations and INEL 5326 design projects.	14

SERVICIOS ESTUDIANTILES

Indicar donde la institución tiene publicadas las siguientes Políticas: Documento, página. En caso de referir a página cibernética, incluir la dirección completa de Internet

Política	Documento, Página, Enlace
1. progreso académico de los estudiantes aplicable a los distintos niveles académicos que espera ofrecer u ofrece.	http://grad.uprm.edu/ http://grad.uprm.edu/oeg/EstudiantesActivos/#exam http://www.uprm.edu/portada/page.php?page=academicos http://www.uprm.edu/catalog/GradCatalog2012-2013.pdf
2. convalidación, traslado y transferencia de cursos y créditos que incluya la política institucional respecto a la convalidación de cursos entre los niveles postsecundarios no universitario y universitario.	http://grad.uprm.edu/ http://grad.uprm.edu/oeg/EstudiantesActivos/Normas/guia.php http://www.uprm.edu/portada/page.php?page=academicos
3. continuidad en el ofrecimiento de cursos de acuerdo con la secuencia curricular y en el tiempo establecido para que el estudiante complete el programa.	http://www.ece.uprm.edu/programs/graduate http://grad.uprm.edu/oeg/EstudiantesActivos/#exam http://www.uprm.edu/portada/page.php?page=academicos http://www.uprm.edu/catalog/GradCatalog2012-2013.pdf Nota: Cursos ofrecidos se ofrecen en el programa de maestría de INEL
4. continuidad en el ofrecimiento de cursos a estudiantes matriculados en programas académicos que la Institución se propone cerrar o colocar en moratoria	http://www.uprm.edu/portada/page.php?page=academicos Nota: Cursos ofrecidos se ofrecen en el programa de maestría de INEL

CAPACIDAD FINANCIERA Y SOLVENCIA ECONÓMICA

Presupuesto detallado por un periodo NO menor de tres (3) años académicos que incluya el año en que solicita la enmienda. Debe incluir los ingresos por fuentes y detalles de gastos y los supuestos utilizados por la institución para su preparación.

Favor de utilizar formulario en Excel provisto por el Consejo.

Justificación de Presupuesto:

Matrícula: Se estimó un promedio de $25,052 anuales como concepto de ingresos por matrícula. Esta cifra presume 7 estudiantes (5 locales y 2 extranjeros) de nuevo ingreso por año. El costo por semestre es $1,280 para estudiantes locales y $3,063 para los extranjeros por semestre.
Cuotas: Se utilizó $94 por estudiante al año.
Fondos externos: Este renglón incluye el estimado de costos indirectos recibidos por la institución cada año. El cómputo se realizó presumiendo que cada profesor del programa recibe dádivas de investigación por $75k anuales. Luego se estimaron los costos indirectos del 49% utilizando como base el 60% de los fondos recaudados.

Salarios docentes: Se consideró que cada profesor adscrito al programa dedicará 50% de su tiempo en tareas de enseñanza e investigación. Para realizar el cómputo, se utilizaron los salarios base y los beneficios marginales de cada profesor. Para el programa doctoral de ingeniería eléctrica consta de 6 Catedráticos Auxiliares, 6 Catedráticos Asociados, y 13 Catedráticos. El salario promedio de un Catedrático Auxiliar es

Desarrollo profesional: Se estima en $10,000 los costos asociados a reunir la junta de asesores externos del programa.
Recursos de información: Se estimaron en $20,000 los costos asociados a mantener las bases de datos en la biblioteca.
Mantenimiento/Sustitución de equipo: Se estima en $50,000 anuales los costos asociados a reparación/sustitución de equipos utilizados en apoyar las actividades de investigación y de enseñanza.
Materiales: Se estima en $2,000 los costos asociados a los materiales a ser utilizados por la oficina del Director(a) Asociado(a) de Estudios Graduados y Asuntos de Investigación para el programa doctoral

Resumen: El departamento de ingeniería eléctrica y computadoras puede implementar el programa doctoral con los recursos existentes. El departamento tiene el personal administrativo e infraestructura física para apoyar el programa. Nosotros tenemos una Oficial Orientador para Asuntos Estudiantiles II (asignada y bajo la supervisión de la oficina del Director(a) Asociado(a) de Estudios Graduados y Asuntos de Investigación) para apoyar los todos programas graduados de nuestro departamento. La Oficial Orientador para Asuntos Estudiantiles II tiene un espacio de oficina en el departamento para efectuar sus labores. Areas de oficina han sido ubicadas en el Centro de Investigación y Desarrollo en los espacios F-217 y F-219, en el edificio Stefani salón S-114 para estudiantes graduados, y en varios de los laboratorios de investigación. Durante los pasados diez años, el departamento ha obtenido sobre $5M en fondos externos para el desarrollo de laboratorios de investigación. Las facilidades de laboratorio son adecuadas para apoyar la investigación a nivel doctoral. El departamento de ingeniería eléctrica y computadoras es uno de los departamentos líderes en obtener fondos externos en la UPR-Mayagüez.

Para la oferta de cursos, el programa usa la ventaja de tener programas graduados existentes en ingeniería eléctrica e ingeniería en computadoras. La mayoría de los cursos avanzados sub-graduados y todos los cursos graduados formaran parte de la oferta de cursos ofrecidos para los estudiantes doctorales. Actualmente se ofrecen sobre 20 cursos graduados (a nivel 6000 o mayor) y sobre 25 cursos avanzados sub-graduados (a nivel 5000) por año. Con respecto a los cursos adiciones a nivel doctoral para el programa Ph.D., los cursos graduados de nivel avanzado (nivel 8000 o mayor), serán ofrecidos en ciclos de dos años intercalados con los cursos electivos existentes graduados. Estos cursos graduados de nivel avanzado tendrán un impacto mínimo en los estudiantes graduados de maestría, los cuales incluso los estudiantes graduados tienen la opción de tomar los cursos a nivel 8000 como parte de sus programas graduados. La carga académica de los profesores con estudiantes en tesis y estudios independientes seguirán la reglas y regulaciones establecidas por UPR-Mayagüez bajo la Certificación 08-09-309 de la Junta de la Administración de UPRM. Créditos de tesis de los estudiantes en proyectos donde la facultad reciba tiempo de descarga no se contarán como parte de su carga académica. Esperamos que la mayoría de nuestros estudiantes doctorales caigan bajo esa categoría. Finalmente, el departamento de ingeniería eléctrica y computadoras ha sido muy exitoso en el obtener fondos externos para apoyar la investigación, proveer los fondos para ayudantías y proveer fondos para las mejoras del los laboratorios. La administración del departamento ha acordado el uso de los fondos recobrados por “overhead” recibidos en el departamento para apoyar las visitas de la junta del consejo asesor de programa doctora para su visita durante los años 2 y 4 luego de la implantación del programa doctoral.

