Proposal for a Doctoral Program in Electrical Engineering

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1 Introduction

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

1.2 Program Description
NCES CIP Code: 14.1001 Electrical, Electronics and Communications Engineering

The proposed program will provide the most advanced education in electrical engineering in Puerto Rico. Graduates of this program will utilize their knowledge and training to think critically and creatively to significantly contribute to the social and economic development of Puerto Rico and its hemisphere in the areas of research, development, and education. The proposed program emerges from the natural evolution of research and graduate studies at the Master level in the Department of Electrical and Computer Engineering. The proposed doctoral program addresses the need for advanced study and research in electrical engineering, according to the description in “Proyecto Manos Tecnológicas” (Technological Hands Project) and “Proyecto Puertorriqueno para el Siglo 21” (Puerto Rican Project for the Twenty-first Century) both sponsored by the government of the Commonwealth of Puerto Rico for the economic development of the island.

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

The proposed academic program will consist of a minimum of forty-nine credits, from which a minimum of twenty-four will be taken in one of the areas previously described. Of the forty-nine required credits, a minimum of six credits will be taken in advanced graduate or undergraduate level mathematics courses, of which at least three credits will be at the 6000 or higher level. The objective behind this requirement is to strengthen essential analytical skills required for state of the art research in electrical engineering. In addition, six credits in electives outside the area of emphasis will be required. Each doctoral candidate will be required to participate in the doctoral seminar each semester for which he will receive one credit at the conclusion of his/her dissertation. Besides, students will be required to pass a qualifying exam and a comprehensive exam as part of the process of evaluating their ability to engage in doctoral level research. Finally, students will be required to pass 12 dissertation credits.
The dissertation will measure the scope of acquired knowledge and it will evidence the student’s degree of creativity. It will require an original contribution to the existing scientific and/or technological body of knowledge in the field of electrical engineering.

1.3 Non-conventional modalities
Not contemplated.

1.4 Beginning Date
The program will begin as soon as it is approved by the corresponding authorities. It is tentatively set to begin during the second semester of the 2009-2010 academic year.

1.5 Program Duration
According to the academic requirements described in this proposal, the doctoral program will have a normal duration of four to five years for students who begin with a bachelor’s degree and three to four years for students starting with a master’s degree.

The maximum time limit allotted for a student to complete the degree will be the same as that specified in the existing UPRM Graduate School Norms which at the time of writing this proposal are:
- Ten years, if the student begins with a Bachelor’s degree when starting the program, even if the student has transferred from another graduate program or has temporarily postponed studies.
- Eight years, if the student begins with a Master’s degree at the initiation of the program, even if the student has transferred from another graduate program or has temporarily postponed studies.

2 Accreditation and Program Licensing

2.1 Professional Accreditation
The proposed program does not require professional accreditation.

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

3 Justification

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

- Devices
- Circuits
- Electronics
- Computers
- Systems
- Power
- Interdisciplinary Areas

Interdisciplinary areas include among others:

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

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

The proposed doctoral program will assist in the development of engineering professionals at the doctoral level through preparation and formation in the previously described tracks while providing the means for developing existing graduate and research endeavors in electrical engineering. Furthermore, it will become a key instrument in strengthening interdisciplinary research projects such as collaborations with Marine Sciences, Geology, Chemical Engineering, Mechanical Engineering, Material Sciences, Industrial Engineering and Computer and Information Science and Engineering.

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

This analysis concludes that the Doctoral Program in Electrical Engineering represents, from the academic perspective, a natural evolution of the master’s degree program in Electrical and Computer Engineering at UPRM. Academic and research experience, faculty competencies, the developed infrastructure, and the country’s needs have established the basis for establishing a doctoral program in electrical engineering at the University of Puerto Rico at Mayagüez.

### 3.2 Public policy reasons for establishing the program

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

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

In 1991, high tech again becomes relevant with the explosion of internet companies. As a result, the Governor creates the Science and Technology Board to evaluate research and development proposals to be funded by the government. This effort comes to fruition and in 1994 the Science and Technology Counsel is created to design the public policy for science and technology. It is not until 1997, after the hiring of the Arthur D. Little company that the policy is started. Its most important points are summarized below:

- **Goal:** increase the gross national product related to science and technology from 5% to 34% by the year 2010.
- **Strategy:** promote the synergy between academia, government, industry and the financial sector.
- **Science and Technology areas to be supported**: pharmaceuticals, global competitive manufacturing, health, communications and informatics, and biotechnology.

To begin implementing this policy of Science and Technology, the government of the Commonwealth of Puerto Rico created the technology corridor on the west end of the island. This technology corridor was based on technology parks elsewhere, such as the North Carolina Research Triangle Park, Silicon Valley and the Singapore Science Park. The proposed Western Technology Corridor envisioned establishing centers of excellence in scientific and engineering research, in addition to incubators and high technology companies dedicated to developing and commercializing new ideas and advances in the above mentioned areas.

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

In the 2000 elections, the two main candidates to governorship promised to back science and technology in Puerto Rico. The Popular Democratic Party, the winner of these elections, supported the initiatives in science and technology with a project entitled “Operación Manos Tecnológicas”, (Operation Technological Hands). From this plan we highlight the following points that we believe support the creation of the proposed program:

- Establish a Unit for Technological and Informatics development which will promote high viability projects in technology and informatics, introducing at the same time tax incentives to stimulate investment, to attract scientists, researchers and development companies.
- Tax incentives to propose Puerto Rico as a center for research, technology and specialized manufacturing. Incentives to industry (combined rate of 5%), to their shareholders, (combined rate of 5%), and essential personnel within these industries (combined rate of 10%).
- Develop an incentive plan to allow the reversal of the brain drain in business, science and technology. Create the environment to attract this talent to Puerto Rico to nurture the growth of new industry and promote the economic development of Puerto Rico.
- Develop human resources to improve the productivity and competitiveness of these firms on the island. Educational proposals will take into account curricular revision and educational development in the areas of informatics, both at a university as well as at the primary and secondary school levels. Establish ties and personnel and technology exchange with academia in the United States and Europe.
- Establish a grid of industry incubators in collaboration with universities and elements of the private sector to nurture the development of start-ups in the high tech and electronics industries.
- Co-finance, with the help of federal funds and with close ties to academia, the formation of research and development institutes in the strategic niche areas in manufacturing and services in Puerto Rico.
• Strengthen technology transfer with mechanisms that protect and commercialize intellectual property of local inventors and the research and development work at universities, and which will permit technology transfer to start-up and multinational companies.

