Appendix G: Syllabuses of Existing Courses

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 5029
Course Title: TELECOMMUNICATIONS ELECTRONICS
Number of credits: 3
Contact Period: Two hours of lecture per week and one two-hour laboratory per week

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 telecomunicaciones.

3. Pre/Co-requisites and other requirements:

Prerequisites: INEL 4301, INEL 4201, and INEL 4152 or Permission of the Director

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:

Applied Electromagnetics Laboratory and standard lecturing facilities

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
Exams	3
Total hours: (equivalent to contact period)	60

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: Lab work**		**20**
TOTAL:		**100%**

10. Bibliography:

1. Practical RF Circuit Design for Modern Wireless Systems vol I, Besser and Gilmore, Artech House, 2003
2. Practical RF Circuit Design for Modern Wireless Systems vol II, Gilmore and Besser, Artech House, 2003
3. Microwave Circuit Design Using Linear and Nonlinear Techniques, Vendelin, Pavio and Rohde, John Wiley and Sons, 2005
4. Introduction to Microwave Circuits: Radio Frequency and Design Applications (IEEE Press Series on RF and Microwave Technology), Robert J. Weber, John Wiley & Sons, 2001
5. Microwave and Rf Design of Wireless Systems by David M. Pozar, John Wiley & Sons, 2000

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 (Chemistry Building, room 019) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258.

Person who prepared this description and date of preparation:

Rafael Rodríguez, August 2007

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 5046
Course Title: Pattern Recognition
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: An introduction to the field of Pattern Recognition: statistical decision making, non-parametric decision making, clustering, artificial neural networks, learning techniques, evaluation of classification rules and image analysis.

Spanish: Una introducción al área de reconocimiento de patrones, incluyendo evaluación de decisiones estadísticas, evaluación de decisiones no-paramétricas, redes neuronales, técnicas de aprendizaje, evaluación de reglas de clasificación y análisis de imágenes.

3. Pre/Co-requisites and other requirements:

ININ 4010 and INEL 4301 or Permission of the Director

4. Course Objectives:

After completing the course, the student should be able to: classify data using parametric, non-parametric and neural network methods, cluster data, design a pattern recognition based algorithms to analyze data.

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. Access to data sets available over the internet. Standard lecturing facilities.

7. Course time frame and thematic outline

Outline		Contact Hours
1.	Introduction	2
2.	Probability Review	2
3.	Bayesian Decision Theory	6
4.	Parameter Estimation	4
5.	Non-Parametric Decision Making	5
6.	Linear Discriminant Functions	4
7.	Artificial Neural Networks	6
8.	Unsupervised Learning and Clustering	5
9.	Applications	5

10. Advanced Topics	5
11. Exams	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**	**varies**	**10**
☒ **Oral Reports**	**1**	**5**
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**25**
☐ **Journals**		
☒ **Other, specify: Homework**	**varies**	**10**
TOTAL:		**100%**

10. Bibliography:

1. S. Theodoridis and K. Koutroumbas, Pattern Recognition, 3rd edition, Academic Press, 2006.
2. A.R. Webb, Statistical Pattern Recognition, 2nd edition, Wiley, 2002.
3. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006
4. W. Gibson, Pattern Recognition, Berkley, 2005
5. R.O. Duda, P.E. Hart and D.G. Stork, Pattern Classification, 2nd edition, John Wiley and Sons, 2000.

11. According to Law 51

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Person who prepared this description and date of preparation:

Vidya Manian, August 2007

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 5205
Course Title: Instrumentation
Number of credits: 3
Contact Period: 3 hours of lecture per week

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. Control Systems laboratory in S-214.

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

	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:

1. R.B. Northrop, Introduction to Instrumentation and Measurements, Second Edition, CRC Press, 2005
2. W.C. Dunn, Introduction to Instrumentation, Sensors, And Process Control (Artech House Sensors Library), Artech House Publishers, 2005
3. C.D. Johnson, Process Control Instrumentation Technology, 7th Ed., Prentice-Hall, New Jersey, 2003.
4. S.A. Dyer, Wiley Survey of Instrumentation and Measurement, Wiley-IEEE Press, 2001
5. A.S. Morris, Measurement and Instrumentation Principles, Third Edition, Butterworth-Heinemann, 2001

11. According to Law 51

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Person who prepared this description and date of preparation:

Eduardo Juan, August 2007

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 5206
Course Title: Digital Systems Design
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: Design methods in combinational and sequential systems; use of programmable logic devices in digital systems design. Analysis and design of system controllers.

Spanish: Métodos de diseño utilizados en el diseño de sistemas combinacionales y secuenciales. Utilización de dispositivos lógicos programables en el diseño de sistemas digitales. Análisis y diseño de controladores de sistemas.

3. Pre/Co-requisites and other requirements:

INEL4207

4. Course Objectives:

Upon completion of the course the student should be able to

- Design combinatorial and sequential digital systems to meet a set of requirements using different technologies.
- Analyze and design system controllers

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
Introduction to system controllers, design procedures	2
Use of MDS diagrams for system specification	4
System controller design	8
Use of decoders and multiplexers in system controller design	4
Combinational design with ROMs.	2
Combinational design with programmable logic devices (PLD).	2
Use of ROMs in controller design	2
Use of PLDs in controller design	4

Design of system controllers based on shift registers and counters.	4
Introduction to asynchronous machines	2
Design of asynchronous machines.	3
Design of digital systems based on asynchronous controllers	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**	**25**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**25**
☐ **Journals**		
☐ **Other, specify:**		
TOTAL:		**100%**

10. Bibliography:

1. A. Saha and N. Manna, Digital Principles and Logic Design, Infinity Science Press, 2007
2. G. Boriello and R.H. Katz, Contemporary Logic Design, Prentice Hall, 2005
3. B. Holdsworth, C. Woods, Digital Logic Design, Fourth Edition, Newnes, 2002
4. A.B. Marcovitz and A. Marcovitz, Introduction to Logic Design with CD ROM, McGraw Hill, 2004
5. N. Balabanian and B. Carlson, Digital Logic Design Principles, John Wiley & Sons, 2000

11. According to Law 51

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Person who prepared this description and date of preparation:

Gladys Ducoudray, August 2007

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 5207
Course Title: Analog Design with Operational Amplifiers and Integrated Circuits
Number of credits: 3
Contact Period: 3 hours of lecture per week

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 está 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, voltages de referencia, convertidores A-D y D-A, amplificadores logarítmicos, PLLs y filtros análogos.

3. Pre/Co-requisites and other requirements:

INEL 4202

4. Course Objectives:

Design and analyze analog integrated circuits for different 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:

1- Seminar on Cadence Tools for simulation modeling and layout.
2- Account on ICDL server for simulation purposes.

7. Course time frame and thematic outline

Outline	Contact Hours
1. Course Introduction	2
2. Operational Amplifier (OA) Fundamentals	2
3. Examples of Linear OA Circuits	3
4. Examples of Non-linear OA Circuits	2

5. OA Limitations	5
6. Stability and Frequency Compensation	3
7. Noise	3
8. Current-feedback amplifiers	3
9. OA Building Blocks and Analog Integrated Circuits a) Active filters types and design methods b) Signal generator c) Voltage references d) D/A and A/D Converters e) Logarithmic Amplifiers f) Phase-lock loops	22
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**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**25**
☐ **Journals**		
☐ **Other, specify:**		
TOTAL:		**100%**

10. Bibliography:

1. S. Franco, DESIGN WITH OPERATIONAL AMPLIFIERS AND ANALOG INTEGRATED CIRCUITS, Third Edition, McGraw-Hill, 2001
2. P.R. Gray, P.J. Hurst, S.H. Lewis, R.G. Meyer, Analysis and Design of Analog Integrated Circuits, 4th Edition, John Wiley, 2001
3. Yannis Tsividis, Mixed Analog-Digital VLSI Device and Technology, World Scientific Publishing Company, November 2002.
4. Willy M.C. Sansen, Analog Design Essentials, Springer Verlag, 2006.
5. Marc Thompson, Intuitive Analog Circuit Design, Newnes 2006

11. According to Law 51

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Person who prepared this description and date of preparation:

Manuel Toledo, August 2007

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

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 isues involved in the layout and test of analog IC's.

Spanish: Análisis y Diseño de circuitos analógicos y de tecnología mixta (analófico-digital) mediante el uso de técnicas de diseño análiticas 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 types 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:

1- Seminar on Cadence Tools for simulation modeling and layout. 8hrs
2- Seminar on Mixed Signal Testing. 5hrs.
3- Account on ICDL server for simulation purposes.