CERTIFICACION

Certifico que toda la información y los documentos aquí incluidos, así como los que se sometan durante el proceso de evaluación son veraces, correctos y de conformidad con las disposiciones reglamentarias aplicables.

Reconozco que la información y documentación puede ser constatada y que ofrecer información incorrecta, falsa o engañosa podría implicar incumplimiento con estos estatutos. Entiendo que la Institución tiene la obligación continua de cumplir con los criterios de evaluación establecidos en la reglamentación vigente del Consejo de Educación de Puerto Rico.

Nombre del Ejecutivo Principal	Título del Puesto
Firma	Fecha

Anejo A: Guías para la preparación de propuestas, tesis, proyectos y disertaciones
(Extraído de http://grad.uprm.edu/oeg/EstudiantesActivos/Normas/guia.php)

Guías para la preparación de propuestas, tesis, proyectos y disertaciones

INTRODUCCIÓN

La mayoría de los programas graduados del Recinto Universitario de Mayagüez requieren la preparación de una tesis o de un informe de proyecto, ambos precedidos por una propuesta. El propósito de esta guía es ayudarte a preparar estos documentos con un mínimo de contratiempos. La guía contiene sugerencias para uniformar la presentación de ambos documentos, pero es flexible para acomodar los estilos de cada disciplina. El estilo particular y la estructura final de la tesis serán las que apruebe el comité graduado del estudiante.

La Oficina de Estudios Graduados no interviene con el formato, el contenido, ni la redacción de las tesis, por lo que te corresponde a ti, a tu consejero y al resto del comité graduado velar por la preparación adecuada y la calidad del documento. La tesis representa tu máximo esfuerzo y es evidencia tu compromiso con la excelencia académica. El buen nombre de los miembros del comité graduado también está en juego porque mediante su firma certifican que leyeron el documento y aprueban su contenido.

LA PROPUESTA

Antes de continuar, debes hacerte la siguiente pregunta:

¿"Mi estudio es una investigación que incluye desarrollo, prueba o evaluación con el propósito de desarrollar o contribuir al conocimiento, y ***para lograrlo involucra seres humanos de los cuales se obtendrán datos o información mediante intervención o interacción****"? (Esto incluye datos obtenidos a través de encuestas, cuestionarios, entrevistas, casos, observación y cualquier otro método)*

Si la respuesta a la pregunta anterior es ***SI****, entonces deberás someter al "Comité para la Protección de Seres Humanos en la Investigación" (IRB) una Solicitud de Revisión, la cual puedes acceder a través del siguiente enlace* ***http://uprm.edu/cpshi/****,* ***en el cual encontrarás además información acerca de la base legal para este procedimiento***

Deberás someter a OEG tu propuesta junto con el documento de autorización o relevo de parte del IRB.

Propósito

El propósito de la propuesta es lograr que el estudiante y su consejero definan con anticipación un tema de investigación que pueda completarse en un tiempo razonable. La propuesta es un compromiso entre el estudiante y su comité con respecto al contenido y la extensión de la investigación. Los objetivos y los procedimientos descritos en el documento pueden cambiar durante el curso de la investigación, pero debe evitarse la modificación excesiva, particularmente añadir metas y procedimientos nuevos que atrasen innecesariamente la investigación y la obtención del grado.

Contenido

- **Portada**- La portada de la propuesta se parece a la portada de la tesis (ver ejemplos al final de este documento) pero sólo lleva las firmas del comité y del director del departamento (no lleva las firmas del representante de Estudios Graduados ni del director de Estudios Graduados). El título de la propuesta es una descripción precisa y concisa del tema de la investigación.
- **Justificación**- Esta sección defiende la importancia de la investigación y describe su posible contribución original.
- **Publicaciones previas**- Esta sección resume el contenido de las publicaciones más importantes y pertinentes al tema de la investigación.
- **Objetivos**- Aquí se exponen las metas y los propósitos principales de la investigación.

- **Métodos**- Esta sección describe los materiales y los métodos principales que se usarán para alcanzar los objetivos de la investigación. También puede informar el costo estimado del proyecto, las facilidades disponibles, los equipos que deben obtenerse y la duración aproximada de la investigación.
- **Literatura Citada**- Aquí se presenta una lista de las referencias citadas en el texto, presentadas y organizadas según el estilo aceptado en el área de especialidad.

LA TESIS Y EL INFORME DE PROYECTO

Diferencias entre tesis e informe de proyecto

La tesis documenta una investigación realizada para explorar un tema teórico o cuyas aplicaciones prácticas no constituyen el propósito principal del trabajo. El producto final demuestra originalidad, creatividad, individualidad, organización y capacidad de pensamiento crítico. El informe de proyecto demuestra las mismas cualidades pero su meta es resolver un problema concreto relacionado con la industria o el comercio. Esta guía usa tesis indistintamente para ambas contribuciones.

Propósito

La tesis tiene dos propósitos principales. El primero es probar que el estudiante sabe trabajar e investigar independientemente. El segundo es confirmar que el estudiante puede comunicarse efectivamente con la comunidad académica y científica. La disertación doctoral tiene también como meta hacer una contribución original y significativa al área de la investigación.

Sugerencias para preparar una tesis excelente

La tesis es el documento más largo y complejo que producirás como estudiante graduado. Además, la tesis probablemente será tu primer intento formal de producir un documento que demuestre tu capacidad para investigar, desarrollar y sintetizar el conocimiento de un campo de estudio. Estas recomendaciones te ayudarán a terminar la tesis con un mínimo de contratiempos.