The Operation Technological Hands plan was given to the Science and Technology Office at PRIDCO to establish the public policy to be adopted. As part of this effort, it was decided that the policy to be developed would be an instrument for:

• Focusing the abilities of the government, private industry and academia, toward more effective measures that would lead Puerto Rico to bettering the areas of Science and Technology, developing in this was the nations competitiveness.
• Assure that necessary resources would be assigned and used to maximize the science and technology capacity in Puerto Rico.
• Attract to Puerto Rico research and development and industry based on research and development, and the promotion of local high tech start-ups.

The policy developed by the Science and Technology Office was supported with wide participation from members of industry, government and academia, calling themselves the “Puerto Rico Science and Technology Alliance”. The developed policy was designed to change Puerto Rico into a world class business competitor in science and technology. Among the main objectives and strategies are the following:

• New culture of science and technology
• Solid infrastructure in science and technology
• Innovation capital
• Strong component in research, development and education.
• Competitive community in science and technology

Among the metrics used determine the success of the new policy, and among which the proposed program would have major impact are:

• Size and strength of the science and technology community
• Growth in the available science and technology infrastructure

To accelerate the policy implementation, the Puerto Rico Science and Technology Alliance commissioned a study by the firm McKinsey & Co. In this study McKinsey & Co. suggest that the policy implementation should be in the communication and information technology area. In terms of the most attractive opportunities for Puerto Rico, McKinsey & Co. identified the following:

• **Computer and electronics manufacturing (including design):** Computers and peripherals, communication equipment, audio and video equipment, optical and magnetic communication media, applications. Focus: a good position in the area of medical devices manufacturing and application for defense.

• **Information services:** Geophysical research (e.g. remote sensing), software, internet, telecom, business with technology access (e.g. e-commerce). Focus: Software development and information technologies related to health.

• **Consumer Services:** Telephonic help centers, repair and maintenance of electronic equipment, facility administration. Focus: Contact centers for hispanic markets, centers for shared services.
Remote Service: Information services, consumer services. Focus: Off-shore bank and insurance processing and outsourcing of pharmaceutical processes.

At present, the Science and Technology Office is in the process of developing operational plans to facilitate implementing the recommendations make by McKinsey & Co.

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

The proposed Doctoral program in Electrical Engineering will be instrumental in developing the personnel with the necessary preparation and will strengthen the research environment in the communication and information areas described by McKinsey & Co. The doctoral program will permit the development of research at the highest level in electrical engineering and the training of future leaders who will contribute to the technological development of Puerto Rico and this hemisphere.

4 Program’s Relation with the Institutional Mission and Planning

4.1 Relation with the UPR and UPRM Mission and Development Plan

The proposed program will provide state of the art education in electrical engineering. The program’s graduates will utilize acquired knowledge and skills to think critically and creatively while contributing significantly to the economic and social development of Puerto Rico and this hemisphere. This program is the a natural evolution of research and graduate programs at the master’s degree level in Electrical and Computer Engineering and responds to Puerto Rico’s need for the development of advanced graduate studies and research in areas where electrical engineering can have far reaching results in the social and economic development of Puerto Rico.

The proposed program addresses several critical areas of the Strategic Plan of the University of Puerto Rico such as:

- More and improved quality research endeavors.
- Academic and professional offerings of known quality in electrical engineering.

The proposed program will help increase the level of research and creative activities by:

- Improving institutional conditions and climate necessary for the increase of research and creative activity in Electrical Engineering
- Stimulating the application of acquired knowledge, generated by research and creative activity, to Puerto Rico’s development through the creation of an industrial affiliates program supporting graduate-level research.
• Continue developing, through proactive activity and practical experiences, creative professional engineers, who are innovative and skilled in the application of research for solving problems in Puerto Rican society.

• Strengthen inter and intra collegiate collaborative efforts, as well as industrial, commercial and governmental collaborative efforts in Puerto Rico and abroad. The creation of this doctoral program is an institutional commitment made in intercollegiate research center in which our department participates.

• Strengthen the institutional infrastructure to continue promoting the search for additional sources of external funding for research by allowing our researchers to become involved in advanced research endeavors.

The program will improve the quality of graduate academic offerings in the Department of Electrical and Computer Engineering by:

• Broadening and improving specialized resources required by existing graduate program within the department.

• Promoting intercollegiate coordination between our department and other universities in order to strengthen offerings and educational experiences among our students and faculty while building upon the foundation of existing collaborations in engineering research centers sponsored by the National Science Foundation.

• Continuing to improve existing departmental resources and facilities used in graduate and undergraduate research programs with the hope of increasing external funding resources in order to reach a higher level of research.

4.2 Relation to the Academic Offer in Other Programs

4.2.1 Within the Mayagüez Campus

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

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

The proposed program is related to the baccalaureate degree programs in Electrical Engineering and Computer Engineering at UPRM. Some advanced undergraduate courses from these programs are included in the proposed program. Any qualified student who has graduated from either program may be admitted directly into the doctoral program.
No other program in UPRM is directly related to the new program. Nevertheless, graduates from other qualified engineering, science, and mathematics programs might be considered for admission into the electrical engineering Ph.D. program. Depending on the applicant’s academic background, deficiency courses may be assigned and admission granted, or a master’s degree in electrical or computer engineering may be recommended prior to consideration for admission into the doctoral program.

4.2.2 In Other UPR Campuses
The proposed program will be the only doctoral program of its type offered within the UPR System and has no direct relation to any other graduate or undergraduate program in the University of Puerto Rico system.

4.2.3 In Other Institutions of Higher Learning in Puerto Rico
The proposed program will be the only doctoral program of its kind offered in Puerto Rico. Nevertheless, there are master’s and BA degree programs in other institutions of higher learning which are related to this one. The new program provides qualified graduates of those programs with the opportunity to pursue a doctoral degree in electrical engineering.

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

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

5 Conceptual Frame

5.1 Mission and Vision
The mission and vision of the doctoral program are:

- **Mission**: Be a program of excellence in research and in the training of doctors in Electrical Engineering.

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

5.2 Goals
The doctoral program’s goals are as follows:
• Serve as the top education and research center of Electrical Engineering in Puerto Rico.
• Prepare the professional engineers at the highest level capable of contributing to the social and economic development of Puerto Rico and its hemisphere in the areas of government, industry, and academia.
• Develop close ties with industry in order to support research relevant to the economic development of Puerto Rico and facilitate technology transfer.