7. Course time frame and thematic outline

Outline	Contact Hours
Models for IC devices large Signal small signal.	8
Model considerations in evolving technological trends.	3
Introduction to CAD tools for analog design: Set up, schematic	8

drawing, symbol and subcircuit creation, simulation, layout, extraction, Prep for fabrication and DFT	
Concepts of analog layout, Bipolar, MOS, and BiCMOS technologies.	2
Basic integrated circuit amplifiers: Darlington, differential pairs, and cascode configutations.	3
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. Seminars on Mixed Signal Test Design Tests	2 5 4
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**		
☒ **Oral Reports**	**1**	**25%**
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**25%**
☐ **Journals**		
☐ **Other, specify:**		
TOTAL:		**100%**

10. Bibliography:

1. Design of Analog CMOS Integrated Circuits, by Behzad Razavi, McGraw Hill, 2000
2. Analysis and Design of Analog Integrated Circuits, by P R Grey, PJ Hurst, S H Lewis, RG Meyer, 4th Edition, John Wiley and Sons,2003
3. CMOS Mixed Signal Circuit Design, by L. Baker, Wiley-IEEE Computer Society, 2003
4. Principles of Cmos Vlsi Design, by Neil H. E. Weste, Kamran Eshraghian, Second Edition, Pearson Education, 2000
5. Analog Circuit Design, by Johan H. Huijsing, Michiel Steyaert,, van Roermund Arthur H. M., Arthur H. Van Roermund, Kluwer Academis Publishers,2005

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 5305
Course Title: ANTENNA THEORY AND DESIGN
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: Radiation mechanisms, radiation patterns. Impedance concepts. Wire antennas. Antenna arrays. Frequency independent antennas. Aperture antennas. Antenna measurements and design.

Spanish: Mecanismo de Radiación. Tipos de Antenas; Impedancia; Patrones de Radiación; Antenas Múltiples. Mediciones en Antenas.

3. Pre/Co-requisites and other requirements:

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:

Software packages to design and analyze Antennas.

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 and Reflector antennas	5
Microstrip patches	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**	**25**
☒ **Short Quizzes**		**5**
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**10**
☐ **Journals**		
☐ **Other, specify:**		
TOTAL:		**100%**

10. Bibliography:

1. C.A. Balanis (2005), Antenna Theory, Analysis and Design. 3rd Edition. NY, NY: John Wiley and Sons.
2. Kraus & Marhefka (2003), Antennas, 2nd edition, McGraw Hill
3. W.L. Stutzman (2003), Antenna Theory and Design, 2nd edition, John Wiley & Sons
4. P. Russer (2006), Electromagnetics, Microwave Circuit, And Antenna Design for Communications Engineering, Second Edition (Artech House Antennas and Propagation Library), Arthech House
5. R.S. Elliott (2003), Antenna Theory & Design, Wiley-IEEE Press

11. According to Law 51

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Person who prepared this description and date of preparation:

José Colom, August 2007

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 5306
Course Title: Microwave Engineering
Number of credits: 3
Contact Period: 3 hours of lecture

2. Course Description:

English: Rectangular and circular waveguides; passive components; tubes and solid state devices used in microwave systems

Spanish: Guías de ondas rectangulares y circulares; componentes, tubos y dispositivos de estado sólido usados en sistemas de microondas.

3. Pre/Co-requisites and other requirements:

INEL 4152 – Electromagnetics II

4. Course Objectives:

This course is intended to provide 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:

Software packages to design and analyze microwave circuits. HP Advanced Design System (ADS) is available for the students.

7. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

8. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**2**	**50**
☒ **Final Exam**	**1**	**25**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☐ **Projects**		
☐ **Journals**		

	☒**Other, specify: Assigned problems**	**6-8**	**25**
	TOTAL:		**100%**

9. Bibliography:

Textbook: David M. Pozar, *Microwave Engineering. John Wiley and Sons Inc.* 3rd Edition, 2005

References:

1. Robert Collin, *Foundations for Microwave Engineering, IEEE Press Series*, 2nd Edition 2000.
2. Joseph White, *High Frequency Techniques:Introduction to RF and Microwave Engineering, Noble Publishing*, 2004
3. David Davidson, *Computational Electromagnetics for RF and Microwave Engineering*, Cambridge, 2005.
4. G.D. Vandelin, A.M. Pavio, U.L. Rohde, *Microwave Circuit Design Using Linear and Non Linear Techniques*, Springer-Verlag, 2005.
5. Guillermo Gonzalez, *Microwave Transistor Amplifiers Analysis and Design*, Prentice Hall, 1997.

10. According to Law 51

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13 Course time frame and thematic outline:

Outline	Contact 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 classes),	4
Microwave Systems	2
Exams	2
Total Hours	45

Person who prepared this description and date of preparation:

Jose G. Colom, November 2006.

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 5307
Course Title: OPTICAL COMMUNICATIONS
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: Optical communication principles; transmitter and receiver design; fiber optic channels.

Spanish: Principios de comunicación óptica; diseño de transmisores y receptores; canales de fibras ópticas.

3. Pre/Co-requisites and other requirements:

INEL 4301 E 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:

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

7. Course time frame and thematic outline

Outline	Contact Hours
Fiber optic communication 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)	45

8. Grading System

☐ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	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:

Fiber Optic Communications , Joseph C. Palais Fifth ed. 2005, Prentice Hall

Reference:

1- James N. Downing, Fiber Optic Communications, Thomson Delmar Learning, 2005
2-Keang-Po Ho, Phase-Modulated Optical Communication Systems, Springer, 2005
3- J.K. Shaw, Mathematical Principles of Optical Fiber Communications, SIAM Books, 2004
4-A.J. Rogers, Understanding Optical Fiber Communications, Artech House, 2001
5-H. T. Mouftah, Jun Sheng, Optical WDM Networks: Concepts and Design Principles, IEEE Press, 2004

11. According to Law 51

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Person who prepared this description and date of preparation:

Hamed Parsiani, August 2007

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 5309
Course Title: DIGITAL SIGNAL PROCESSING
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: Signal classification; Z-Transform and discete fourier transform; matrix representation of digital filters and digital systems; digital filter design; discrete Fourier transform algorithms.

Spanish: Clasificación de señales, transformada Z y transformada de Fourier discreta; representación de filtros y sistemas digitales usando matrices; diseño de filtros digitales; algoritmos para la transformada de Fourier discreta.

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:

Standard lecturing facilities, MATLAB Software, and S-222 DSP Laboratory facilities for demonstrations.

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

	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:

1. S. Mitra, "Digital Signal Processing: A Computer Based Approach," McGraw Hill 3rd ed. 2006.
2. V. K. Ingle, J.G. Proakis, Digital Signal Processing using MATLAB, Engineering – Nelson, 2006
3. J.G. Proakis, D.G. Manolakis, Digital Signal Processing, Prentice Hall, March 2006.
4. J. Kronenburger, J. Sebeson, Digital Signal Processing, Thomson Delmar Learning, 2007
5. S.K. Mitra, Digital Signal Processing: A Computer Based Approach, McGraw-Hill, 2005
6. A. Oppenheim, R. Schafer, J. Buck, Discrete time Signal Processing, Prentice Hall 1999.

11. According to Law 51

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Person who prepared this description and date of preparation:

Shawn D. Hunt, August 2007.

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 5315
Course Title: Theory of Communications II
Number of credits: 3
Contact Period: 3 hours of lecture

2. Course Description:

English: Information Theory; Coding Theory; Signal Design; Noise and Probability Theory.

Spanish: 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:

Standard lecturing facilities and MATLAB software.

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	6
Elements of information theory: Entropy and information. Source-coding theorem. Data compaction.	7

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 codes.Trellis-coded modulation	9
Error-control coding: Introduction to compound codes (Turbo codes)	2
Baseband and passband digital transmission	3
Spread-spectrum modulation	1
Exams	2
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**	**10**
☐ **Journals**		
☒ **Other, specify: Take-home problems**	**2-4**	**15**
TOTAL:		**100%**

10. Bibliography:

1. Mc. Eliece R. J. (2002). The theory of information and coding (2nd edition). Cambridge.
2. Simon Haykin (2000). Communication systems (4th edition). Wiley.
3. Tse D. and P. Viswanath (2005). Fundamentals of wireless communications. Cambridge.
4. Yeung, R. E (2006). A first course in information theory: information technology: Transmission, Processing and Storage. Springer.
5. Ziemer, R.E., and W.H. Tranter (2001) Principles of communications: systems modulation and noise (5th edition).Wiley.