1. **Dedícale suficiente tiempo a la preparación del documento.** Muchos estudiantes creen que preparar la tesis es una tarea sencilla que pueden completar en pocas semanas al final del semestre. Cuando comienzan a trabajar y enfrentan la magnitud del proyecto, estos estudiantes se frustran y abandonan el esfuerzo, o trabajan apresuradamente y producen una tesis inferior que seguramente enfrentará problemas durante el examen de defensa. Planifica para dedicarle a la preparación de la tesis un semestre sin compromisos que ocupen mucho tiempo. Incluye en tus planes el tiempo que necesitará tu consejero para corregir los borradores del documento. Si tienes dificultad con el idioma considera contratar a una persona que te ayude a mejorar el documento (por ejemplo, un profesor o un estudiante graduado de los departamentos de Inglés o de Estudios Hispánicos).
2. **Planifica y cumple tus metas**. Prepara un bosquejo de la tesis y discútelo con los miembros del comité graduado. La tesis será más manejable si la divides en secciones que puedes completar en relativamente poco tiempo. Terminar la primera sección te estimulará para alcanzar la próxima meta y continuar trabajando hasta terminar el proyecto. Trabaja con la tesis todos los días, aunque inicialmente sea por poco tiempo. Dentro de unos días te acostumbrarás a la rutina, le dedicarás cada vez más tiempo al proyecto y verás más cerca la meta de terminar puntualmente y rendir un trabajo de excelencia.
3. **Comunícate regularmente con tu consejero**. Cuando tu consejero te aceptó como estudiante, aceptó también la obligación de orientarte y ayudarte a terminar el grado. Sin embargo, los consejeros tienen otros compromisos y a menudo resienten que el estudiante aparezca a última hora con peticiones, consultas y exigencias urgentes. Para evitar estos contratiempos, establece con tu consejero un calendario de reuniones para mantenerle informado, discutir dudas y resolver problemas. Reúnete también con los demás miembros del comité para discutir tus últimos adelantos e infórmales con anticipación cuándo piensas entregarles material para revisión.
4. **Escribe para la audiencia**. Es natural que escribas la primera versión de la tesis para ti mismo porque en esa etapa tú eres la única persona en la audiencia. Sin embargo, las versiones posteriores tienen que ir dirigidas a una audiencia amplia. Algunas tesis son redactadas de tal forma que solamente el autor puede entenderlas; en muchas de estas tesis el título no refleja fielmente el contenido del trabajo, el resumen no contiene toda la información importante, los materiales y métodos no tienen toda la

información necesaria para repetir la investigación y las conclusiones no contienen los puntos sobresalientes de la discusión.

5. **Adopta un estilo y síguelo consistentemente**. La tesis debe tener un mismo estilo, formato y organización a través de todo el documento. Estudia cuidadosamente esta guía y la sugerida por tu consejero, y aplícalas consecuentemente. Seguir instrucciones es un requisito indispensable para la publicación de cualquier trabajo que se somete al escrutinio público, hacerlo te evitará problemas ahora y cuando enfrentes las reglas aún más rigurosas de las revistas profesionales.
6. **Revisa cuidadosamente el manuscrito**. El documento que entregarás en la Oficina de Estudios Graduados antes del examen debe ser una versión casi final de la tesis y no un borrador preliminar que sufrirá modificaciones sustanciales luego del examen. La práctica de someter un borrador para cumplir con la fecha límite es indeseable porque después del examen no tendrás ni el tiempo ni la disposición para hacer cambios mayores. Revisa cada versión del documento con el corrector gramatical del procesador de textos, pero recuerda que esta herramienta tiene limitaciones; por ejemplo, el corrector no detecta palabras que han sido sustituidas por otras palabras escritas correctamente (e.g., especia por especie).

Idioma

Puedes redactar la tesis en español o en inglés. Aunque se recomienda escribir las tesis de ciencias y de ingeniería en inglés, es mejor redactar el documento en español si no dominas adecuadamente el idioma inglés, si no tienes los recursos para pagarle a un corrector profesional, o si tu comité no puede dedicarte tiempo adicional para corregir el documento. La tesis final debe estar bien redactada sin importar el idioma empleado.

Longitud de la tesis

No hay reglas sobre cuán larga debe ser una tesis. La longitud del documento depende de varios factores, tales como el área de concentración, el tema de la investigación, el número de tablas y el tamaño de las figuras. La extensión de la tesis no es necesariamente proporcional a su calidad ni a la importancia de la contribución. Todo el contenido de la tesis debe tener una función definida y contribuir significativamente al valor del documento.

Derechos de autor

La ley de derechos de autor te protege contra el uso, la duplicación y la distribución desautorizada de la tesis. Esto significa que nadie puede reproducir partes sustanciales del documento sin tu permiso. El mismo derecho que tienes sobre tu obra lo tienen los demás autores sobre las suyas. Aunque el principio de uso justo o uso lícito (*fair use*) te permite reproducir sin permiso (aunque otorgando el crédito correspondiente) partes de otras obras para propósitos académicos, este principio tiene límites y sus alcances legales son ambiguos. Se recomienda pedir permiso para la reproducción de poemas, canciones, cuestionarios, entrevistas, cartas, y partes sustanciales de otras tesis, libros y artículos publicados en revistas. Los documentos publicados en Internet tienen la misma protección legal que los documentos impresos.

La obtención de permisos puede tomar mucho tiempo y los dueños de los derechos de autor no están obligados a responder ni a otorgarte el permiso. Si no te contestan o te niegan el permiso debes remover el material de la tesis. Si cambias el material ligeramente para poder usarlo sin permiso cometerás plagio (presentación de material ajeno como si fuese propio).

Experimentación con humanos o con animales

Si tu tesis incluye experimentos donde participaron personas o animales, incluye en el apéndice una copia de la autorización emitida por el comité institucional que revisó y aprobó la experimentación.

Entrega del documento

Debes entregar en la Oficina de Estudios Graduados una copia sin encuadernar de la tesis 30 días antes de la fecha del examen de defensa. Este periodo es necesario para conseguir un representante de estudios graduados que pueda acudir al examen en el día y hora acordados por el comité graduado, darle tiempo al representante para que lea cuidadosamente el documento, conseguir un lugar apropiado para realizar el examen y preparar todos los documentos relacionados con el examen oral.

Luego del examen de defensa y de hacerle todos los cambios y ajustes necesarios al documento, debes entregar en la Oficina de Estudios la versión final de la tesis en formato PDF- ya no se entrega una copia impresa. Puedes entregar la tesis en disco floppy, disco compacto o traerla en un *flash* (USB) *drive*. La versión digital se enviará electrónicamente a la biblioteca del RUM y a la compañía Proquest. Hay recursos útiles para la producción del archivo PDF en http://grad.uprm.edu/stat.html#Anchor-6135

PRESENTACIÓN DEL MANUSCRITO

Estilo de letra

Usa para el texto caracteres de 11 o 12 puntos, preferiblemente de los estilos Arial o Times New Roman. Los títulos y los subtítulos deben ser uno o dos puntos más grandes. Usa *itálicas* para nombres científicos y para el texto citado de otro idioma. Usa **negritas** para títulos, subtítulos, ocasionalmente para énfasis y en la bibliografía si lo requiere el estilo adoptado para la tesis. Puedes usar letras tamaño 8 ó 9 para notas al calce (notas a pie de página), tablas colocadas en los apéndices y texto que forma parte de las figuras. No uses negritas para las letras pequeñas porque se dificulta su lectura.