5.3 Objectives
The specific objectives of the doctoral program are:

• Award a minimum of 15 PhD’s during the first ten years of the program.
• Increase departmental external funding by 50% percent during the first five years of the program’s initiation.
• Establish a system for the distribution of publications and technical reports providing public access to research work performed by the department.
• Increase the number of peer reviewed articles by research professors to two (or more) per year which is the average publication rate in the United States.
• Establish recruitment programs in Puerto Rico, United States, and Latin America.
• Establish mechanisms for the continual improvement of laboratory infrastructure, equipment, library, and collaborations supporting the doctoral program.
• Increase the number of IEEE “Senior Members” in our department and at least one IEEE “Fellow Member” in the next ten years.

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

The faculty advisor and the student’s graduate committee are viewed as mentors in the process of developing a professional who can perform advanced research work in electrical engineering and be a contributor to the society. The student in coordination with his/her graduate advisor and graduate committee will propose a study program that will meet the core requirements of a particular track and structure the technical, mathematical and free electives to meet the student interest and the needs of the proposed research project. The student in coordination with his/her graduate advisor and graduate committee will work on defining a research project that will constitute and original contribution to the state of the art in electrical engineering and related areas. The proposed open structure will allow the program to have the capability to adapt to address more efficiently the fast changing technological societal needs in Puerto Rico and the world.
This track model for graduate research areas is used at MIT Electrical Engineering and Computer Sciences Department and we think it can be adapted to our particular academic and research culture successfully.

5.5 Graduate Profile

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

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

6 Curriculum Design

6.1 Curriculum Scheme and Balance

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

- 18 credits in graduate or advanced undergraduate level courses within a particular area of specialization
- 6 credits in advanced level courses (8000 or higher) in the area of specialization
- 6 credits in mathematics at a graduate level (at least one course at 6000 level or above)
- 6 credits in elective courses outside the area of specialization
- 1 credit in doctoral seminar
- 12 credits in doctoral dissertation
No more than nine credits in advanced undergraduate courses (5000 level) may be used to complete the PhD course requirements. Additionally, the student must take a qualifying and a comprehensive exam, and must present and defend a dissertation which shows an original work in their emphasis area.

6.2 Course Descriptions

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

6.2.1 Existing Courses

INEL 5029 TELECOMMUNICATION ELECTRONICS. Three credit hours. Three hours of lecture per week. Prerequisite: INEL 4301, INEL 4201 and INEL 4152. Study of the operation theory of radio frequency and microwave devices and components and foundations of the design techniques for RF systems with the purpose of understanding the operation of the different components of a telecommunication system.

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

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

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

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

INEL 5265 ANALOG INTEGRATED CIRCUITS DESIGN. Three credit hours. Three hours of lecture per week. Prerequisite: INEL 4205 and INEL 4201. Design and analysis of analog and mixed-signal (digital-analog) circuits using advanced analytical design techniques and advanced computer aided design tools. Discussion of topics about physical design and development of functional testing of analog integrated circuits.
INEL 5305 ANTENNA THEORY AND DESIGN. Three credit hours. Three hours of lecture per week. Prerequisite: INEL 4152 and INEL 4301. Radiation mechanism. Types of antennas; impedance; radiation patterns; arrays. Antenna measurements.

INEL 5306 MICROWAVE ENGINEERING. Three credit hours. Three hours of lecture per week. Prerequisite: INEL 4152. Rectangular and circular wave guides; passive components; tubes, and solid-state devices used in microwave systems.

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

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

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


INEL 5325 COMMUNICATION SYSTEM DESIGN: CIRCUITS AND ANTENNAS. Three credit hours. One hour of lecture and two two-hour laboratories per week. Prerequisite: INEL 5305 or INEL 5306. Design of communication circuits and antennas. Several design projects including: specification, evaluation and selection of alternatives and implementation. Written reports and computer use required.

INEL 5326 COMMUNICATION SYSTEM DESIGN: SIGNAL PROCESSING. Three credit hours. One hour of lecture and two two-hour laboratories per week. Prerequisite: INEL 5309. Block diagram design and simulation of communication systems. Design projects including: specification, evaluation and selection of alternatives, and implementation. Computer and laboratory work and written reports required.

INEL 5327 IMAGE PROCESSING Three credit hours. Three hours of lecture per week. Prerequisite: INEL 5309. Mathematical representation of 2-D digital signals. 2-D filter design. Image coding standards. Image filtering, enhancement and compression.
INEL 5406 DESIGN OF TRANSMISSION AND DISTRIBUTION SYSTEMS. Three credit hours. Three hours of lecture per week. Prerequisite: INEL 4415. Design of electric power distribution systems with emphasis on distribution transformer connections and energy tariffs. Transmission line design with emphasis on conductor selection, and mechanical considerations. Review of transmission line parameters.

INEL 5407 DESIGN OF TRANSMISSION AND DISTRIBUTION SYSTEMS. Three credit hours. Three hours of lecture per week. Prerequisites: INEL 4415. Generation, Transmission, and Distribution of Electric Power. Reliability; Consumer Services; Overhead and Underground Lines.

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

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

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

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

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

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

INEL 5995 SPECIAL PROBLEMS. One to six credit hours. Investigations and special problems in Electrical Engineering or related fields. Open to outstanding Electrical Engineering students.
INEL 6000 INTRODUCTION TO NONLINEAR CONTROL SYSTEMS. Three credit hours. Three hours of lecture per week. Analysis and synthesis of nonlinear control systems; phase plane and describing function techniques; Lyapunov's second method and its application in the design and stability determination of nonlinear systems.

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

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

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

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

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

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

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

INEL 6047 ADVANCED CONTROL SYSTEM THEORY. Three credit hours. Three hours of lecture per week. Advanced Problems In Linear and Nonlinear Control Systems. The use of Linear Algebra for The Analysis and Design of Linear Systems Is Emphasized. The Implementation of Linear Systems Via Analog and Digital Simulation Diagrams Is Also Studied.
INEL 6048 ADVANCED MICROPROCESSOR INTERFACING. Three credit hours. Three hours of lecture per week. Architecture of 8, 16, and 32 bits microprocessors; bus, input/output and memory interfacing; parallel processing architecture; configuration and interfacing of multiprocessors; applications of the multiprocessor system.

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

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

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

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

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

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

INEL 6068 MICROWAVE ANTENNA ENGINEERING. Three credit hours. Three hours of lecture per week. Analysis and design of microwave and millimeterwave antennas.

INEL 6069 MICROWAVE REMOTE SENSING. Three credit hours. Three conference hours per week. The interaction of electromagnetic waves with natural (i.e. clouds, rain, snow) and artificial targets. It provides with an introduction to radiometry (Planck’s Law) and to operation
principles of active (radars) and passive (radiometers) instrumentation used in remote sensing, with emphasis on passive systems.