11. According to Law 51

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Person who prepared this description and date of preparation:

Henrick M. Ierkic, August 2007.

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 5316
Course Title: Wireless Communications
Number of credits: 3
Contact Period: 3 hours of lecture

2. Course Description:

English: Study of cellular radio and personal wireless communications, multiple access techniques for the efficient use of the radio spectrum, and wide-area wireless systems. Description of some wireless systems. Description of some wireless systems and their standards. Effects of EM radiation on health. Development of modulation and diversity methods to facilitate signal transmission and to improve quality of reception.

Spanish: Estudio sobre las celdas de radio, las comunicaciones inalámbricas personales, las técnicas de acceso múltiple para el uso eficiente del espectro de radio y los sistemas de comunicaciones móviles de amplia cobertura. Descripción de algunos sistemas inalámbricos y sus normas. Efectos de la radiación electromagnética sobre la salud. Desarrollo de métodos de modulación y de diversidad para facilitar la transmisión de la señal y para mejorar la calidad de la recepción.

3. Pre/Co-requisites and other requirements:

INEL 4301, and INEL 4152

4. Course Objectives:

After this course the student should be able to describe problems associated with the design of a wireless communication system; explain propagation models to account for large-scale and short-scale (fading) variations of the signal intensity; describe basic modulation schemes; describe diversity, channel coding, and multiple access techniques for wireless communications; recognize wireless networking, and wireless systems and standards and the importance of: the agencies charged with promoting the vitality of telecommunications in the USA; 1996 telecommunications law, health issues associated with electromagnetic fields; describe 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 and/or Colleagues (if available).

6. Minimum or Required Resources Available:

Standard lecturing facilities.

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	12
Mobile radio propagation for large scales. Reflection. Diffraction. Outdoor and indoor propagation models.	9
Mobile propagation for small scales. Multipath channel. Parameters. Measurements. Types of fading. Statistical models for fading channels.	10
Modulation techniques for mobile radio	3
Diversity and channel coding	2
Multiple access techniques for wireless communications	1
Wireless networking	1
Wireless systems and standards	1
Exams	2
Total hours: (equivalent to contact period)	45

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**2**	**55**
☒ **Final Exam**	**1**	**35**
☐ **Short Quizzes**		
☒**Oral Reports**	**1**	**5**
☐ **Monographies**		
☐ **Portfolio**		
☐ **Projects**		
☐**Journals**		
☒**Homework, Seminar**	**2-4**	**5**
TOTAL:		**100%**

10. Bibliography:

1. *Andrea Goldsmith* (2005).Wireless communications. Cambridge University Press
2. *David Tse, Pramod Viswanath* (2005). Fundamentals of Wireless Communications. Cambridge University, Press.
3. *Andreas F. Molisch* (2005). Wireless Communications. John Wiley and Sons.
4. *William Stallings* (2004), Wireless Communications & Networks, Prentice Hall
5. *Todor Cooklev (2004),* Wireless Communication Standards: A Study of IEEE 802.11, 802.15, and 802.16, Standards Information Network/ IEEE Press
6. *IEEE Standards*: http://ieeexplore.ieee.org/xpl/standards.jsp

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Person who prepared this description and date of preparation:

Henrick M. Ierkic, August 2007.

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 5325
Course Title: COMMUNICATION SYSTEM DESIGN: CIRCUITS AND ANTENNAS
Number of credits: 3
Contact Period: 1 hour of lecture plus 2 sessions of 2 hours of lab per week

2. Course Description:

English: Design of communication circuits and antennas. Several design projects including; specification, evaluation and selection of alternatives and implementation. Written reports and computer use required.

Spanish: Diseño de circuitos de comunicaciones y antenas. Varios proyectos de diseño que incluyen: especificación, evaluación y selección de alternativas e implantación. Se reqieren informes escritos y uso de computadora.

3. Pre/Co-requisites and other requirements:

INEL 5305, INEL 5316 and (INEL 5306 or INEL 5029)

4. Course Objectives:

After completing the course, students should be able to design several circuits and system components, and to select appropriate components and methods for the integration in a communication system, within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

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: oral presentation of a design project.

6. Minimum or Required Resources Available:

Network analyzer, spectrum analyzer, signal generators and other microwave equipment. Use of commercial communication systems and several software packages.

7. Course time frame and thematic outline

Outline	Contact Hours
Labs and field experiments with commercial equipment	30
Review of courses of the Applied EM option.	5
Project specifications, FCC, ITU-R,IEEE regulations and standards	5
Use of software packages (i.e.,Radio Mobil) for system design	5
Use of Matlab to simulate signals and determine link reliability	5

Identify providers and cost of required equipment and components	5
Discussion of project design, and of the state of the art and future trends of telecommunication systems	15
Design project oral presentations and exams	5
Total hours: (equivalent to contact period)	75

8. Grading System

☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**2**	**33.33%**
☐ **Final Exam**		
☐ **Short Quizzes**		
☒ **Oral Reports**	**1**	**33.33%**
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**33.33%**
☐ **Journals**		
☐ **Other, specify:**		
TOTAL:		**100%**

10. Bibliography:

1. Barry Hyman (2003), Fundamentals of Engineering Design, Prentice Hall, Second Edition
2. Tse, David&Viswanath, Pramod (2005), Wireless Communication, New York, NY, Cambridge University Press.
3. R.J. Weber (2001), Introduction to Microwave Circuits: Radio Frequency and Design Applications (IEEE Press Series on RF and Microwave Technology), John Wiley
4. Ulrich L. Rohde and David P. Newkirk (2000), RF/Microwave Circuit Design for Wireless Applications, Wiley Intersciences.
5. P. Russer (2006), Electromagnetics, Microwave Circuit, And Antenna Design for Communications Engineering, Second Edition (Artech House Antennas and Propagation Library), Arthech House

11. According to Law 51

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Prepared by Rafael Rodríguez, August 2007

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: INEL5326
Course Title: Communication Systems Design:Digital Signal Processing
Number of credits: 5
Contact Period: 1 hour lecture, 4 hours laboratory per week

2. Course Description:

English: Capstone course in which student teams design a project to solve a complete Communication or Signal Processing Engineering Problem considering engineering standards and realistic constraints.

Spanish: Curso integrador en la cual equipos de estudiantes diseñan un proyecto para resolver un problema completo de Ingeniería en comunicaciones o prosesamiento de señales, tomando en consideración estándares de ingeniería y restricciones realistas.

3. Pre/Co-requisites and other requirements:

INEL5309 or INEL 5315

4. Course Objectives:

After completing the course, students should understand and be able to manage different aspects of the design of a communication or signal processing system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

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:

Signal Processing Laboratory in S-222

7. Course time frame and thematic outline

Outline	**Contact Hours**
Introduction to desig	15
Introduction to proposal preparation	3
Ethics Seminar	2
Guidelines for Literature Review	3
Revision, discusion and update of proposals	8
Algorithm Design, Testing and implementation	30
Design process	4
Periodic and Final Project Presentations	10
Total hours: (equivalent to contact period)	75

8. Grading System

☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☐ **Exams**		
☐ **Final Exam**		
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☐ **Projects**		
☐ **Journals**		
☒ **Other, specify: Written reports, Demonstrations.**	**15**	**100**
TOTAL:		**100%**

10. Bibliography:

1. Barry Hyman, *Fundamentals of Engineering Design*, Prentice Hall, Second Edition, 2003
2. P. Gaydecki, *Foundations of Digital Signal Processing: Theory, Algorithms and Hardware Design*, Institution of Electrical Engineers, 2005
3. S. Mitra, *Digital Signal Processing: A Computer Based Approach*, McGraw Hill 3rd ed. 2006.
4. V. K. Ingle, J.G. Proakis, *Digital Signal Processing using MATLAB*, Engineering – Nelson, 2006
5. J.G. Proakis, D.G. Manolakis, *Digital Signal Processing*, Prentice Hall, March 2006.
6. J. Kronenburger, J. Sebeson, *Digital Signal Processing*, Thomson Delmar Learning, 2007
7. http://101science.com/dsp.htm
8. *IEEE Standards*: http://ieeexplore.ieee.org/xpl/standards.jsp
9. *InterNational Committee for Information Technology Standards (INCITS)*: http://www.incits.org/
10. *MPEG Standard*: http://www.chiariglione.org/mpeg/
11. *JPEG Standard*: http://www.jpeg.org/jpeg/
12. *ISO Standards*: http://en.wikipedia.org/wiki/Category:ISO_standards

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Prepared by Shawn Hunt, August 2007