Espacio entre líneas

Usa espacio sencillo para la bibliografía, las notas al calce, las citas largas en el texto, los títulos largos en la tabla de contenido, la lista de tablas, la lista de figuras, los títulos de las tablas, las leyendas de las figuras y los títulos de las secciones del texto. Usa espacio doble entre las referencias en la bibliografía, entre párrafos, entre los subtítulos y el párrafo siguiente, entre los títulos en la lista de tablas y la lista de ilustraciones, y entre el número de la página y la línea de texto más cercana. Usa espacio y medio o espacio doble para el cuerpo de la tesis. Sangra (*indent*) el comienzo de cada párrafo por cinco espacios o un *tab.*

Justificación del texto

Puedes justificar los dos márgenes o solamente el margen izquierdo. Si al justificar los márgenes queda demasiado espacio entre las palabras, puedes mejorar la apariencia del texto haciendo que el procesador divida las palabras con guiones.

Márgenes

Usa los márgenes por defecto (default) de tu procesador de textos o 2.5 cm (1 pulgada) en los cuatro lados. Todo el texto, las tablas y las ilustraciones deben estar dentro de los márgenes; el número de la página puede ir fuera del margen.

Paginación

Las páginas preliminares llevan números romanos pequeños centralizados en el margen inferior de la página. Las demás páginas llevan números arábigos colocados cerca de la intersección del margen superior y el margen derecho; si se desea, el número de la primera página de cada sección principal de la tesis puede centralizarse en el margen inferior de la página. La portada es la primera página de la tesis pero no se numera. La primera página numerada (ii) corresponde al resumen en inglés (*abstract*). El número de la página no lleva puntuación ni se acompaña de palabras (correcto: 3 incorrecto: 3. o Página 3). Cada página preliminar y cada capítulo o sección comienzan en una página nueva.

Headers *y* footers

El uso de encabezamientos (*headers*) o notas en el pie de la página (*footers*) queda a discreción del estudiante y su comité graduado. Los *footers* son útiles para identificar el documento cuando el lector imprime páginas individuales de la tesis. Ejemplo: © José A. Pérez-Pinedo, 2005, tesis MS, UPR/RUM.

Plantilla para la tesis

La Dra. Sandra Cruz Pol, del Departamento de Ingeniería Eléctrica y Computadoras, ha preparado una plantilla que te permite redactar la tesis manteniendo el formato recomendado en esta guía. La plantilla está disponible en http://grad.uprm.edu/plantilla.doc.

ORGANIZACIÓN

Portada

La portada incluye el título de la tesis, el nombre del estudiante, el año de entrega del documento final y los nombres (con sus firmas) de los miembros del comité examinador, el director del departamento y el director de Estudios Graduados (el último sólo para tesis doctorales). Los nombres de los profesores y de los funcionarios son seguidos por el grado académico superior de cada uno (e.g., M.S. o Ph.D.) El título es una descripción precisa, clara y concisa del contenido de la tesis; revísalo varias veces durante la preparación del documento para que refleje fielmente la naturaleza del trabajo. El título no lleva punto final, como tampoco lo llevan los títulos de las divisiones de la tesis.

Páginas Preliminares

- **Abstract**- el resumen en inglés explica el contenido del proyecto en un solo párrafo de no más de 150 palabras para tesis de maestría y 350 palabras para disertaciones doctorales (estos límites son impuestos por Proquest). El *abstract* debe informarle al lector el objetivo de la investigación, los métodos principales usados, los resultados principales obtenidos y las conclusiones más importantes.
- **Resumen**- esta es la versión en español del *abstract*. Ambos resúmenes tienen que proveer la misma información, pero los resúmenes no son traducciones literales uno del otro; cada uno se redacta correctamente en su propio idioma.
- **Declaratoria de derechos de autor**- usa el símbolo © seguido por tu nombre y el año de entrega de la tesis final a Estudios Graduados. Algunos estudiantes incluyen información adicional, por ejemplo otorgándole permiso a la biblioteca para que reproduzca la tesis para uso académico, pero esto es innecesario y no tiene valor legal.
- **Dedicatoria**- muchos estudiantes incluyen una dedicatoria como homenaje o agradecimiento a una o más personas que influyeron en el éxito de la investigación. El uso del título Dedicatoria es opcional.
- **Agradecimientos**- esta sección reconoce la ayuda de personas e instituciones que contribuyeron significativamente al desarrollo de la investigación. Se acostumbra agradecer el apoyo económico, la ayuda en la toma de datos, el préstamo de literatura y equipo, la asistencia en la preparación de tablas e ilustraciones, las sugerencias útiles para el desarrollo de la investigación, las ideas que ayudaron a explicar los resultados, y la ayuda con la lectura crítica y corrección del documento.
- **Tabla de contenido-** aquí se detalla el contenido de la tesis comenzando con la próxima página preliminar y terminando con los apéndices. Todos los capítulos y secciones deben aparecer en la tabla de contenido, con sus correspondientes páginas y encabezamientos según aparecen en el texto. Las tesis que tienen muchas subdivisiones deben emplear un sistema lógico para organizar la tabla de contenido y el texto.
- **Lista de tablas**- usa los mismos títulos que aparecen en el texto pero sin las notas aclaratorias que siguen después de la descripción inicial de la tabla.
- **Lista de figuras**- usa las mismas leyendas que aparecen en el texto pero sin las notas aclaratorias que siguen después de la descripción inicial de la figura.
- **Lista de símbolos o abreviaturas-** recomendable si la tesis tiene muchos símbolos o abreviaturas.
- **Lista de apéndices**- usa los mismos títulos que aparecen en los apéndices pero sin las notas aclaratorias.

Introducción

El primer capítulo de la tesis describe el proyecto, anuncia sus objetivos y establece su importancia. Aunque pienses que el propósito del trabajo es obvio o que se deduce del título de la tesis, nunca está demás anunciarlo directamente: “El propósito de esta investigación es...”. Recuerda que una de tus metas principales es producir un texto libre de ambigüedades. Esta sección también establece la importancia del proyecto (su valor teórico o aplicación práctica) y describe cualquier limitación teórica o práctica que tenga el trabajo.

Revisión de Literatura

Esta sección es un recuento completo y usualmente cronológico de investigaciones previas y del conocimiento actual del tema. Muchos estudiantes alargan innecesariamente la revisión de la literatura con trabajos que no son directamente pertinentes a la investigación.