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

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

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


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

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

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

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

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

**INEL 6105 ACTIVE REMOTE SENSING TECHNIQUES.** Three credit hours. Three hours of lecture per week. This course presents the theory behind radar and ladar techniques. Topics discussed include wave propagation and polarization, transversal section of objects, coupled filters, ambiguity function, radar coded signals, processing and interpretation of radar and ladar echo signals. Typical applications discussed include weather radar, synthetic aperture radar, and lidar.

**INEL 6106 INTRODUCTION TO RADAR SYSTEMS.** Three credit hours. The course aims to develop the basic theory underlying the radar system, focusing in the hardware. The students will learn basic radar concepts including the radar equation for different applications; different types of radars such as Fm, Fm-cw, Pulse, etc., are discussed; strengths and weaknesses are addressed, as well as applications for different types of radars. Calibration and detection of signals in noise techniques are also discussed. Typical radar transmitters and receivers are studied.

**INEL 6115 MICROWAVE ACTIVE CIRCUITS.** Three credit hours. Three hours of lecture per week. This course studies the theory and analysis of the design of microwave transistor amplifiers and oscillators. Parameters such as noise, bandwidth, gain and power are considered for the design of the amplifiers. Different transistor amplifiers such as broadband, low noise, and power amplifiers are discussed. The course also covers the design of microwave oscillators using dielectric resonators.

**INEL 6216 ADVANCED ELECTROMAGNETICS.** Three credit hours. Three hours of lecture per week. Advanced study of Maxwell equations, electric properties of the matter, wave propagation, polarization, reflection, and transmission and the techniques and theory for the analysis of electromagnetic systems, use of Green functions.

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

### 6.2.2 Courses that can be used to the Mathematics Requirement

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

### 6.2.3 New Courses

The course creation forms are presented in Appendix B.
INEL 8295 ADVANCED TOPICS IN ELECTRONICS. One to six credits. One to six contact hours per week. Study of selected topics in electronics or related fields.

INEL 8296 ADVANCED TOPICS IN COMPUTER ENGINEERING. One to six credits. One to six contact hours per week. Study of selected topics in computer engineering or related fields.

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

INEL 8396 ADVANCED TOPICS IN APPLIED ELECTROMAGNETICS One to six credits. One to six contact hours per week. Study of selected topics in applied electromagnetics or related fields.

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

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

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

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

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

INEL 8997 INDEPENDENT STUDY. One to three credits. Independent student research in electrical engineering and related fields.

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

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

6.3 Proposed Program Course Sequences

The curriculum will be administered by the ECE Graduate Committee in Coordination with the area coordinators and the ECE Associate Chair for Graduate Studies and Research. The Ph.D. program is a research oriented program and as such we decided to have a general structure that leaves enough freedom to develop study programs that meet student interest and research opportunities. Students will have an advisor who will, in conjunction with the student graduate com-
mittee, decide which of the available tracks to follow and which courses to take to meet student interest and research project needs. Information about the existing tracks is given in Appendix A. Examples of programs of study for each track are given in Appendix F. New tracks in biomedical engineering and networking are being considered as future expansions. The open structure also gives the opportunity to develop individual programs of study that will meet multidisciplinary research opportunities not satisfied by a single track such programs will need the approval of the ECE Departamental Graduate Committee.
### 6.3.1 Course sequence for a student admitted with a BS in Electrical Engineering.

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**Qualifying Exam**

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**Comprehensive Exam**
### Course sequence for a student admitted with an MS in Electrical Engineering

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#### Course sequence for a student admitted with an MS in Electrical Engineering

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**Qualifying Exam**

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Table 5.1: Summary of Credit Distribution
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6.4 Curriculum Coherence and Sufficiency

The curriculum is the instrument to implement the process to meet the program educational objectives and achieve the desired student profile. The mapping between curriculum components (courses, seminar, and dissertation) and profile skills is summarized in Table 5.3. Skills 1,3,4 and 12 in the student profile will be addressed by means of course work. Skills 5,6,7,8,9,10 and 11 of the student profile will be gained through the doctoral seminar. Skills 2,4,5,6,8,10 and 12 in the student profile will be gained through the preparation of the thesis proposal and dissertation. The mathematical requirements have been included to help our students develop the analytical skills and the capability for abstract thinking needed to pursue doctoral level research work and study the advanced technical literature.

6.5 Educational Method

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

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

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

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

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### 6.6 Assessment of Student Learning

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

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

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

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

### 6.7 Course Syllabus

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

### 7 Admission, Registration and Graduation

#### 7.1 Admission Requirements

General requirements necessary for admission into the graduate program appear in the section titled NORMS WHICH REGULATE GRADUATE STUDIES AT UPRM which at the moment of writing this proposal are established in Certifications 97-21 and 97-55 issued by the UPRM Academic Senate. Specific program requirements are as follows:

- Bachelor Degree or Master’s Degree in Electrical Engineering, Computer Engineering or their equivalents from an accredited institution of higher learning. The graduate departmental committee will evaluate each applicant’s qualifications and the reputation of their graduating institution to determine if the applicant fulfills admission requirements of the doctoral program and decide on the type of admission to be awarded.
- Applicants with a bachelor degree or a master’s degree in other types of engineering, in science, in mathematics or in related areas may be considered for direct admission into the electrical engineering doctoral program. Depending on the applicant’s academic background, admission may be granted with deficiency courses or a master degree in Electrical or Computer Engineering may be recommended before admission into the doctoral program.
- A general grade point average of 3.3/4.0 or its equivalent if the applicant holds a BS degree
• A general grade point average of 3.3/4.0 GPA or its equivalent if the applicant holds an MS degree or a higher degree.
• Mastery of both English and Spanish skills that may allow understanding of printed publications in the areas of electrical and computer engineering and related areas, and to write technical documents in both languages.

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

### 7.2 Enrollment Projections

It is estimated that at least five students will be admitted to the program annually during the initial five years. At present, the department has the required physical infrastructure to accommodate these students.

Having these doctoral candidates will strengthen research endeavors within the department by increasing external funding given to the same and contributing to the improvement and development of physical facilities. Furthermore, a stronger research program will attract applicants to all existing graduate programs in the department. This has already been evidenced by graduate programs such as the Master’s degree program in Electrical Engineering and Computer Engineering, where admissions have tripled from 1998-1999 through 2003-2004 as evidenced on Figure 2.1.

