GRADUATE PROGRAM IN POWER AND ENERGY ENGINEERING

ELECTRICAL AND COMPUTER ENGINEERING DEPARTMENT
UNIVERSITY OF PUERTO RICO-MAYAGÜEZ

1. INTRODUCTION

This document describes the graduate Power and Energy Engineering Program at the University of Puerto Rico-Mayagüez (UPRM). The purpose of this document is to facilitate the admissions process by clearly stating the minimum requirements for power engineering. The information in this document is also useful to graduate students preparing their programs of study.

Power and Energy Engineering deals with the efficient generation, transmission, distribution and utilization of energy using traditional technologies and power converter technology. Our Graduate Program combines power systems and power electronics into a Power and Energy Engineering program. Research areas include power electronic converters, modeling and control of electric drives, power quality, alternate and renewable energy sources, energy storage, commercial and industrial design, transient phenomena and insulation coordination, system protection, energy management, stability, dynamics and reliability, device and load modeling, power system analysis.

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 is also supported by the Microgrid Laboratory, the Power Quality and Energy Studies Laboratory, the Native Energy Microgrid Laboratory and the Power Electronics Laboratory.

2. ADMISSION REQUIREMENTS

2.1 Masters

Both the Power and Energy Engineering Master program and PhD program are Energy programs that include both power systems and power electronics. A person that applies to the Masters of Power end Energy Engineering program must meet the following minimum requirements:

INEL 4415 Power System Analysis or equivalent and
INEL 4416 Undergraduate Power Electronics or equivalent

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.

All students are considered Power and Energy Engineering students, some specializing in power system others in power electronics. Students are encouraged to approve courses in both options. This will give a better understanding of power engineering and would prepare students for the challenges of working in industry or to continue studies. Further guidelines are given in Section 3.

For students enrolled in M.S. (Plan I) or M.E. with project option (Plan II), the program requires a minimum of 30 credits distributed as follows:

- 15-18 credits in core courses and technical electives in the area of specialization.
- 6-9 credits in electives outside the area of specialization.
- 6 credits of graduate thesis (M.S. Plan I)
- 3-6 credits of graduate project (M.E. Plan II).

The Master of Engineering program course option (Plan III) requires 30 credits distributed as follows:

- 6 credits in core courses in the area of specialization.
- 18 credits in technical electives in the area of specialization.
- 6 credits in electives outside the area of specialization.
- No more than 9 credits in advanced undergraduate level (5000 level) courses can be used to meet the degree requirements for any of the three plans.

2.2 PhD

General requirements necessary for admission into the graduate program appear in the section titled NORMS WHICH REGULATE graduate studies at UPRM (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.

3. CORE COURSES

All students in the Master program must approve two core courses. All students in the PhD program must approve three core courses. The core courses are:

INEL 6027 Power System Dynamics and Control
INEL 6028 Economic Operation of Power Systems
INEL 6058 High Frequency Power Converters
INEL 6085 Advanced Power Electronics

Graduate students can take up to 9 credits in 5000-level courses (senior undergraduate courses). The following courses, in addition to the core courses, are power and energy engineering courses:

INEL 5406 Transmission and Distribution
INEL 5408 Motor Control
INEL 5415 Power System Protection Design
INEL 5417 Power Electronics Applied to Renewable Energy
INEL 5496 Design Project in Power Electronics
INEL 6025 Advanced Energy Conversion
INEL 6066 Electric Drive Systems
INEL 6077 Surge Phenomena
INEL 6096 Power Quality

5. PROGRAMS OF STUDY

The purpose of this section is to guide students in the process of creating their programs of study (POS). Students and their Faculty mentors have room to accommodate the profes-

sional goals of the student as well as the needs of their research projects. During this process, it is important that the student consults with his/her Graduate Committee for further guidance.

There are ECE courses from other areas (e.g., Controls) that can be considered area courses in power and energy engineering. Special permission from the student's Graduate Committee is required to include up to 2 of these courses as "area courses" in a POS. A maximum of three out-of-area courses may be selected from any UPRM department as long as they are approved by the Student's Graduate Committee (these three courses do not include the two courses a student may use as "area courses"). A maximum of three 5000-level and up to two special topics courses may appear in a student's POS. ***Students must file a POS before registering for their second semester.***

Guidelines for programs of study in Power Engineering:

Thesis option:

6 courses in-area*****:	18 credits
2 out-of-area courses:	6 credits
Thesis:	6 credits
Total:	30 credits

Project option:

7 courses in-area*****:	21 credits
2 out-of-area courses:	6 credits
Project	3 credits
Total:	30 credits

Courses-only option:

Courses in-area******:	24 credits
Out-of-area courses:	6 credits
Total:	30 credits

***** For this option, the student's Graduate Committee can approve up to two non-power engineering courses to be considered as "area courses" if these courses are relevant to the student's research work.