Materiales y Métodos

Esta sección describe los materiales y los métodos usados para hacer la investigación. Es imperativo proveer toda la información que un investigador competente necesita para repetir el trabajo y validar los resultados. Si la sección es muy larga puedes dividirla por temas o hacer una sección de materiales y otra de métodos. Esta sección se redacta en tiempo pasado (se midió, se visitó, etc.).

Algunos procedimientos son tan bien conocidos que puedes nombrarlos sin más explicación. Si la técnica está publicada basta con citar el artículo, aunque es preferible describirla si el proceso es corto o si la publicación es difícil de conseguir. Si modificaste un método de otro investigador debes dar la referencia bibliográfica y explicar el cambio. Si usaste un método nuevo tendrás que describirlo y explicarlo (quizás también justificarlo) minuciosamente. No tienes que especificar las marcas y los modelos de los equipos de laboratorio si hay varios instrumentos que pueden hacer lo mismo. En esta sección también informas y defiendes las pruebas estadísticas empleadas para analizar los datos.

Resultados

Los resultados usualmente se presentan por medio de texto, tablas o figuras. El texto es la forma más rápida y efectiva de exponer pocos datos. Las tablas son preferibles para presentar datos precisos o repetitivos. Las figuras son ideales cuando los datos exhiben tendencias o patrones importantes. Evita presentar los mismos datos de más de una forma, ya que las revistas profesionales no favorecen dicha práctica y podrías perder tiempo preparando tablas o ilustraciones que deberás eliminar más tarde. Usa el sistema internacional (SI o sistema métrico moderno) para las unidades de peso y medida. Los resultados se presentan en tiempo pasado (se contó, se observó, etc.).

Tablas (Cuadros)

Antes de preparar una tabla verifica que sea realmente necesaria y que aporte significativamente al contenido de la tesis; muchos estudiantes preparan una cantidad excesiva de cuadros que deben eliminar cuando someten artículos para publicación. Préstale atención especial a las tablas cortas; con frecuencia su contenido puede presentarse adecuadamente mediante texto.

Como regla general, el cuerpo de la tabla no debe tener espacios en blanco. Un espacio en blanco puede significar que no hay datos, que existen pero que el autor no los tiene, o que se omitieron por error. Los espacios en blanco pueden llenarse con un símbolo explicado con una nota; cuatro símbolos frecuentes son ND para no hay datos, NA para no aplica, + para presente y - para ausente. No incluyas filas o columnas con los mismos datos a lo largo de toda la tabla, ni columnas con datos que pueden calcularse fácilmente de columnas adyacentes. Tampoco se recomienda incluir columnas de datos no significativos.

El título de la tabla se coloca sobre la tabla, comenzando a nivel del margen izquierdo de la tabla o centralizado sobre la misma. Las tablas y las ilustraciones copiadas de otros trabajos deben tener el crédito correspondiente; esto puede indicarse en el título o en una nota en el caso de las tablas: tomado de Smith (1993) es apropiado para material que reproduces sin cambio alguno; modificado de Smith (1983) es adecuado para material reproducido parcialmente.

Ilustraciones

Las ilustraciones son ideales para presentar datos que tienen tendencias o patrones que no se aprecian claramente en las tablas. Las figuras son también indispensables para presentar ideas complejas e imágenes que no pueden describirse fácilmente con palabras. Como sucede con las tablas, antes de preparar una ilustración debes confirmar que la misma es realmente necesaria y que aumenta significativamente el valor de la tesis.

Las leyendas se colocan debajo de las ilustraciones. Si la ilustración es muy grande y la leyenda no cabe en la página, entonces se centraliza en una hoja colocada opuesta a la figura. Esta hoja lleva invertidos los márgenes izquierdo y derecho, no se numera y no cuenta en la paginación del documento. Si la ilustración se coloca de lado, la leyenda en la página opuesta también se imprime de lado. En ambos casos el material se orienta para que el texto se lea de izquierda a derecha cuando el papel se gira a favor del reloj. Estas figuras (y las tablas colocadas de lado) se numeran preferiblemente en la esquina superior derecha del papel, como en el resto de la tesis.

Ocasionalmente los mismos datos pueden presentarse en una tabla o en una figura. Como regla general, se prefieren las tablas cuando la precisión de los datos es importante y cuando los datos fluctúan al azar o no presentan una tendencia definida. Se prefieren las figuras cuando los datos presentan un patrón o cuando la figura resalta una diferencia que podría pasar desapercibida en una tabla.

Para cumplir con su propósito, las ilustraciones deben entenderse fácil y rápidamente; evita las gráficas muy complejas, recargadas de datos y con curvas que se entrecruzan excesivamente. Las ilustraciones a color deben entenderse si se reproducen en blanco y negro. Convierte las fotografías a formato jpg para que la tesis no se torne excesivamente grande; trata en todo momento de que la tesis completa sea un solo documento de Word (o del procesador de textos que uses).

Colocación y numeración de las tablas y las ilustraciones

Las tablas que ocupan más de una página llevan el título sólo en la primera página. Las páginas siguientes llevan el número de la tabla acompañado por la palabra **continuación** y los encabezamientos de las columnas. Las notas al calce se colocan en la página correspondiente o se agrupan al final de la tabla.

Las tablas y las ilustraciones pueden integrarse de distintas formas al texto. Una opción común es colocarlas lo más cerca posible del lugar donde se mencionan por primera vez. Otra opción es agrupar el material al final de cada capítulo o al final de la tesis entre la bibliografía y los apéndices. Todas las tablas y las ilustraciones incluidas en el cuerpo de la tesis tienen que citarse en el texto. Las tablas y las ilustraciones pueden numerarse de varias formas; los dos sistemas principales son la numeración consecutiva desde el comienzo hasta el final de la tesis (Tabla 1, Tabla 2, Tabla 3, etc.) y la numeración por capítulos (Tabla 1.1, 2.1, 3.1, etc.). El material colocado en los apéndices se numera aparte.

Ecuaciones

Las ecuaciones se numeran y se centralizan en la página o se colocan a lo largo del margen izquierdo. La ecuación $a = b + c$ (6.1) incluye entre paréntesis el número del capítulo (antes del punto) y el número de la ecuación (después del punto). La ecuación $a = b + c$ (11) incluye entre paréntesis el número de la ecuación sin indicar el capítulo. No tienes que numerar las ecuaciones que son parte de una derivación.

Otros materiales

Consulta con la Oficina de Estudios Graduados sobre la inclusión en la tesis de materiales no tradicionales, tales como grabaciones, vídeos, discos compactos o programas de computadora.