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: INEL5327
Course Title: Image Processing
Number of credits: 3
Contact Period: 3 hours of lecture per week

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

4. Course Objectives:

At the end of the course, the student should be able to

- Describe the process of sensing, acquisition, sampling, and relationships in Digital images
- Describe relationships in Digital imaging
- Apply spatial transformations & spatial filters for image enhancement
- Apply frequency domain filters to smoothen & sharpen images
- Perform restoration of images affected by noise and sensor degradations
- Perform compression of images using different coding 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:

MATLAB Software with the Image Processing Toolbox

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	9
Image Compression	7
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**	**25**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**2**	**35**
☐ **Journals**		
☐ **Other, specify:**		
TOTAL:		**100%**

10. Bibliography:

Textbook:

Gonzalez/ Woods, Digital Image Processing, 2nd edition Addison Wesley, 2002

References:

1- Russ, J. C. The Image Processing Handbook, 5th ed.., CRC Press, 2006.
2- J.A. Richards, Xiuping Jia, Remote Sensing Digiatal Image Analysis: An Introduction 4th edition, Springer, 2006.
3-Scott E. Umbaugh, Computer Imaging: Digital Image Analysis And Processing, CRC Press Book 2005
4- Frederico Cao, Geometric Curve Processing and Image Processing, Springer 2003.
5- Tony F. Chan, Jianhong Shen, Image Processing and Analysis: Variational, PDE, Wavelet, and Stochastic Methods, SIAM Books, 2005

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 (Chemistry Building, room 019) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258.

Prepared by Hamed Parsiani, August 2007

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 5406
Course Title: DESIGN OF TRANSMISSION AND DISTRIBUTION SYSTEMS
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: Generation, Transmission, and distribution of electric power. Reliability; consumer services; overhead and underground lines.

Spanish: Generación, transmisión y distribución de energía eléctrica. Confiabilidad; servicio al consumidor; líneas aéreas y soterradas.

3. Pre/Co-requisites and other requirements:

Chairman Authorization.

4. Course Objectives:

The purpose of the course is to provide students a practical introduction to the design of transmission and distribution systems. This course is intended to provide junior- or senior-level electric power engineering majors an introduction to utility power transmission and distribution systems. Topics covered include tariffs and load characteristics, fundamentals of distribution systems, distribution transformer connections and loading, fundamentals of distribution system protection, distribution system voltage regulation, distribution system capacitor application, transmission line design considerations, substation design considerations, and electrical safety considerations. This is an upper-level course open to both undergraduate and graduate students

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
Tariffs & Load Characteristics	4.5
Fundamentals of Distribution Systems	3
Distribution Transformer Connections & Loading	3
Fundamentals of Distribution System Protection	6
Distribution System Voltage Regulation	4.5

Distribution System Capacitor Application	3
Transmission Line Design Considerations	7.5
Substation Design Considerations	7.5
Electrical Safety Considerations	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**	**25**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☐ **Projects**		
☐ **Journals**		
☒ **Other, specify: homework**	**Various**	**15**
TOTAL:		**100%**

10. Bibliography:

1. T.A. Short, 2003, Electric Power Distribution Handbook. Boca Raton, Florida: CRC Press.
2. W.H. Kersting, 2001, Distribution System Modeling and Analysis. Boca Raton, Florida: CRC Press.
3. A.J. Pansini, 2005, Power Transmission & Distribution, Second Edition, CRC Press.
4. T.A. Short, 2005, Electric Power Distribution Equipment and Systems, CRC Press.
5. C. Bayliss, 1999, Transmission and Distribution Electrical Engineering. Second Edition. Oxford, England: Elsevier. (classical textbook in the field)

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 (Chemistry Building, room 019) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258.

Person who prepared this description and date of preparation:

Dr. José R. Cedeño, August 2007

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 5408
Course Title: Electric Motors Control
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: 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.

Spanish: Carácterísticas y Criterios de Selección de Motores de Corriente Alterna (c.a.) y de Corriente Continua (c.c); Diseno y Control de Sistemas Motrices de Estado Solido; Métodos de Frenar; Computo de Calentamiento y Ciclo de Trabajo. Computo de Las Características de Funcionamiento y Diseño de Controladores de Lazo Cerrado.

3. Pre/Co-requisites and other requirements:

INEL4405, INEL4416 and INEL4505

4. Course Objectives:

After completing the course, students will be able to describe 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 characteristicss.

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 demonstrations of drive systems in power electronics laboratory S-101 and electric energy systems instrumentation laboratory S-103B

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	6
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**	**1**	**10**
☐ **Journals**		
☐ **Other, specify:**		
TOTAL:		**100%**

10. Bibliography:

Textbook: G.K. Dubey, 'Fundamentals of Electric Drives', CRC Press 2002

Bibliography:

1. J. Chiasson, Modeling and High Performance Control of Electric Machines, John Wiley, 2005
2. R. Krishnan, Electric Motor Drives, Prentice Hall, 2001
3. N. Mohan, Electric Drives: An Integrative Approach, MNPERE Press, 2000
4. M.A. El-Sharkawi, Fundamentals of Electric Drives, Brooks/Cole Publishing Company, 2000.
5. D.W. Novotny and T.A. Lipo, Vector Control and Dynamics of AC Drives, Oxford University Press, 1998. (Clasic textbook in AC drives control)
6. I. Boldea, A. Boldea, S.A. Nasar, Electric Drives, Second Edition, CRC Press, 2005.
7. Marian P. Kazmierkowski, Henryk Tunia, Automatic Control of Converter-Fed Drives, Elsevier Science, 2005
8. W. Leonhard, Control of Electrical Drives, Third Edition, Springer-Verlag New York, LLC, 2001

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 (Chemistry Building, room 019) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258.

Person who prepared this description and date of preparation:

Miguel Vélez-Reyes, August 2007

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 5415
Course Title: Power System Protection
Number of credits: 3
Contact Period: 3 hours per week

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:

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:

Standard lecturing facilities. Scientific calculator.

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

	Quantity	Percent
☐ **Exams**		
☐ **Final Exam**		
☒ **Short Quizzes**	**__7__**	**80%**
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**20%**
☐ **Journals**		
☐ **Other, specify: Homework**	**_____**	
TOTAL:		**100%**

10. Bibliography:

1. Elmore, W., Protective Relaying: Theory & Application (2nd Ed), Monticello, NY, Marcel Dekker, Inc., 2004
2. J.L. Blackburn, T.J. Domin, Protective Relaying: Principles and Applications, Third Edition, CRC Press, 2006
3. Blackburn, J. L., Protective Relaying: Principles & Applications (2nd Ed), Monticello, NY, Marcel Dekker, Inc., 1998
4. Donald Reimert, Protective Relaying for Power Generation Systems, CRC Press, 2005
5. Mason, C. R. The Art & Science of Protective Relaying, GE Publication, available at http://www.geindustrial.com/pm/notes/artsci/

11. According to Law 51

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Person who prepared this description and date of preparation:

José R. Cedeño, August 2007

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 5505
Course Title: LINEAR SYSTEM ANALYSIS
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: Linear spaces and matrices; state variable representation for linear continuous and discrete systems; the Z transform and its applications; controlability and observability; state estimators; stability.

Spanish: Espacios lineales y matrices; representaciones en términos de variables de estado para sistemas lineales continuos y discretos; la transformación Z y sus aplicaciones; controlabilidad y observabilidad; estimadores del estado; estabilidad.

3. Pre/Co-requisites and other requirements:

INEL 4505

4. Course Objectives:

At the end of the course the student should be able to

- derive state space representations for different physical dynamical systems,
- solve the linear time invariant (LTI) state equation using analytical methods based on Laplace and Z-transforms
- derive a linear state space representation by linearizing a nonlinear state space equation
- determine the system stability using the eigenvalues of the system matrix
- determine the observability and controllability of a linear LTI systems
- determine the system modes using the eigenvalues and eigenvectors of the system matrix
- explain the invariability properties of system modes
- study modal controllability and obsevability using different tests
- design simple state feedback laws using pole placement methodologies
- design simple observers using pole placement
- design simple observer-based state-feedback compensators
- implement simple state feedback controllers in the control systems laboratory

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 Control Systems Toolbox for analysis and design of control systems. Control Systems

laboratory in S-214 equipped with computers, interface cards, and model plants for laboratory exercises and projects.