### 7.3 Academic Requirements for Conferring the Degree

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

#### 7.3.1 Total Credit-Hour Requirement

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

- 18 credits in graduate or advanced undergraduate level courses within a particular area of specialization
- 6 credits in advanced graduate courses (8000 or higher) within the area of specialization
- 6 credits in graduate or advanced undergraduate level mathematics courses. At least one course must be at the graduate level.
- 6 credits in elective courses outside the area of specialization
- 1 credit in doctoral seminar
- 12 credits in doctoral dissertation

No more than 9 credits at the advanced undergraduate level can be used to complete doctoral degree course requirements.

#### 7.3.2 Minimal Academic Index Requirements

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

7.3.3 Maximum Number of Transfer Credits to be Allowed
Courses taken at UPRM in fulfillment of requirements of another graduate program may be utilized to fulfill the requirements of the doctoral program. Courses taken at other institutions of higher learning may be utilized to fulfill doctoral program requirements but are subject to residency requirements specified in “Norms that Regulate Graduate Studies at UPRM” which at the moment of writing this proposal require that 60% of the courses to be taken at UPRM. The departmental graduate committee will determine in all cases the number of transfer credits. All transfer courses must have been approved with a minimum grade of B. Under no condition may thesis credits be transferred.

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

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

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

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

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

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

7.3.8 Dissertation
All Ph.D. candidates must undertake an independent research project that is a significant contribution to the advancement of knowledge in the area of specialization. All doctoral candidates must pass the oral exam in defense of his dissertation. Students must have passed the qualifying exam in order to register for the doctoral dissertation course, and have passed the comprehensive exam before defending the thesis.

7.3.9 Language Requirements
This program has no language requirements

7.3.10 Time Limit for Program Completion
The time limit to complete the degree will be determined by the “Norms that Regulate Graduate Studies at UPRM” which at the time of the publication of this proposal are as follows:

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

8 Available Faculty

8.1 Program Faculty Credentials
The Department includes the necessary faculty members to initiate this program. At present, the department has 61 professors, of which, 38 have pledged support to the proposed program. The department has five professors on study leave who are pursuing PhD’s in universities in the United States. These professors should become active participants in the proposed program once they finish their degrees. Table 8.1 summarizes the faculty’s academic background and their possible course offerings. All faculty participating in the program is capable of teaching the Special Topics/Problems courses INEL 5995, INEL 6995, INEL 8X95, INEL 8X96, and 8997 in topics associated with their research work and area of specialization as well as the Disertation (INEL 8999) and Seminar (INEL 8998) courses. Table 8.2 summarizes Faculty on study leave and the institutions where they are conducting their graduate work. All program professors in Table 8.1 have either a tenure-track or tenure status. Individual biosketches of participating pro-
8.1.1 Publications
The available faculty for the proposed program is very active in their area of research as evidenced by the number of publications and the amount of external funding received by the Department in past years. All together, during the last five years, they have published over 200 peer reviewed articles in their respective research areas. Appendix D presents a partial list of publications from the last five years. More recent information about publications can be found in the Faculty CVs on Appendix C.

8.1.2 Research
The Department of Electrical and Computer Engineering is one of the leaders in research in the UPR system. During the last ten years, external funding secured by professors for the department averages over $4 million annually. The department’s faculty bring in close to one-fifth of the total external funding awarded to UPRM. A sample of active projects and participating faculty are shown in Table 8.3. The following are various statistics associated with research taken from the 2003-04 academic year supporting the claims above. All statistics were provided by the Center for Research and Development (CID, by its Spanish initials) at UPRM.