Discusión

Esta sección explica los resultados de la investigación y los compara con el conocimiento previo del tema. Limítate a explicar los resultados; no los presentes nuevamente. Los resultados se discuten mediante referencia a la literatura sobre el tema, investigaciones en progreso e información sin publicar cedida por otros investigadores. Citar demasiado entorpece la lectura y la comprensión del texto; tres citas deben ser suficientes para respaldar cualquier aseveración. Consulta con tu consejero sobre la discusión de resultados que no son significativos; algunos consejeros opinan que deben discutirse mientras que otros opinan lo contrario.

Conclusiones

Esta sección debe informar si se cumplieron o no los objetivos del trabajo. La sección puede numerar los resultados principales de la investigación o recapitular someramente el contenido del artículo, mencionando el propósito, los métodos principales, los datos más importantes y el significado principal de los resultados. Esta sección debe ser corta y no debe dar detalles de los resultados, duplicar excesivamente el contenido del resumen, o referirse a artículos, tablas o figuras.

Recomendaciones

Esta sección opcional y corta sugiere proyectos para investigadores interesados en el tema.

Bibliografía

Aunque los términos bibliografía, literatura citada y referencias se usan comúnmente como sinónimos, el primero debe usarse cuando la sección contiene una recopilación completa de la literatura (incluyendo todas las referencias citadas en el texto), el segundo cuando se incluyen sólo los artículos citados en el texto y el tercero cuando se provee una selección de artículos para lectura futura (raro en una tesis). Esta sección incluye artículos publicados en periódicos y revistas profesionales, artículos aceptados para publicación en revistas profesionales [se citan en el texto como (en prensa) o (*in press*)], capítulos de libros, libros, tesis, documentos (e.g., mapas y datos climáticos publicados por agencias gubernamentales) e información publicada en la Internet. Esta sección generalmente no incluye resúmenes (*abstracts*) de presentaciones hechas en congresos, informes de proyectos, publicaciones internas de agencias públicas o privadas, manuscritos inéditos, artículos sometidos para publicación [se citan como (en prep.) o (*in litt.*)], comunicaciones personales [se citan como (com. pers.) o (*pers. com.*)] y datos sin publicar [se citan como (datos sin publicar) o (*unpubl. data*)].

Hay dos sistemas principales para citar la literatura: el sistema de **autor y año** y el sistema de **cita por números**. En el primero los artículos se citan en el texto por el apellido del autor y la fecha de publicación. Se usan letras para distinguir los artículos publicados por un autor en un mismo año (e.g., Pérez 1998a, Pérez 1998b) y los artículos con tres o más autores se citan por el apellido del primer autor seguido por et al. (e.g., Pérez et al., 1998), pero se incluyen todos los autores en la sección de literatura citada. Las fichas bibliográficas se ordenan alfabéticamente. En el segundo sistema los artículos se citan en el texto por un número que se asigna al artículo en la literatura citada [e.g., Según Pérez (1)]. Los artículos en la literatura citada se ordenan alfabéticamente, por orden de aparición en el texto, o incluso al azar, según la guía de estilo adoptada. En el segundo sistema es crucial que el número usado en el texto corresponda a la referencia correcta en la literatura citada. Si usas el sistema de autor y año no debes numerar los artículos en la literatura citada. Sigue estos pasos para alfabetizar las referencias:

- Separa los artículos por el apellido del primer autor. Por ejemplo, saca a parte los artículos de Jackai, los de Kritsky y los de Urrutia.
- Toma los artículos del primer autor como único autor y colócalos en orden cronológico. Por ejemplo, Jackai 1978, Jackai 1989a, Jackai 1989b, Jackai 1992.
- Toma los artículos de cada autor con otro autor y ordénalos por el apellido del segundo autor y por orden cronológico si hay más de un artículo con el mismo segundo autor. Por ejemplo, Jackai y Horsfall 1984, Jackai y Metcalf 1983, Jackai y Metcalf 1992, Jackai y McCleod 1996.

- Toma los artículos del primer autor con dos o más autores y colócalos en orden cronológico sin importar el apellido del tercero o demás autores ni el número de autores. Por ejemplo: Jackai, Delong, Massoud y Salmon, 1985; Jackai, Smith y Kirk 1987; Jackai, Ames y Maynard 1992. Esto se hace porque los artículos que tienen tres o más autores se citan en el texto por el apellido del primer autor seguido por et al. y el año.

Hay muchos estilos para redactar las citas, pero en todos debes proveer suficiente información para que el lector interesado pueda obtener el documento. Usa el mismo estilo a través de toda la sección. Para evitar errores en la redacción de las citas, usa como fuente el artículo original y no la bibliografía de otro artículo. Si tienes que citar un artículo por medio de otro, cítalo así: Smith (1916, citado de Jones, 1995) e incluye las dos referencias en la literatura citada. Este estilo de redactar las citas se usa en muchas revistas profesionales (el trabajo es ficticio):

- **Artículo**- Greenspan, E. H. y J. Stern. 2003. Analysis of the chemical composition of Spanish lime (*Melicoccus bijugatus*). J. Chem. Anal. 45(3): 334-359.
- **Artículo en un libro**- Greenspan, E. H. y J. Stern. 2003. Analysis of the chemical composition of Spanish lime (*Melicoccus bijugatus*). En: E. Cassidy (ed.). Chemical composition of tropical fruits, pp. 334-359. Smith & Sons Publishing Company, Montreal.
- **Libro**- Greenspan, E. H. y J. Stern. 2003. The chemical composition of Spanish lime (*Melicoccus bijugatus*). Smith & Sons Publishing Company, Montreal, 335 pp.
- **Tesis**- Greenspan, E. H. 2003. The chemical composition of Spanish lime (*Melicoccus bijugatus*). Tesis M.S. Universidad de Puerto Rico, Mayagüez, P.R., 335 pp.
- **Artículo de periódico**- Greenspan, E. H. 2003. The chemical composition of Spanish lime. The San Juan Star, San Juan, Puerto Rico, Feb. 20, 1995, p.5-6.
- **Página de Internet**- Greenspan, E. H. y J. Stern. 20003. Analysis of the chemical composition of Spanish lime (*Melicoccus bijugatus*). http://www.uier.edu/art/greens/paper.html.

Las citas se redactan en el idioma original del artículo citado, con la excepción de artículos escritos en chino, japonés, ruso y otros lenguajes basados en símbolos idiomáticos. Si escribes en inglés usa **and** (en el texto y en la literatura citada) antes del último autor del artículo; usa **y** si escribes en español. Esta regla aplica sin importar el idioma de la cita.