7. Course time frame and thematic outline

Outline	Contact Hours
System classification and structures	2
Introduction to linear algebra	3
Mathematical description of systems and examples of physical systems	3
Analysis and solution of linear continuous system	3
Linearization of dynamical systems	2
Discrete time systems, difference equations, and the Z transform and its application	3
Discretization of continuous time systems	2
Stability of continuous and discrete time linear systems	6
Controllability and observability	6
State feedback an pole placement	9
State estimators	6
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**	**3-5**	**10**
TOTAL:		**100%**

10. Bibliography:

1. P.J. Antsaklis, and A.N. Michel, Linear Systems, Birkhauser, 2006.
2. P.J. Antsaklis, and A.N. Michel, A Linear Systems Primer, Birkhauser, 2007.
3. Robert L. Williams, II, Douglas A. Lawrence, Linear State-Space Control Systems, John Wiley, 2007.

Classical Textbooks:

4. Chen, C.T. Linear System Theory and Design, Oxford University Press, New York, 1999.
5. J.S. Bay, Fundamental of Linear State Space Systems, McGraw Hill, 1999.

11. According to Law 51

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Person who prepared this description and date of preparation:

Miguel Vélez-Reyes, August 2007

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 5506
Course Title: PROCESS INTRUMENTATION AND CONTROL ENGINEERING
Number of credits: 3
Contact Period: 3 hours of lecture per week

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 intrumentación analógica y digital y en mini o microcompuadoras. Enfasis en normas establecidas y consideraciones prácticas.

3. Pre/Co-requisites and other requirements:

INEL 4505 and INEL 4206

4. Course Objectives:

Design practical process instrumentation and control systems using computers and analog and/or digital instruments.
Select 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 available at the Control Systems Laboratory S-214.

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	10
Total hours: (equivalent to contact period)	45

8. Grading System

☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	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:

1. Johnson, CD, Process Control Instrumentation Technology, 7th Ed., Prentice Hall, New Jersey, 2003.
2. Berge, J., Fieldbuses for Process Control: Engineering, Operation and Maintenance, ISA - Instrumentation, systems and Automation, 2004.
3. Altmann, W., Practical Process Control for Engineers and Technicians, Newnes, 2005.
4. Bequette, B.W., Process Control: Modeling, Design and Simulation, Prentice Hall, 2002.
5. Smith, C.A., Corripio, A.B., Principles and Practices of Automatic Process Control 3rd Ed., Wiley, 2005.

11. According to Law 51

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Person who prepared this description and date of preparation:

Eduardo Juan, August 2007

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 5508
Course Title: Digital Control Systems
Number of credits: 3
Contact Period: 3 hours of lecture per week

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 pácticas 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.
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

	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:

1. C.L. Phillips, H.T. Nagle, Jr., Digital Control System Analysis and Design, 4th Edition, Prentice Hall, 2007.
2. G.F. Franklin, J.D. Powell, M.L. Workman, Digital Control of Dynamic Systems, 3rd. ed., Ellis-Kagle Press, 2006.
3. Ioan D. Landau and Gianluca Zito, Digital Control Systems: Design, Identification and Implementation, Springer, 2006.
4. Rolf Isermann, Digital Control Systems : Fundamentals, Deterministic Control (Volume 1), Springer, 2000.
5. K.J. Astrom, B. Wittenmark, Computer-Controlled Systems: Theory and Design, 3rd. Ed., Prentice-Hall, 1997. (Classical textbook in the area)

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 (Chemistry Building, room 019) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258.

Person who prepared this description and date of preparation:

Gerson Beauchamp, August 2007

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 5516
Course Title: AUTOMATION AND ROBOTICS
Number of credits: 3
Contact Period: 3 hours of lecture per week

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.

4. Course Objectives:

After completing the course, the student should be able to describe, 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:

Standard lecturing facilities and the Robotics Laboratory in S-102. Laboratory is equipped with robotic arms, programmable controllers, pneumatic equipment, electromechanical actuators and other components used in project preparation.

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	5

motors	
Pneumatic systems: compressors, valves, cylinders, and air preparation devices	4
Programmable controllers	17
Robotics	12
Exams	1
Total hours: (equivalent to contact period)	45

8. Grading System

☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	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:

- J.A. Rehg, Introduction to Robotics in CIM Systems, Fifth Edition, Prentice Hall, 2003
- J.A. Rehg, Glenn J. Sartori, Programmable Logic Controllers, Prentice Hall 2006
- W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Third Edition, Prentice Hall, 2003
- M.P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, Third Edition, Prentice Hall, 2008.
- Igor Lazar Krivtsun, German V. Krejnin, Pneumatic Actuating Systems for Automatic Equipment: Structure and Design, CRC Press, 2006.

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 (Chemistry Building, room 019) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258.

Person who prepared this description and date of preparation:

Raúl Torres, August 2007

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 5995
Course Title: SPECIAL PROBLEMS
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: Investigations or special problems in electrical engineering or related fields. Open to outstanding electrical engineering students.

Spanish: Investigación o problemas especiales de ingeniería eléctrica y ramas afines. abierto a estudiantes sobresalientes de ingeniería eléctrica.

3. Pre/Co-requisites and other requirements:

Chairman authorization.

4. Course Objectives:

Depend on the problems or topics being studied.

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 journals and other serial publications in the library. Other resources depend on the problems or topics being studied.

7. Course time frame and thematic outline

Depend on the problems or topics being studied.

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

Depend on the problems or topics being studied. It could include: proposal, reports, oral presentations, and exams.

10. Bibliography:

Depend on the assignment

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 (Chemistry Building, room 019) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258.

Person who prepared this description and date of preparation:
Miguel Vélez-Reyes, August 2007

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
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:

H. Khalil, Nonlinear Systems, 3rd Edition, Prentice Hall, 2001.

H.J. Marquez, Nonlinear Control Systems: Analysis and Design, Wiley, 2003.

W.E. Dixon, S. Nagarkatti, D. Dawson, A. Behal, Nonlinear Control of Engineering Systems: A Lyapunov-Based Approach, Birkhäuser Boston, 2003.

Classical textbooks still among the best in the subject:

A. Isidori, Nonlinear Control Systems II, Third Edition, Springer-Verlag, 1999.

S. Sastry, Nonlinear Systems: Analysis, Stability, and Control, Springer-Verlag, 1999.

M. Vidyasagar, Nonlinear Systems Analysis, Second Edition, Prentice Hall, 1993

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 (Chemistry Building, room 019) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258.

Person who prepared this description and date of preparation:

Miguel Vélez-Reyes, August 2007

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:

1. F.L. Lewis and V.L. Syrmos, Optimal Control, 2nd Ed., Wiley-Interscience, 1995. (Clasical textbook)
2. B.D.O. Anderson and J.B. Moore, Optimal Control: Linear Quadratic Methods, Dover Publications, 2007.
3. M. Athans and P.L. Falb, Optimal Control: An Introduction to the Theory and its Applications, Dover Publications, 2006.
4. C.T. Chen, Linear System Theory and Design, 3rd Ed., Oxford University Press, New York, 1999.
5. R.L. Williams, II, Douglas A. Lawrence, Linear State-Space Control Systems, John Wiley, 2007.

11. According to Law 51

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Person who prepared this description and date of preparation:

Gerson Beauchamp, August 2007

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:

1. M.J. Canty, Image Analysis, Classification and Change Detection in Remote Sensing with Algorithms for ENVI/IDL, CRC Press, 2007.
2. F.D. van der Meer and S.M. de Jong, Remote Sensing Analysis: Including the Spatial Domain, Springer, 2006.
3. L.L. Richardson and E.F. LeDrew, Remote Sensing of Aquatic Coastal Ecosystems Processes, Springer, 2006.
4. J.A. Richards and X. Jia, Remote Sensing Digital Image Analysis, 4th Edition, Springer Verlag, 2005.
5. D.A. Landgrebe, Signal Theory Methods in Multispectral Remote Sensing, John Wiley &

Sons, 2003.
6. F.D. van der Meer and S.M. de Jong, Imaging Spectrometry: Basic Principles and Prospective Applications, Kluwer Academic Publishers, 2003.