- The department submitted 22 proposals through the CID. This represents 16% of all proposals submitted by the College of Engineering and 10% of the total submitted by all academic departments at UPRM.
- The department obtained $4.36 M in external funding, making it the department with the most external funding this year. This represents 41% of all funding obtained by the College of Engineering and 15% of the total obtained by all departments at UPRM.
- The department awarded a total of 167 graduate-teaching assistantships, the second largest of all departments at UPRM (171 in Marine Sciences). The department was responsible for 20% of all graduate-teaching assistantships awarded at UPRM and of 21% of all funding awarded for this purpose.
- The department awarded 178 undergraduate assistantships, the highest of any department at UPRM. The department was responsible for granting 33% of all undergraduate assistantships offered at UPRM and of 27% of all funding utilized for such purposes. These assistantships were awarded with external funds.
- The department awarded 114 additional compensations for research and support personnel at UPRM, making it the department with the highest number in UPRM.
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<tr>
<td>Name</td>
<td>Type of Position</td>
<td>Rank</td>
<td>Degree - Year</td>
<td>Institution</td>
<td>Specialty Area</td>
<td>Courses to teach (all courses are INEL)</td>
<td>Expected Academic load in credits</td>
<td>Expected Number of Preparations</td>
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<tr>
<td>HENRICK MARIO IERKKIC</td>
<td>Permanent</td>
<td>Professor</td>
<td>Ph.D. 1980</td>
<td>Cornell University</td>
<td>Electromagnetics</td>
<td>5315, 5316, 6078, 6105, 6106, 8395, 8396, 8995, 8997, 8998, 8999</td>
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<tr>
<td>AGUSTIN A. IRIZARRY RIVERA</td>
<td>Permanent</td>
<td>Professor</td>
<td>Ph.D. 1996</td>
<td>Iowa State University</td>
<td>Power</td>
<td>5406, 6025, 6027, 6028, 8495, 8995, 8997, 8998, 8999</td>
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<tr>
<td>MANUEL A. JIMENEZ-CEDENO</td>
<td>Permanent</td>
<td>Professor</td>
<td>Ph.D. 1999</td>
<td>Michigan State University</td>
<td>Electronics</td>
<td>5206, 5265, 6048, 6055, 6075, 6079, 6080, 8295, 8995, 8997, 8998, 8999</td>
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<tr>
<td>LUIS O. JIMENEZ RODRIGUEZ</td>
<td>Permanent</td>
<td>Professor</td>
<td>Ph.D. 1996</td>
<td>Purdue University</td>
<td>Signal Processing</td>
<td>5046, 6007, 6078, 8395, 8995, 8997, 8998, 8999</td>
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<tr>
<td>EDUARDO J. JUAN</td>
<td>Permanent</td>
<td>Assistant Professor</td>
<td>Ph.D. 2001</td>
<td>Purdue University</td>
<td>Control</td>
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<tr>
<td>KEJIE LU</td>
<td>Tenure Track</td>
<td>Assistant Professor</td>
<td>Ph.D. 2003</td>
<td>University of Texas at Dallas</td>
<td>Electronics</td>
<td>6076, 6078, 8395, 8995, 8997, 8998, 8999</td>
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<tr>
<td>VIDYA MANIAN</td>
<td>Tenure Track</td>
<td>Assistant Professor</td>
<td>Ph.D. 2004</td>
<td>University of Puerto Rico at Mayaguez</td>
<td>Signal Processing</td>
<td>5046, 5327, 6007, 6088, 8395, 8995, 8997, 8998, 8999</td>
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<tr>
<td>EFRAIN O’NEILL CARRILLO</td>
<td>Permanent</td>
<td>Professor</td>
<td>Ph.D. 1999</td>
<td>Arizona State University</td>
<td>Power Systems</td>
<td>6025, 6096, 8495, 8496, 8995, 8997, 8998, 8999</td>
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<tr>
<td>LIONEL R. ORAMA-EXCLUSA</td>
<td>Permanent</td>
<td>Professor</td>
<td>Ph.D. 1997</td>
<td>Rensselaer Polytechnic Institute</td>
<td>Power Systems</td>
<td>5406, 5415, 6077, 8495, 8995, 8997, 8998, 8999</td>
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<tr>
<td>EDUARDO L. ORTIZ-RIVERA</td>
<td>Tenure Track</td>
<td>Assistant Professor</td>
<td>Ph.D. 2006</td>
<td>Michigan State University</td>
<td>Control Systems and Power Electronics</td>
<td>5505, 6000, 6047, 6085, 6058, 8496, 8995, 8997, 8998, 8999</td>
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<tr>
<td>ROGELIO PALOMERA-GARCIA</td>
<td>Permanent</td>
<td>Professor</td>
<td>Sc.D. 1979</td>
<td>Swiss Federal Polytechnical Institute</td>
<td>Electronics</td>
<td>5206, 5265, 6055, 6075, 6080, 8295, 8995, 8997, 8998, 8999</td>
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<tr>
<td>HAMED PARSIANI</td>
<td>Permanent</td>
<td>Professor</td>
<td>Ph.D. 1979</td>
<td>Texas A&amp;M University</td>
<td>Signal Processing</td>
<td>5307, 5327, 6078, 8395, 8396, 8995, 8997, 8998, 8999</td>
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<td>Rank</td>
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<td>Courses to teach (all courses are INEL)</td>
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<td>DOMINGO RODRIGUEZ</td>
<td>Permanent</td>
<td>Professor</td>
<td>Ph.D. 1988</td>
<td>City University of New York</td>
<td>Signal Processing</td>
<td>5309, 5326, 6049, 6050, 8395, 8995, 8997, 8998, 8999</td>
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<tr>
<td>MANUEL RODRIGUEZ-MARTINEZ</td>
<td>Permanent</td>
<td>Associate Professor</td>
<td>Ph.D. 2001</td>
<td>University of Maryland at College Park</td>
<td>Computer Engineering</td>
<td>8395, 8995, 8997, 8998, 8999</td>
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<tr>
<td>NESTOR J. RODRIGUEZ</td>
<td>Permanent</td>
<td>Professor</td>
<td>Ph.D. 1990</td>
<td>University of Wisconsin – Madison</td>
<td>Computer Engineering</td>
<td>8099, 8295, 8995, 8997, 8998, 8999</td>
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<tr>
<td>RAFAEL A. RODRIGUEZ - SOLIS</td>
<td>Permanent</td>
<td>Professor</td>
<td>Ph.D. 1997</td>
<td>Pennsylvania State University</td>
<td>Electromagnetics</td>
<td>5305, 5306, 5325, 6068, 6105, 8396, 8995, 8997, 8998, 8999</td>
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<tr>
<td>JOSE M. ROSADO-ROMAN</td>
<td>Permanent</td>
<td>Associate Professor</td>
<td>Ph.D. 1999</td>
<td>Cornell University</td>
<td>Electromagnetics</td>
<td>5029, 6216, 8396, 8995, 8997, 8998, 8999</td>
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<tr>
<td>NAYDA G. SANTIAGO</td>
<td>Tenure Track</td>
<td>Assistant Professor</td>
<td>Ph.D. 2003</td>
<td>Michigan State University</td>
<td>Computer Engineering</td>
<td>6009, 8295, 8395, 8995, 8997, 8998, 8999</td>
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<tr>
<td>JAIME SEGUEL</td>
<td>Permanent</td>
<td>Professor</td>
<td>Ph.D. 1987</td>
<td>City U. of New York</td>
<td>Computer Engineering</td>
<td>8995, 8997, 8998, 8999</td>
<td>Assoc. Dean</td>
<td>3</td>
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<tr>
<td>NELSON SEPULVEDA</td>
<td>Tenure Track</td>
<td>Assistant Professor</td>
<td>Ph.D. 2005</td>
<td>Michigan State U.</td>
<td>Electronics</td>
<td>6055, 8295, 8396, 8995, 8997, 8998, 8999</td>
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<tr>
<td>GUILLERMO J. SERRANO-RIVERA</td>
<td>Tenure Track</td>
<td>Assistant Professor</td>
<td>2007</td>
<td>Georgia Institute of Technology</td>
<td>Electronics</td>
<td>5265, 8295, 8995, 8997, 8998, 8999</td>
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<tr>
<td>JUAN E. SURIS</td>
<td>Tenure Track</td>
<td>Assistant Professor</td>
<td>2007</td>
<td>Virginia Polytechnic Institute</td>
<td>Computer Engineering</td>
<td>8395, 8995, 8997, 8998, 8999</td>
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</tr>
<tr>
<td>RAUL E. TORRES MUNIZ</td>
<td>Permanent</td>
<td>Associate Professor</td>
<td>Ph.D. 1998</td>
<td>University of Virginia</td>
<td>Control Systems</td>
<td>5516, 6059, 6088, 8395, 8995, 8997, 8998, 8999</td>
<td>6</td>
<td>2</td>
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<tr>
<td>RAMON E. VASQUEZ ESPINOSA</td>
<td>Permanent</td>
<td>Professor</td>
<td>Ph.D. 1984</td>
<td>Louisiana State U.</td>
<td>Signal Processing</td>
<td>5046, 6007, 6088, 8395, 8995, 8997, 8998, 8999</td>
<td>Dean</td>
<td>N/A</td>
</tr>
<tr>
<td>J. FERNANDO VEGA-RIVERA</td>
<td>Permanent</td>
<td>Professor</td>
<td>Ph.D. 1989</td>
<td>Syracuse University</td>
<td>Signal Processing</td>
<td>5046, 8395, 8995, 8997, 8998, 8999</td>
<td>6</td>
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<tr>
<td>MIGUEL VELEZ-REYES</td>
<td>Permanent</td>
<td>Professor</td>
<td>Ph.D. 1992</td>
<td>MIT</td>
<td>Control Systems and Signal Processing</td>
<td>6000, 6007, 6047, 6076, 6078, 8395, 8995, 8997, 8998, 8999</td>
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<tr>
<td>KRISHNASWAMY VENKATESSAN</td>
<td>Permanent</td>
<td>Professor</td>
<td>Ph.D. 1974</td>
<td>University of Roorkee</td>
<td>Power Electronics</td>
<td>5408, 6085, 6066, 8496, 8995, 8997, 8998, 8999</td>
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Table 8.2: Faculty Members on Study Leave