Notas al calce

Las notas al calce o notas a pie de página (*footnotes*) se usan con más frecuencia en tesis de las humanidades. Estas notas se identifican con un número superior pequeño (*superscript*) y usualmente se colocan al pie de la página, dentro del margen y debajo de una corta línea divisoria; también pueden colocarse al final de cada capítulo (*endnotes*) o al final de la tesis en una sección creada a tal efecto y colocada antes de la bibliografía. Las notas se numeran por página, por capítulo o consecutivamente a través de la tesis, dependiendo del estilo adoptado.

Apéndice(s)

En esta sección opcional se coloca material importante pero que no es fundamental para la comprensión de la tesis (de serlo no estaría en el apéndice). La tesis puede tener uno o más apéndices; si hay más de uno se numeran consecutivamente usando letras mayúsculas (Apéndice A) o números arábigos (Apéndice 1). Todos los apéndices llevan título y cada apéndice debe comenzar en una página nueva. Las tablas y las figuras colocadas en esta sección se numeran por separado pero su paginación es consecutiva con la del cuerpo de la tesis. Ejemplos de material a colocarse en apéndices: listas de material estudiado, listas de localidades visitadas, mapas, datos climáticos, métodos detallados, datos de todas las repeticiones del experimento, todos los resultados del análisis estadístico (incluyendo quizás los que no son significativos), tablas muy largas, cuestionarios, respuestas a los cuestionarios, derivaciones matemáticas extensas, formularios de permiso para trabajar con humanos o con animales, correspondencia con otros investigadores y permisos para reproducir material en la tesis.

ERRORES COMUNES EN LAS TESIS

1) **Portada**

- Faltan los nombres o el grado académico superior de los miembros del comité
- Está numerada (es la página i de la tesis pero no lleva número)
- Dice propuesta sometida en vez de tesis sometida
- Incluye al Director de Estudios Graduados (sólo se incluye en tesis doctorales)

2) **Páginas Preliminares**

    - No están numeradas o están fuera de orden (y por lo tanto numeradas incorrectamente)
    - Están incompletas (falta el *abstract*, resumen, agradecimientos, etc.)
    - El *abstract* y el resumen exceden las150 palabras para tesis de maestría y 350 palabras para tesis doctorales
    - El *abstract* y el resumen difieren en contenido
    - El *abstract* y el resumen tienen citas bibliográficas o referencias a tablas y figuras
    - La tabla de contenido incluye páginas que le preceden (sólo debe incluir páginas colocadas después de la tabla de contenido)
    - La tabla de contenido no incluye los títulos Lista de tablas, Lista de figuras o Lista de Apéndices
    - Los títulos en la tabla de contenido, la lista de tablas o la lista de figuras difieren de los que aparecen en el cuerpo del documento
    - Los números de las páginas en la tabla de contenido, la lista de tablas o la lista de figuras no coinciden con los números en el texto.
    - Los números de las páginas en la tabla de contenido, la lista de tablas o la lista de figuras no están alineados con el margen derecho de la página.
    - No se agradece la contribución de personas o de instituciones que apoyaron significativamente la investigación

3) **Paginación**

    - El número de las páginas preliminares está fuera de lugar (debe estar centralizado a lo largo del margen inferior de la página)
    - El número de la página está de lado en las páginas que tienen figuras colocadas de lado (*landscape*); el número debe estar derecho, como en las otras páginas
    - Las páginas del apéndice no están numeradas o su numeración no es consecutiva con las páginas anteriores

4) **Texto**

    - Algunas letras son muy pequeñas
    - El número de la página no corresponde con el número en la tabla de contenido
    - La primera línea de los párrafos no está sangrada (“indentada”)
    - La sintaxis es deficiente- hay oraciones confusas o que transmiten un significado incorrecto
    - El sujeto y el verbo no corresponden en tiempo (el sujeto es singular y el verbo es plural o viceversa)
    - El antecedente de los pronombres no está claro
    - Se incluyen palabras inventadas, traducciones deficientes y demasiados anglicismos

- Uso frecuente de términos redundantes (e.g., especies diferentes, error involuntario, estadísticamente significativo)
- Redacción verbosa (exceso de palabras para expresar un pensamiento)
- Uso de palabras rebuscadas en vez de términos sencillos
- Uso excesivo de la voz pasiva (ha sido observado, se ha contado, fue llevado). La voz activa (se observó, se contó, se llevó) es más breve, directa y asertiva.
- Uso de contracciones y frases coloquiales. Las contracciones (e.g., *don't*, *won't*, *we'll*) y las frases coloquiales (e.g., un montón de- *lots of*) no se usan en la redacción formal
- El texto se escuda demasiado (a veces, aparentemente, por lo general, puede ser, quizás) y debilita las conclusiones del estudio
- Se emplean abreviaturas y términos especializados sin definirlos adecuadamente
- Oraciones excesivamente largas y difíciles de entender
- Párrafos muy largos (una página promedio debe tener dos o tres párrafos)
- Párrafos mal organizados (se salta de un tema a otro)
- El texto contiene errores tipográficos y gramaticales
- Se confunden palabras que tienen la misma pronunciación (e.g., encima-enzima, tasa-taza, *stake-steak*, *were-where*)
- Se usan variantes gramaticales propias del inglés británico o internacional (e.g., *behaviour*, *colour*, *metre*, *centre*, *minimise*, *recognise*).
- Faltas de acentuación
- Se usan incorrectamente los signos de puntuación, particularmente la coma y el punto y coma. Las faltas de puntuación entorpecen la lectura y pueden alterar dramáticamente el significado de la oración.
- La última línea de la página es un subtítulo o es la primera línea de un párrafo (la última línea debe tener por lo menos dos líneas de texto)
- La primera línea de la página es un fragmento de la última oración del párrafo anterior
- Oraciones que comienzan con abreviaturas
- Información fuera de lugar (métodos en la introducción, conclusiones en la discusión, etc.)
- Se cita excesivamente la literatura (tres citas deben ser suficientes para respaldar cualquier aseveración)
- Se respaldan con citas aseveraciones que son de conocimiento general

5) **Tablas e Ilustraciones**

- Las figuras son muy pequeñas y el texto es ilegible
- Demasiadas curvas en la misma gráfica o las curvas se entrecruzan excesivamente
- Parte de la tabla o de la figura está fuera del margen de la página
- El título está fuera de lugar (el título de la tabla va encima de la tabla, la leyenda de la figura va debajo de la figura)
- El título difiere del que aparece en la lista de tablas o en la lista de figuras
- Las figuras a colores no se entienden cuando se reproducen en blanco y negro

6) **Bibliografía**

- Artículos citados en el texto que no están en la bibliografía
- El año de publicación en la bibliografía no corresponde con el año citado en el texto

