University of Puerto Rico at Mayagüez
College of Engineering
Department of Electrical and Computer Engineering

COURSE SYLLABUS

1. General Information:

Course Number: INEL 6079
Course Title: ADVANCED IC DESIGN TECHNIQUES
Credit-Hours: 3

2. Course Description:

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.

3. Pre/Co-requisites:

INEL 4202, or INEL-5265, or equivalent.

4. Textbook, Supplies and Other Resources:

Textbook: Instructor Notes

References

1- J. Rabaey, A. Chandrakasan, and B. Nikolic, "Digital Integrated Circuits: A Design Perspective", 2ndk. Edition, Prentice Hall-Pearson Education, Inc., 2003
2- Gray, Hurst, Lewis, and Meyer, "Analysis and Design of Analog Integrated Circuits", 4th. Edition, John Whiley & Sons, Inc., 2001
3- B. Razavi, "Design of Analog CMOS Integrated Circuits", McGraw-Hill, Inc., 2001
4- K. Granzow, "Digital Transmission Lines: Computer Modeling and Analysis", Oxford University Press, Inc., 1998
5- H. Haznedar, "Digital Microelectronics", The Benjamin Cummings Pub. Co. 1991.
6- H. Ott, "Noise Reduction Techniques in Electronic Systems", Second Edition, John Wiley & Sons, Inc., 1988
7- J. Rabaey and M. Pedram, "Low Power Design Methodologies", Kluwer Academic Publishers, 1996
8- De Micheli, "Synthesis and Optimization of Digital Circuits", Mc. Graw Hill, Inc. 1994.
9- Baker et al., "CMOS: Circuit Design, Layout, and Simulation", IEEE Press, 1998.
10- Technical papers from journals and conferences in Circuits and Systems and Computer Aided Design of Electronic Circuits.

5. Purpose:

This course is open to graduate level and senior year students in Electrical and Computer Engineering. 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.

6. Course Goals:

After completing this course, each student should be able to understand, recommend, and apply techniques for optimizing digital and analog electronic circuits. Students will also get in contact with contemporary research problems faced in the optimization of electronic circuits.

7. Requirements:

All students are expected to have basic notions on:

1- Circuit design techniques for analog and digital systems
2- Familiarity with VLSI design techniques
3- Spice circuit modeling and simulation
4- Development and programming of algorithms

8. Laboratory/Field Work (If applicable):

Students will be expected to use CAD tools on engineering workstations for class homework and to develop a class term paper.

9. Department/Campus Policies:

9a. **Class attendance:** Class attendance is compulsory. The University of Puerto Rico, Mayagüez Campus, reserves the right to deal at any time with individual cases of non-attendance. Professors are expected to record the absences of their students. Frequent absences affect the final grade, and may even result in total loss of credits. Arranging to make up work missed because of legitimate class absence is the responsibility of the student. (Bulletin of Information Undergraduate Studies, pp. 39 1995-96)

9b. **Absence from examinations:** Students are required to attend all examinations. If a student is absent from an examination for a justifiable reason acceptable to the professor, he or she will be given a special examination. Otherwise, he or she will receive a grade of zero of "F" in the examination missed. (Bulletin of Information Undergraduate Studies, pp. 39, 1995-96)

9c. **Final examinations:** Final written examinations must be given in all courses unless, in the judgment of the Dean, the nature of the subject makes it impracticable. Final examinations scheduled by arrangements must be given during the examination period prescribed in the Academic Calendar, including Saturdays. (see Bulletin of Information Undergraduate Studies, pp. 39, 1995-96).

9d. **Partial withdrawals:** A student may withdraw from individual courses at any time during the term, but before the deadline established in the University Academic Calendar. (see Bulletin of Information Undergraduate Studies, pp. 37, 1995-96).

9e. **Complete withdrawals:** A student may completely withdraw from the University of Puerto Rico, Mayagüez Campus, at any time up to the last day of classes. (see Bulletin of Information Undergraduate Studies, pp. 37, 1995-96).

9f. **Disabilities:** All the reasonable accommodations according to the Americans with Disability Act (ADA) Law will be coordinated with the Dean of Students and in accordance with the particular needs of the student.

9g. **Ethics:** Any academic fraud is subject to the disciplinary sanctions described in article 14 and 16 of the revised General Student Bylaws of the University of Puerto Rico contained in Certification 018-1997-98 of the Board of Trustees. The professor will follow the norms established in articles 1-5 of the Bylaws.

10. Campus Resources (If applicable):

Engineering workstations and CAD tools necessary in the elaboration of homework and term papers are located in S-201 (Integrated Circuits Design Laboratory -- ICDL).

11. General Topics:

No.	Topic	Lectures[1]
Part I	**MODELING AND ANALYSIS OF NOISE IN ANALOG CIRCUITS**	**16**
1.	Introduction to Electronic Noise	1
2.	Sources of Electronic Noise	2
3.	Noise Models for IC Components	2
4.	Circuit Noise Calculations	2
5.	Equivalent Input Noise Generators	2
6.	SPICE Models for Electronic Noise Analysis	1
7.	Effect of Feedback on Noise Performance	2
8.	Noise Performance in Amplifier Circuits	2
9.	Noise Metrics	2
Part II	**MODELING AND ANALYSIS OF NOISE IN DIGITAL CIRCUITS**	**12**
10.	Introduction to Noise in Digital Systems	1
11.	Topics on Digital Transmission Lines	2
12.	Transmission-Line Effects in Digital Circuits	2
13.	SPICE Model for Digital Transmission Lines	1
14.	Crosstalk Analysis	2
15.	Electromagnetic Interference (EMI)	2
16.	Power Supply Noise	1
17.	Techniques for Noise Reduction in Digital Systems	1
Part III	**POWER ESTIMATION AND REDUCTION TECHNIQUES**	**12**
18.	Analysis of Power Dissipation Mechanisms in Digital Circuits	2
19.	Power Estimation in IC Design	3
20.	Power Management & Reduction Techniques in Digital Systems	2
21.	High-Level Low-Power Design Techniques for Digital Circuits	2
22.	Power Considerations in Circuit Reliability	1
23.	Layout Design Considerations in Circuit Performance and Power Dissipation	2
Part IV	**STUDENT DELIVERED LECTURES**	**5**
	Technical Paper Analysis	1
	Term Paper Presentations	3
	Test	1

[1] Based on 1-hour lectures. Adjustments made for Tue/Thr 90-minute lectures.