<table>
<thead>
<tr>
<th>Name</th>
<th>Area</th>
<th>Institution</th>
<th>Expected Graduation</th>
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<tr>
<td>Lizdabel Morales</td>
<td>Communication Systems</td>
<td>Virginia Tech</td>
<td>Dec 2009</td>
</tr>
<tr>
<td>Dalimar Vélez</td>
<td>Signal Processing</td>
<td>Michigan State University</td>
<td>May 2010</td>
</tr>
<tr>
<td>Jessica Jiménez</td>
<td>Signal Processing</td>
<td>University of California at Berkley</td>
<td>May 2013</td>
</tr>
<tr>
<td>Felix Fernández</td>
<td>Electronics</td>
<td>University of California at Berkley</td>
<td>May 2010</td>
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</table>

Figure 8.1 Total Research dollars for ECE and percentage of ECE research dollars within the School of Engineering

Figure 8.2 Ratio of External to Institutional Assistantships for different departments within the School of Engineering
### Table 8.3: Sample of Research Projects in the ECE Department.

<table>
<thead>
<tr>
<th>Project Title</th>
<th>Funding Agency</th>
<th>Award</th>
<th>Duration</th>
<th>ECE Faculty Involved</th>
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</thead>
<tbody>
<tr>
<td>Center for Power Electronic Systems</td>
<td>NSF/ERC</td>
<td>1,450,000*</td>
<td>2003-08</td>
<td>Miguel Vélez, Efraín Oneill, Ricardo Cedeño, Manuel Jiménez, Carlos Cuadros</td>
</tr>
<tr>
<td>Center for Subsurface Sensing and Imaging Systems</td>
<td>NSF/ERC</td>
<td>3,700,000*</td>
<td>2000-05</td>
<td>Miguel Vélez, Luis Jiménez, Shawn Hunt, Raúl Torres, Wilson Rivera, José L. Cruz, Rafael Rodríguez, Sandra Cruz, José Colom</td>
</tr>
<tr>
<td>Collaborative Adaptive Sensing of the Atmosphere Engineering Research Center</td>
<td>NSF/ERC</td>
<td>3,113,000*</td>
<td>2003-08</td>
<td>Sandra Cruz, José Colom, Rafael Rodríguez, Lionel Orama, Shawn Hunt, Mario Ierkic</td>
</tr>
<tr>
<td>PRECISE</td>
<td>NSF</td>
<td>1,500,000</td>
<td>1999-04</td>
<td>Domingo Rodríguez, Ramón Vásquez, Jaime Seguel, Wilson Rivera, Néstor Rodríguez, José Borges</td>
</tr>
<tr>
<td>Tropical Center for Earth and Space Studies</td>
<td>NASA University Research Centers Program</td>
<td>8,500,000</td>
<td>2000-05</td>
<td>Miguel Vélez, Rafael Fernández, Shawn Hunt, Luis Jiménez, Ramón Vásquez, Hamed Parsiani, Rafael Rodríguez, Sandra Cruz</td>
</tr>
<tr>
<td>EPNES: Intelligent Power Routers for Distributed Coordination in Electric Energy Processing Networks</td>
<td>NSF</td>
<td>500,000</td>
<td>2002-05</td>
<td>Agustín Irizarry, Efraín Oneill, Ricardo Cedeño, Manuel Rodríguez, Bienvenido Vélez</td>
</tr>
<tr>
<td>Acoustical Guidance of Liquid Filled Tubes and Catheters</td>
<td>NIH</td>
<td>78,000</td>
<td>2003-07</td>
<td>Eduardo Juan</td>
</tr>
<tr>
<td>E-Government</td>
<td>NSF</td>
<td>750,000</td>
<td>2003-06</td>
<td>Bienvenido Vélez, Manuel Rodríguez, Wilson Rivera</td>
</tr>
<tr>
<td>Tera-Scale Facility</td>
<td>IBM</td>
<td>$100,000</td>
<td>2003</td>
<td>Manuel Rodríguez, Bienvenido Vélez, Jaime Seguel, Wilson Rivera, Pedro Rivera</td>
</tr>
<tr>
<td>Parameter Estimation of Ill Conditioned Systems with Applications to Electric Drives and Power Systems</td>
<td>NSF PECASE</td>
<td>677,000</td>
<td>1997-03</td>
<td>Miguel Vélez</td>
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<tr>
<td>Advanced Technology Platforms</td>
<td>HP</td>
<td>Wilson Rivera</td>
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<tr>
<td>Wideband Slot-like Antennas</td>
<td>NSF CAREER</td>
<td>584,000</td>
<td>2001-06</td>
<td>Rafael Rodríguez</td>
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<tr>
<td>Power Quality Research and Education</td>
<td>NSF CAREER</td>
<td>530,000</td>
<td>2002-07</td>
<td>Efraín O’Neill</td>
</tr>
<tr>
<td>Acquisition of Instrumentation for the Electric Energy Processing Systems Laboratory</td>
<td>NSF MRI</td>
<td>210,848</td>
<td>2002-03</td>
<td>Efraín Oneill, Miguel Vélez, Lionel Orama, Ricardo Cedeño</td>
</tr>
<tr>
<td>Integrating Laboratory Practices and Undergraduate Research to the Power Engineering Curriculum at UPRM</td>
<td>NSF CCLI</td>
<td>2001-2003</td>
<td>162,902</td>
<td>Efraín Oneill, Miguel Vélez</td>
</tr>
<tr>
<td>Iterative Algorithms for Unmixing Hyperspectral Data</td>
<td>Mission Research Co</td>
<td>$10,000</td>
<td>2003</td>
<td>Miguel Vélez</td>
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<tr>
<td>Development of a Compact, Air Cooled Solar Air Conditioning System</td>
<td>NSF STTR</td>
<td>$500,000</td>
<td>2002-05</td>
<td>Gerson Beauchamp</td>
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<tr>
<td>Microwave Remote Sensing of Clouds</td>
<td>NASA FAR</td>
<td>$300,000</td>
<td>2002-05</td>
<td>Sandra Cruz</td>
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<tr>
<td>Modeling of MMIC Passive Structures for mm-waves</td>
<td>Raytheon</td>
<td>$51,000</td>
<td>2000-03</td>
<td>José Colom</td>
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<tr>
<td>PR Wind Resource Assessment</td>
<td>AAE</td>
<td>$32,000</td>
<td>2003</td>
<td>Agustín Irizarry</td>
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</tbody>
</table>
8.1.3 Honors and Distinctions