11. According to Law 51

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Person who prepared this description and date of preparation:

Miguel Vélez-Reyes, August 2007

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:

1. William Stallings, Computer Organization and Architecture, (sixth edition), Prentice Hall, 2002.
2. Hennessy J. and Patterson, David A., Computer Architecture: A Quantitative Approach (3rd Edition) Morgan Kaufmann, 2002.
3. Hamacher, V.C., et. al, Computer Organization (fifth edition), McGraw –Hill, 2001.
4. Miles J. Murdocca & Vincent P. Heuring, Principles of Computer Architecture, Prentice Hall, 2000
5. Hesham El-Rewini and Mostafa Abd-El-Barr, Advanced Computer Architecture and Parallel Processing, Wiley-Interscience, 2005

11. According to Law 51

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Person who prepared this description and date of preparation:

Nestor Rodríguez, August 2007

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:

1. M. R. Patel. Wind and Solar Power Systems: Design, Analysis and Operation, CRC Press, 2006.
2. S. Heier. Grid Integration of Wind Energy Conversion Systems, Wiley, 2006.
3. J. A. Duffie and W. A. Beckman. Solar Engineering of Thermal Processes, Wiley, 2006.
4. Photovoltaics Design And Installation Manual: Renewable Energy Education for a Sustainable Future by "Solar Energy International", Berkley Press, 2004.
5. J. Brooke. Wave Energy Conversion, Elsevier Ocean Engineering Series, 2003.
6. Vaclav Smil, Energy at the Crossroads : Global Perspectives and Uncertainties, 2003.
7. International Energy Agency, Renewables for Power Generation -- Status & Prospects, OECD, 2003.
8. C. Humphrey, T. Lewis, F. Buttel, Environment, Energy and Society: A New Synthesis, Wadsworth, 2003.

11. According to Law 51

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Person who prepared this description and date of preparation:

Agustín Irizarry, August 2007

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:

1. D. Dumitrescu, "Evolutionary Computation", CRC Press, 2000.
2. T. Bäck, D.B. Fogel, and T. Michalewicz (Editors), "Evolutionary Computation 1: Basic Algorithms and Operators", Institute of Physics Publishing, 2000.
3. T. Bäck, D.B. Fogel, and T. Michalewicz (Editors), "Evolutionary Computation 2: Advanced Algorithms and Operators", Institute of Physics Publishing, 2000.
4. Ruhul Sarker, Masoud Mohammadian, and Xin Yao, Evolutionary Optimization, Springer, 2002.
5. J.A. Momoh, Electric Power System Applications of Optimization, CRC Press, 2001.

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Person who prepared this description and date of preparation:

José R. Cedeño, August 2007.

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 6027
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 su análisis y solución. Se enfatizan métodos para el análisis dinámico de sistemas grandes.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

Develop mathematical models of power system components and apply them in varying degrees of detail to analyze the dynamic behavior of interconnected power systems in response to small and large disturbances. Students will learn to analyze the dynamic behavior of interconnected power system when subject to large and small perturbations.

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 System dynamic performance and criteria for system dynamic performance Types of stability studies	3
The Classical Model	3
The swing equation	3

Synchronizing power and natural frequencies of oscillations	
The Equal Area Criterion	3
Multimachine dynamics and stability studies Digital simulation of multimachine systems	1
Synchronous Machine Physics and two-axis model Parameters	6
Synchronous Machine and Network Interaction Power Transfer Interface	5
Modeling of Controls and Loads Loads Excitation Systems Turbine-Governor	8
Small Signal Stability • Linearization of system equations • Eigenvalues analysis, sensitivity techniques • Modes, participation factors	8
Current Developments	4
One exam	1
Total hours: (equivalent to contact period)	

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

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:

This the most modern available reference.

1. K. R. Padiyar. Power System Dynamics: Stability & Control, Anshan; 2nd Ed, 2004.

Another modern reference.

2. M. Ilic and J. Zborsky. Dynamics and Control of Large Electric Power Systems, Wiley, 2000.

These are the BEST modern references.

3. P. M. Anderson and A. A. Fouad, Power System Control and Stability , 2nd Ed. IEEE Press, 2002.
4. P. W. Sauer and M. A. Pai, Power System Dynamics and Stability, Prentice Hall, 1997.
5. J. Machowski, J.W. Bialek and J.R. Bumby, Power System Dynamics and Stability, Wiley, 1997.

11. According to Law 51

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Person who prepared this description and date of preparation:

Agustín Irizarry, August 2007

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:

Pre- Inel 4415 or equivalent

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:

1. Allen J. Wood and Bruce F. Wollenberg, "Power Generation, Operation, and Control", John Wiley and Sons, Second Edition, 1996. (Classic textbook in the area)
2. P. Venkataraman, "Applied Optimization with MATLAB Programming", John Wiley & Sons, 2002.
3. S. A. Soman, S. A. Khaparde, and S. Pandit, "Computational Methods for Large Sparse Power Systems Analysis: An Object Oriented Approach", Kluwer Academic Publishers, 2002.
4. M. Crow, "Computational Methods for Electric Power Systems", CRC Press, 2003.
5. Abur and A. Gómez Expósito, "Power System State Estimation: Theory and Implementation", Marcel Dekker, 2004.
6. U. G. Knight, "Power Systems in Emergencies: From Contingency Planning to Crisis Management", John Wiley & Sons, 2001.
7. M. M. Adibi, "Power System Restoration: Methodologies and Implementation Strategies", IEEE Press, 2000.

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 (Chemistry Building, room 019) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258.

Person who prepared this description and date of preparation:

José R. Cedeño, August 2007

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:

1. P.J. Antsaklis, and A.N. Michel, Linear Systems, Birkhauser, 2006.
2. P.J. Antsaklis, and A.N. Michel, A Linear Systems Primer, Birkhauser, 2007.
3. Robert L. Williams, II, Douglas A. Lawrence, Linear State-Space Control Systems, John Wiley, 2007.
4. Chen, C.T. Linear System Theory and Design, Oxford University Press, New York, 1999.
5. J.S. Bay, Fundamental of Linear State Space Systems, McGraw Hill, 1999.
6. T. Kailath, Linear Systems, Prentice-Hall, 1980.
7. W.L. Brogan, Modern Control Theory, Prentice-Hall, Second and Third Edition, 1991.

W.J. Rugh, Linear System Theory, Prentice-Hall, 1993.

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 (Chemistry Building, room 019) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258.

Person who prepared this description and date of preparation:

Miguel Vélez-Reyes, August 2007

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:

1. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design; MORGAN Kaufmann Publishers; Inc. 2001.
2. Frank Vahid and Tony Givargis, Embedded system Design: A Unified Hardware/Software Introduction, John Wiley and Sons, 2002.
3. Stuart Ball, Analog Interfacing to Embedded Microprocessor Systems, Second Edition (Embedded Technology Series) Newnes, 2003
4. Richard Zurawski, Embedded Systems Handbook, CRC Press, 2005
5. Spartan-3 Generation FPGA Users Manual and ISE 9.2i Software Manuals, http://www.xilinx.com

11. According to Law 51

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Person who prepared this description and date of preparation:

Manuel Toledo, August 2007

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:

1. J. Woods, Multidimensional Signal, Image, and Video Processing and Coding, Elsevier Science & Technology Books , 2006
2. H. Schröder, H. Blume, One-and-Multidimensional Signal Processing: Algorithms and Applications in Image Processing, John Wiley, 2000.
3. Dan E. Dudgeon, Russell M. Mersereau, Multidimensional Signal Processing, 1984 (Classical textbook in the subject)
4. Alan C. Bovik, ed., Handbook on Image and Video Processing, Academic Press, 2000.
5. Alexandre Smirnov, Processing of Multidimensional Signals, Springer Verlag, 1999

11. According to Law 51

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Person who prepared this description and date of preparation:

Domingo Rodríguez, August 2007

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:

1. Guoan Bi and Yonghong Zeng (2004), Transforms and Fast Algorithms for Signal Analysis and Representations, Birkhäuser

2. Richard E. Blahut (1992), Algebraic Methods for Signal Processing and Communications, Springer-Verlag. (Classic textbook in the subject)
3. Richard E. Blahut (2002), Algebraic Codes for Data Transmission, Cambridge Press University
4. S. Lin and D. Costello (2004), Error Control Coding, Second Edition, Prentice Hall
5. R.L. Allen and D. Mills (2004), Signal Analysis: Time, Frequency, Scale, and Structure, Wiley - IEEE Press
6. J. F. Humphreys and M. Y. Prest (2004), Numbers, Groups and Codes, Cambridge University Press

11. According to Law 51

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Person who prepared this description and date of preparation:

Domingo Rodríguez, August 2007

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: PHYSICS OF SEMICONDUCTOR DEVICES
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 optical properties of materials. Some of the topics included are atomic structure, inter-atomic forces and crystal structures, conduction mechanisms, transport phenomena, and application of these theories to semiconductor devices.

Spanish: Este curso trata con aparatos electrónicos de estado sólido que utilizan las propiedades de conducción, dieléctricas, magnéticas y ópticas de los materiales. Algunos tópicos incluidos son la estructura atómica, fuerzas inter-atómicas, estructuras cristalinas, mecanismos de conducción, fenómenos de transporte, y aplicaciones de estas teorías a los aparatos semiconductores.