****** For this option only, students can take up to three control courses and include them as power engineering "area courses." These can be either 5000 or 6000 level courses.

6. COURSE SEQUENCE

Course	2015-2016		2016-2017		2017-2018		2018-2019		2019-2020	
	I	II	I	II	I	II	I	II	I	II
INEL 5406						1				1
INEL 5408	1				1				1	
INEL 5415			1				1		1	
INEL 5417	1	1		1		1		1		1
INEL 6025		1	1				1			
INEL 6027		1		1		1		1		1
INEL 6028	1		1		1		1		1	
INEL 6058	1					1				1
INEL 6066								1		
INEL 6077					1				1	
INEL 6085			1		1		1		1	
INEL 6096				1				1		
INEL 8000 A			1		1		1		1	
INEL 8000 B				1		1		1		1
INEL 8000 C					1			1		

These courses are usually taught by the following professors:

INEL 5406 Transmission and Distribution: Cedeño, Irizarry, Orama
INEL 5408 Motor Control: Castro
INEL 5415 Power System Protection Design: Cedeño, Orama
INEL 5496 Design Projects in Power Electronics: Ortiz
INEL 6025 Advanced Energy Conversion: O'Neill, Irizarry
INEL 6027 Power System Dynamics and Control: Irizarry
INEL 6028 Economic Operation of Power Systems: Aponte, Cedeño
INEL 6058 High Frequency Power Converters: Andrade
INEL 6066 Electric Drive Systems: Andrade, Castro, Ortiz
INEL 6077 Surge Phenomena: Orama
INEL 6085 Advanced Power Electronics: Castro, Ortiz
INEL 6096 Power Quality: O'Neill

7. POWER ENGINEERING FACULTY AT UPRM

NAME AND RANK	DEGREE/UNIVERSITY	AREAS OF SPECIALIZATION
Erick E. Aponte Associate Professor	DEng (2006) Rensselaer Polytechnic Institute	Power system analysis, power electronics
Fabio Andrade Assistant Professor	PhD (2013) Universitat Politècnica de Catalunya.	Microgrid, renewable energy source, power electronics
Marcel Castro Sitiriche Associate Professor	PhD (2007) Howard University	Appropiate technology, native dc power, responsible wellbeingrural electrification,
J. Ricardo Cedeño Professor	PhD (2002) Ohio State University	Operation and control of power systems, applications of artificial intelligence in power systems
Agustín A. Irizarry-Rivera Professor	PhD (1996) Iowa State University	Power systems dynamics and operation, renewable energy sources.
Efraín O'Neill-Carrillo Professor	PhD (1999) Arizona State University	Sustainable energy, distributed generation, energy policy, power quality, power distribution systems, engineering education, social and ethical implications of engineering and technology.
Lionel R. Orama-Exclusa Professor	DEng (1997) Rensselaer Polytechnic Institute	Power system transients and protection, switching devices, switchgear technology, arc discharges in vacuum and gases, EMTP modeling of power devices
Eduardo Ortiz Associate Professor	PhD (2006) Michigan State University	
Alberto Ramírez-Orquín Associate Professor	PhD (2002) University of Texas, Arlington.	Power system operation and control, power systems dynamics and stability, power system transients and protection, deregulation, power markets, congestion management.

APPENDIX II: EXAMPLES OF PROGRAMS OF STUDY (POS)

The following are examples of POS. These are meant to guide students in the process of creating their own POS. The student's advisor, graduate committee and/or the Power Engineering Coordinator will help in this process. An MS student must approve three core courses as defined in Section 4 and may use up to 6 credits in Special Topics in Power Engineering as part of the required courses.

semester	Emphasis in power systems	Emphasis in power electronics
First (Fall)	INEL 5406 or INEL 5407 INEL 6028 Economic Operation One out of area course (6000 level) Semester total: 9 crs	INEL 6085 Adv. Pwr Electronics INEL 5408 Motor Control One out of area course (6000 level) Semester total: 9 crs
Second (Spring)	INEL 5415 Protection INEL 6027 Dynamics INEL 6096 Power Quality Semester total: 9 crs	INEL 6058 High Freq. Power Converters INEL 6096 Power Quality INEL 6025 Advanced Energy Conversion Semester total: 9 crs
Third (Fall)	INEL 6077 Surge Phenomena One out of area course (6000 level) THESIS Semester total: 6 crs + thesis	Out of area course INEL 5995/6995 Special topics course THESIS Semester total: 6 crs + thesis
Fourth (Spring)	THESIS Semester total: 6 crs (Thesis)	THESIS Semester total: 6 crs (Thesis)