- Se incluye el nombre completo del autor (el nombre debe abreviarse; e.g., Carrillo, A. en vez de Carrillo, Antonio)
- Uso de et al. en la bibliografía (se incluyen todos los autores)
- Se incluyen manuscritos en preparación, datos sin publicar y comunicaciones personales
- Los nombres de las revistas están mal abreviados o se abrevian erráticamente (consulta una fuente adecuada para obtener las abreviaturas correctas o escribe todos los nombres completos)
- Citas incompletas (falta el título, el volumen, las páginas, etc.); usa consistentemente el estilo adoptado para la tesis
- Inconsistencias en el orden de la información bibliográfica (autor, año, título, volumen, número de páginas, etc.)
- La tesis es en español pero usa **and** en vez de **y** antes del último autor de los artículos escritos en inglés
- La tesis es en inglés pero usa **y** en vez de **and** antes del último autor de los artículos escritos en español

Anejo B: Guías para Exámenes Comprensivos, Portafolios u otros requisitos del grado

Anejo B Qualifying Examination

All students will be required to take a Qualifying Exam. This exam will serve to evaluate a candidate's competency in areas related to Electrical Engineering. The exam will be prepared by the department Graduate Committee. This committee will determine the minimum competencies required to pass the exam. Students admitted to the program with a Masters degree should take the exam at the end of the first year of studies. Those admitted with a Bachelors degree should take the exam at the end of the second year of studies. Students must have passed the qualifying exam in order to register for the doctoral dissertation course. Doctoral students who fail this exam will be allowed to repeat the exam only once, and will be suspended after failing twice. Students who fail the qualifying exam twice may not be re-admitted or given a new admission to the program. Once the qualifying exam is passed, the student becomes a doctoral candidate.

Candidacy Examination

This is an oral exam based on the student´s thesis proposal. The examination is conducted by an Examination Committee formed by the student Advisory Committee and a Guest Examiner appointed by the program director. Students need to stop by the ECE Graduate Studies and Research Affairs Orientation Office to apply for the examination. The student adviser chairs the Examination Committee and reports the result to the program director. The program director then reports the result to the Graduate School Office.

The approval of the Candidacy Examination is a condition for the approval of the student´s Thesis Proposal. A complete draft of the Thesis Proposal, reviewed and approved in principle by the student adviser is made available to each member of the examining committee at least three weeks before the examination.

The exam is graded Pass or Fail by the Examination Committee. Pass grade decision must be unanimous. In order to pass the candidacy examination the student must show:

- A well-defined research direction including specific aims, main objectives, methodologies, expected contributions, and action plan;
- Expected research outcomes consistent with the standard of quality of a doctoral dissertation;
- Adequate breadth and depth of knowledge in areas related to the research proposal;
- A well-defined ethical issue related to the main research topic of the dissertation

In order to register for the Candidacy Examination the student must have:

- Passed the Qualifying Exam;
- Have a Thesis Proposal in draft form reviewed and approved in principle by the adviser;
- Write a short paper (up to six pages) describing the background and history of the proposed research problem with citations to all the relevant literature. Emphasis should be made on the contributions of the proposed research to the current knowledge in electrical engineering.

Doctoral Dissertation

A doctoral dissertation in Electrical Engineering is a formal document that argues in defense of a particular thesis; this is a particular hypothesis or conjecture on the nature, philosophy, representation, and transformation of information, including computational modeling and simulation of natural phenomena. The research performed to support a thesis must be original and substantial, and the dissertation must show it to be so, by highlighting original contributions. The dissertation must include a chapter about the impact of the research on the society quality of life, including a clear understanding and respect for the legal, social and cultural issues associated with the research.

Electrical Engineering Doctoral Program

Doctoral Qualifying Examination

Purpose and General Information

The purpose of the doctoral qualifying examination is to evaluate the candidate's ability to organize for doing research at the doctoral level, to write a technical paper, to speak from a prepared talk and in response to live questioning, and to think logically and clearly, under some pressure. The assessment is based on the student's performance in a written examination and an oral examination. The exams will be prepared, supervised and evaluated by the program's Graduate Studies Committee in coordination with its faculty.

The qualifying examination is offered each semester, during the first month of classes. Students entering the program with a M.S. must take the qualifying examination the semester immediately after their first year of study, and students entering the program with a B.S. degree must take the exam the semester immediately after their second year of study. Students who are required to take deficiency courses must complete the all the deficiencies before taking the qualifying exam. The Graduate Studies Committee may, under well justified circumstances, offer extensions to these time requirements. Failure to take the examination within the established periods will count as a failed attempt, except in the case of extenuating circumstances. According to UPRM's regulations, each student has two opportunities to pass the exam.

Format

The doctoral qualifying examination consists of a written exam and an oral exam. The Graduate Committee, in coordination with the department faculty, will pose an open question to each candidate during the first week of classes, and will assign an Evaluation Committee for each student. The Evaluation Committee will consist of two faculty selected from the ECE Department, and one representative from the Graduate Committee. The candidates must complete a research paper on the assigned question in two weeks, and turn them in to their Evaluation Committee. The oral exam will take place two weeks after the completion of the research paper. In the oral exam, the candidates will present their papers to the Evaluation Committee.

The candidates will work on both the oral and written exam without any external consultation.

Assessments of Results

The result of the qualifying examination is determined as follows:

1. Each evaluator submits numerical evaluations of the student's performance in the written and oral examinations. Each exam will have a maximum score of 100 points.

2. The Graduate Studies Committee will tabulate the results of the individual exams. The results of the examination will then be compared and evaluated and a consensus vote will be made to decide the passing grade for that particular exam offering. If a student fails the exam and feels that additional information is needed, he/she may request a meeting with the president of the program Graduate Studies Committee.
3. The Graduate Studies Committee will inform the program's Director of the results of the examination, who will in turn inform the student and the Office of Graduate Studies no later than two weeks after the qualifying exam.

A student who has passed the examination will be allowed to register in INEL 8999 – Doctoral Dissertation. This student is henceforth regarded as a doctoral degree candidate in the Electrical Engineering Program at UPRM.

A student who has failed the qualifying examination the first time may retake it a second and final time within one semester of the first attempt. According to UPRM regulations, a second failure will result in the student's dismissal from the graduate program. If the student does not hold a Master's degree in Electrical Engineering, the student will be given the opportunity to transfer to the Electrical Engineering's Master of Science or Master of Engineering programs. If none of these options is selected, the student will be suspended from the Electrical Engineering graduate program. After one year of suspension, the student may apply for a second and final admission to the same program or to another UPRM graduate program.