3. Pre/Co-requisites and other requirements:

4. Course Objectives:

Student should be able to describe physical theories that explain the behavior of solid state devices that will provide them with a foundation for advance work in electronics.

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
1. Semiconductor physcs and conductivity	10
2. Capacitance of reverse-biased PN junctions and MOS structures	6
3. Forwar-biased PN junctions	5
4. MOSFETs	4
5. Bipolar transistors	6
6. IC Devices and technologies	4
7. Photonic devices	7

8. Tests	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**		
☐ **Journals**		
☒ **Other, specify: Homework**	**3-4**	**10**
TOTAL:		**100%**

10. Bibliography:

1. Sima Dimitrijev, Principles of Semiconductor Devices, Oxford University Press, 2006.
2. S.M. Sze and Kwok K. Ng, Physics of Semiconductor Devices, Wiley and Sons, 2006.
3. J.P. Colinge and C.A. Colinge, Physics of Semiconductor Devices, Springer, 2005
4. R.F. Pierret, Advanced Semiconductor Fundamentals, Prentice-Hall, 2002
5. R. Muller and T. Kamins, Device Electronics for Integrated Circuits, .Wiley, John and Sons, 2002

11. According to Law 51

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Person who prepared this description and date of preparation:

Manuel Toledo, August 2007

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:

1. Moorthi, V. R., Power Electronics: Devices, Circuits and Industrial Applications: Oxford University Press, 2005.
2. Mohan, N., Undeland, T., and Robbins, W. Power Electronics-Converters, Applications and Design: John Wiley & Sons Inc., 2003.
3. Rashid M. H., Power Eectronics: Circuits, Devices and Applications: Prentice Hall, 2003.
4. Van den Bossche, A. and Valchev V. C., Inductors and transformers for Power Electronics: CRC, 2005.
5. Rashid M. H. and Rashid, H. M., SPICE for Power Electronics and Electric Power (Electrical and Computer Engineering): CRC, 2005
6. Paiece, D. A., Clean Power Electronic Converters: Paice and Associates Inc., 2005.
7. Grebennikov A. and Sokal N.: Switch Mode RF Power Amplifiers: (Communications Engineering): Newnes, 2007.
8. Buso, S.: Digital Control in Power Electronics (Synthesis Lectures in Power electronics): Morgan and Claypool Publishers, 2007.
9. Jacob J. M., Power Electronics: Principles and Applications: Thomson Delmar Learning, 2001.

11. According to Law 51

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Person who prepared this description and date of preparation:

Carlos Cuadros, August 2007

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:

1. A. Ruano, Intelligent Control Systems Using Computational Intelligence Techniques, IEE Press, 2005
2. H.T. Nguyen, N.R. Prasad, C.L.Walker and E.A. Walker, "A First Cource in Fuzzy and Neural Control", Chapman &Hall/CRC, 2003.
3. M. Jamshidi, L. dos Santos Coelho, R.A. Krohling and P.J. Fleming, "Robust Control Systems with Genetic Algorithms", CRC Press LLC, 2003.
4. Hung T. Nguyen, Nadipuram R. Prasad, Carol L. Walker, and Ebert A. Walker, A First Course in Fuzzy and Neural Control, CRC Press 2002
5. Ali Zilouchian and Mo Jamshidi, Intelligent Control Systems Using Soft Computing Methodologies, CRC Press, 2001

11. According to Law 51

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Person who prepared this description and date of preparation:

Raúl Torres, August 2007

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.	3
12- Exams	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:

J. Chiasson, Modeling and High Performance Control of Electric Machines, John Wiley, 2005
R. Krishnan, Electric Motor Drives, Prentice Hall, 2001
M.A. El-Sharkawi, Fundamentals of Electric Drives, Brooks/Cole Publishing Company, 2000.
D.W. Novotny and T.A. Lipo, Vector Control and Dynamics of AC Drives, Oxford University Press, 1998. (Clasic textbook in AC drives control)
I. Boldea, A. Boldea, S.A. Nasar, Electric Drives, Second Edition, CRC Press, 2005.
Marian P. Kazmierkowski, Henryk Tunia, Automatic Control of Converter-Fed Drives, Elsevier Science, 2005
W. Leonhard, Control of Electrical Drives, Third Edition, Springer-Verlag New York, LLC, 2001
G.K. Dubey, 'Fundamentals of Electric Drives', CRC Press 2002

11. According to Law 51

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Person who prepared this description and date of preparation:

Carlos Cuadros, August 2007

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 6068
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 5305 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**		**25**
☐ **Journals**		
☐ **Other, specify:**		
TOTAL:		**100%**

10. Bibliography:

1. C. A. Balanis, Antenna Theory, Analysis and Design, 3rd ed, John Wiley and Sons, NY, 2006
2. R. Mailloux, Phased Array Antenna Handbook, 2nd ed, Artech House, Boston, 2005
3. G. Kumar, K.P. Ray, Broadband Microstrip Antennas, Artech House, Boston, 2003
4. R.S. Elliott, Antenna Theory & Design, Wiley-IEEE Press, 2003
5. R. Bancroft, Microstrip and Printed Antenna Design, Noble Publishing, 2004

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 (Chemistry Building, room 019) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258.

Person who prepared this description and date of preparation:

José Colom, August 2007

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 6069
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:

IEEE Transactions on Geoscience and Remote Sensing (available online from UPRM library)
Iain Woodhouse, Introduction to Microwave Remote Sensing, CRC Press, 2004
Eugene A. Sharkov, Passive Microwave Remote Sensing of the Earth: Physical Foundations, Springer, 2004
Ulaby, F. T., R.K. Moore, and A. K. Fung, Microwave Remote Sensing: Active and Passive, Vol. 1, Addison-Wesley, 1986
Doviak, R.J. and D. S. Zrnic, Doppler Radar and Weather Observations, Academic Press, 1993.
Lutgens, F. K. and E. J. Tarbuck, The Atmosphere, Prentice Hall, 1998.

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 (Chemistry Building, room 019) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258.

Person who prepared this description and date of preparation:

Sandra Cruz-Pol, August 2007

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:

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

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 (Chemistry Building, room 019) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258.

Person who prepared this description and date of preparation:

Nelson Sepulveda, August 2007

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:

1. Simon Haykin, Adaptive Filter Theory, 4th ed. Prentice Hall, 2002.
2. L.C. Ludeman, Random Processes: Filtering, Estimation, and Detection, John Wiley & Sons, 2003.
3. Ali H. Sayed, Fundamentals of Adaptive Filtering, Wiley-IEEE Press, 2003
4. D. Manolakis, V. Ingle, S. Kogon, Statistical and Adaptive Signal Processing, Artech House 2005
5. J.C. Bertein, R. Ceschi, Discrete Stochastic Processes and Optimal Filtering, ISTE Publishing Company, 2007

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 (Chemistry Building, room 019) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258.

Person who prepared this description and date of preparation:

Shawn D. Hunt, August 2007

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 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:

Transients in Power Systems, by Lou van der Sluis, John Wiley, 2001

Electrical Transients in Power Systems, 2nd. Ed., by Allan Greenwood; Jonh Willey and Sons, 1991.

Power System Transients: Parameter Determination by Juan A. Martinez-Velasco, CRC Press 2008.

Power Systems Electromagnetic Transients Simulation (Iee Power & Energy Series, 39) by J. Arrillaga, and N. Watson, Institution of Electrical Engineers, 2002

Transients in Power Systems, by L. van der Sluis, John Wiley & Sons, New York, NY, 2001.

Electromagnetic Transients in Power Systems, by P. Chowdhuri, Research Studies Press, 2nd edition, 2005.

Transient Analysis of Electric Power Circuits Handbook, by A. L. Shenkman, Springer Verlag, 2005

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 (Chemistry Building, room 019) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258.

Person who prepared this description and date of preparation:

Lionel Orama, August 2007

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 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:

1. V. Krishnan, Probability and Random Processes, John Wiley, 2006.
2. J.A. Gubner, Probability and Random Processes for Electrical and Computer Engineers, Cambridge University Press, 2006.
3. R.D. Yates and D.J. Goodman, Probability and Stochastic Processes: An Friendly Introduction for Electrical and Computer Engineers, John Wiley and Sons, 2005.
4. M. Barkat, Signal Detection and Estimation, Second Edition, Artech House Inc, 2005.
5. L.C. Ludeman, Random Processes: Filtering, Estimation, and Detection, John Wiley & Sons, 2003.
6. H. Stark and J.W. Woods, Probability, Random Processes, and Estimation Theory for Engineers, 3rd Edition, Prentice Hall, 2002.
7. Papoulis and S.U. Pillai, Probability, Random Variables, and Stochastic Processes, Fourth Edition, McGraw-Hill, 2002.

11. According to Law 51

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Person who prepared this description and date of preparation:

Miguel Vélez-Reyes, August 2007

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 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:

1- A. Srivastava, D. Sylvester, and D. Blaauw, Statistical Analysis and Optimization for VLSI: Timing and Power, Springer, 2005.
2- J. Rabaey, A. Chandrakasan, and B. Nikolic, "Digital Integrated Circuits: A Design Perspective", 2nd Edition, Prentice Hall-Pearson Education, Inc., 2003
3- D.A. Hodges, Analysis and Design of Digital Integrated Circuits, McGraw Hill, 2003
4- P.R. Grey, PJ Hurst, S H Lewis, RG Meyer, Analysis and Design of Analog Integrated Circuits, 4th Edition, John Wiley and Sons, 2003
5- S.M. Kang and Y. Leblebici, CMOS Digital Integrated Circuits Analysis & Design, McGraw-Hill, 2002
6- Gray, Hurst, Lewis, and Meyer, "Analysis and Design of Analog Integrated Circuits", 4th. Edition, John Whiley & Sons, Inc., 2001
7- B. Razavi, "Design of Analog CMOS Integrated Circuits", McGraw-Hill, Inc., 2001
8- K. Granzow, "Digital Transmission Lines: Computer Modeling and Analysis", Oxford University Press, Inc., 1998
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.

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 (Chemistry Building, room 019) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258.

Person who prepared this description and date of preparation:

Manuel Jiménez, August 2007

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 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. N. Weste and D. Harris, CMOS VLSI Design: A Circuits and Systems Perspective , Third Ed., Addison-Wesley Publishing 2004
2. R.J. Baker, D.E. Boyce, S.K. Tewksbury, and J.E. Brewer, CMOS: Circuit Design, Layout, and Simulation, John Wiley, 2004
3. J. Rabaey, A. Chandrakasan, and B. Nikolic, "Digital Integrated Circuits: A Design Perspective, 2nd Edition", Prentice Hall, Inc., 2003.
4. Hastings, "The Art of Analog Layout", Prentice Hall, Inc., 2001.
5. J. Rabaey, A. Chandrakasan, B. Nikolic, "Digital Integrated Circuits: A Design Perspective, 2nd Edition", Prentice Hall, Inc., 2003.
6. Technical papers from journals and conferences in Circuits and Systems and Computer Aided Design of Electronic Circuits.

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 (Chemistry Building, room 019) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258.

Person who prepared this description and date of preparation:

Manuel Jiménez, August 2007

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:

1. Erickson, R., and Maksimovic, D. Fundamentals of Power Electronics: Springer, 2003.
2. Mohan, N., Undeland, T., and Robbins, W. Power Electronics-Converters, Applications and Design: John Wiley & Sons Inc., 2003.
3. M.H. Rashind, Power Electronics: Circuits, Devices and Applications, Prentice Hall, 2003
4. H.J. Sira-Ramirez, R. Silva-Ortigoza, Control Design Techniques in Power Electronics Devices, Springer-Verlag New York, LLC, 2006
5. J. Kassakian, M. Schlecht and G. Verghese, Principles of Power Electronics, Prentice Hall, 1991. (Clasic book in the area)

11. According to Law 51

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Person who prepared this description and date of preparation:

Carlos Cuadros, August 2007

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**		**10%**
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**30%**
☐**Journals**		
☒**Other, specify: Laboratory Exercises and Homework**		**30%**
TOTAL:		**100%**

10. Bibliography:

-Forsyth, David A., and Ponce, Jean, Computer Vision: A Modern Approach, Prentice Hall 2003
-Shapiro G. Linda, and Stockman, Geroge, Computer Vision, Prentice Hall 2001
-Jain, R., Kasturi R. and Schunck, B.G., Machine Vision, McGraw-Hill, Inc. 1995
-M. Sonka, V. Hlavac, R. Boyle, Image Processing, Analysis, and Machine Vision, Engineering-Nelson, 2007.
-W.E. Snyder, H. Qi, Machine Vision, Cambridge University Press, 2004.

11. According to Law 51

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Person who prepared this description and date of preparation:

Raul Torres, August 2007

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:

J. Arrillaga, Power System Harmonics Analysis, Wiley, 2003.

E. Acha, Harmonics and Power Systems, TF-CRC, 2005.

R. Dugan, Electric Power System Quality, McGraw Hill, 2003.

IEEE Standard 1547, Recommended Practice for the Interconnection of Distributed Resources, IEEE Press, NY, 2005.

IEEE Transactions on Power Delivery, Power Electronics and Power Systems, Articles on Power Quality, Policy Issues, and Power Electronics, IEEE Press, NY, from 2003-2007.

11. According to Law 51

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Person who prepared this description and date of preparation:

Efrain O'Neill, August 2007

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 6105
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:

1. Bringi V.N. and V. Chandrasekar (2001). Polarimetric Doppler weather radar. Cambridge.
2. Doviak R.J. , D. S. Zrnic (1993). Doppler radar and weather observations, 2nd ed., Academic Press
3. Hein, A. (2003). Processing of SAR data: Fundamentals, Signal Processing, Interferometry. Springer.
4. Richards, M. A. (2005). Fundamentals of radar signal processing. Mc Graw Hill.
5. Weitkamp C., Editor (2005). Lidar: Range-resolved optical remote sensing of the atmosphere.

11. According to Law 51

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Person who prepared this description and date of preparation:

Rafael Rodríguez, August 2007

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 6106
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:

1. Text: Merril I. Skolnik, Introduction to Radar Systems, 3rd Ed., Mc Graw-Hill, 2001

References:

2. Richard J. Doviak, Dusan S. Zrnic, Doppler radar and weather observations, 2nd Ed., AP, 1993
3. Pozar, D, Microwave and RF Design of Wireless Systems, Wiley, 2004..
4. Peebles, P., Radar Principles, John Wiley, 1998.
5. Bringi V.N. and V. Chandrasekar, Polarimetric Doppler weather radar, CUP, 2001.

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Person who prepared this description and date of preparation:

Rafael Rodríguez, August 2007

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 6115
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: Guillermo Gonzalez, Microwave Transistor Amplifiers Analysis and Design, Prentice Hall, 1997.

References:

1. David M. Pozar, Microwave Engineering. John Wiley and Sons Inc. 3rd Edition, 2005
2. Robert Collin, Foundations for Microwave Engineering, IEEE Press Series, 2nd Edition 2000.
3. Joseph White, High Frequency Techniques:Introduction to RF and Microwave Engineering, Noble Publishing, 2004
4. David Davidson, Computational Electromagnetics for RF and Microwave Engineering, Cambridge, 2005.
5. G.D. Vandelin, A.M. Pavio, U.L. Rohde, Microwave Circuit Design Using Linear and Non Linear Techniques, Springer-Verlag, 2005.

11. According to Law 51

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Person who prepared this description and date of preparation:

José Colom, August 2007

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 6216
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:

text book:: C. A. Balanis, Advanced Engineering Electromagnetics, Wiley, 1989.
Este es el texto más comúnmente utilizado para cursos equivalentes en universidades de Estados Unidos. No hay edición más reciente del mismo y todavía está en impresión.

References:

Matthew N. O. Sadiku, Numerical techniques in electromagnetics, 2nd ed., CRC Press, 2001
Jefimenko, Oleg. D., Causality, Electromagnetic Induction, and Gravitation: A Different

Approach to the Theory of Electromagnetic and Gravitational Fields, 2nd edition Oleg D. Jefimenko (2000)
Duffy, D. G. , Green's Functions with Applications, Chapman & Hall/CRC, 2001.

IEEE Transactions on Antennas and Propagation
IEEE Transactions on Microwave Theory and Techniques
IEEE Transactions on Electromagnetic Compatibility .

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 (Chemistry Building, room 019) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258.

Person who prepared this description and date of preparation:
Sandra Cruz, August 2007

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 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 Ingenieria Electrica.

3. Pre/Co-requisites and other requirements:

Permission of 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

Depend on the topics

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

Depend on the topics.

10. Bibliography:

Depend on the topic.

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Person who prepared this description and date of preparation:
Miguel Vélez-Reyes, August 2007