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

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

- **NSF CAREER Award Recipients**: The “Early Career Development Program” is a program supported by all NSF directorates, and is the most prestigious award the Foundation has for new faculty members. The “CAREER” program acknowledges and supports professional development activities of those teaching—professors who will probably become the academic leaders of the 21st century. Those awarded with the CAREERS distinction are selected on the
basis of their creative professional development endeavors in effectively integrating research and education within the mission of the institution. These plans must build a solid foundation for lifelong integrated contributions in research and education. Five members of our department have been distinguished with “CAREER” awards. Four of them are presently available to participate in the proposed doctoral program: Dr. José Luis Cruz (1997), Dr. Rafael Rodríguez Solís (2001), and Dr. Efraín O’Neill (2002) and Dr. Manuel Rodríguez Martínez (2005).

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

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

Finally, it is important to distinguish those members of our departmental faculty who have been actively involved in professional association such as Colegio de Ingenieros y Arquitectos de Puerto Rico, The American Society of Engineering Educators (ASEE) and the Institute of Electrical and Electronics Engineers (IEEE). Multiple symposia, conferences, and national and international workshops have been organized in Puerto Rico. Those hosted most recently include:

- IEEE Workshop on Computers in Power Electronics, June 2002
- Caribbean Colloquium in Power Quality, June 2003
- Parallel and Distributing Computer Workshop, November 2003

By awarding the distinction of “Senior Members” to several of our professors, the IEEE has acknowledged professional contributions by our faculty:

1. Dr. Thomas L. Noack (Life Senior Member)
2. Dr. Ramón Vásquez Espinosa
3. Dr. José L. Cruz
4. Dr. Miguel Vélez Reyes
5. Dr. K. Venkatesan
6. Dr. Alberto Ramírez
7. Dr. Sandra Cruz-Pol
8. Dr. Efrain O’Neill-Carrillo
9. Dr. Isidoro Couvertier
10. Dr. Kejie Lu
11. Dr. José Rosado
12. Dr. Raúl Torres
13. Dr. Fernando Vega
This distinction is awarded to only 7% of the association’s membership—the largest professional association in the world.

It is clear that the faculty available for the proposed doctoral program is highly qualified and brings a large diversity in research endeavors and interests.

9 Program Administration

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

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

The Departmental Graduate Committee is responsible for the elaboration of academic regulations applicable to the departmental graduate program. In addition, in accordance with Certification 97-21 Norms for Graduate Studies at UPRM, it has the following responsibilities:

- Evaluate admission, readmission, and transfer applications and submit recommendations to the Faculty Dean for a final decision.
- Award credit-equivalencies for courses taken and approved at other universities.
- Award credit equivalencies for courses approved prior to admission.
- Determine the procedure for the elaboration, administration and evaluation of qualifying and comprehensive exams, as defined by departmental programs.
- Promote the Graduate Program.
- Periodic evaluations of the Graduate Program’s progress and rate of success through activities such as, and including, the evaluation of program graduates.

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

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

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

The department has an ‘Oficial de Asuntos Estudiantiles II’ (Student Affairs Officer II), which has the following duties:

• Assist the director in calculating the demand and offerings, establishing capacity and schedules of graduate courses for regular and summer semesters.
• Coordinate preregistration and registration for graduate students. Register graduate students in collaboration with the Associate Director and work on adjustments to these as required. In coordination with the Associate Director, prepare and publish for use on university bulletin boards information and registration instructions. Serve the graduate students during registration and the adjustment periods.
• Work on orientation about the graduate program for graduate students and visitors, including program offerings, admission requirements and academic regulations.
• Counsel graduate students on their programs of study and academic regulations.
• Collaborate with the graduate committee on admission application evaluation and processing. Prepare the applicant profile and in area GPA. Maintain a digital database of applicants for report statistics. Communicate with admitted students to offer information about their admissions, assistantships and registration processes.
• Assist in the assignment of teaching assistantships and graders.
• Maintain a digital database of departmental graduate students for statistical reports and monitor their academic progress.
• Assist in the orientation of new graduate students.
• Assist the Associate Director and area coordinators in the preparing class schedules for newly admitted students and their registration.
• Prepare documents and statistical reports. Provide the projected assistantship budget to the Director. Provide information and statistical reports to the Director as required.
• Assist the Associate Director in preparing and publishing the projected five year graduate course offerings.
• Coordinate the preparation of promotional material and participate in activities which promote the programs as required by the Director.
• Collaborate with the Director and Graduate Committee in activities related to the departmental graduate programs.

10 Information Resources

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

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

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

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

11 Physical Installation and Equipment

11.1 Inventory of Available Facilities
The department has approximately 58,600 square feet of classroom, office and laboratory space, which are distributed between Stefani Building and the UPRM Research and Development Center. The space devoted to research and teaching laboratories that will provide direct support to the doctoral program consists of approximately 8,639 square feet. Research laboratories include instrumentation and computer equipment that serve to support the type of research which typically characterizes a doctoral program in Electrical Engineering. This infrastructure has been achieved through a series of proposals submitted to NSF, NASA, the Department of Defense, and private companies such as Texas Instruments, Lockheed Martin, Intel, IBM, Raytheon, Kodak, and Hewlett Packard. During the past five years, over two million dollars has been employed to improve the Department of Electrical and Computer Engineering’s infrastructure.

The facilities include seven laboratories that support undergraduate courses, and courses at the advanced and graduate levels. A list of these laboratories is included below:

- Control Systems Laboratory
- Communication and Signal Processing Laboratory
- Applied Electromagnetic Group Laboratory
- Energy Systems Instrumentation Laboratory
- Automation and Robotics Laboratory
- Microprocessor Interfacing Laboratory
- Integrated Circuit Design Laboratory
Tools and Toys Laboratory

Besides the aforementioned laboratories, the department houses ten laboratories mainly devoted to research that will provide key support to the proposed doctoral program in Electrical Engineering. A list follows.

- Laboratory for Applied Remote Sensing and Image Processing
- Electric Energy Processing Systems Laboratory
- Power Quality Laboratory
- Power Electronics Laboratory
- CLIMMATE
- Radiation Laboratory
- Rapid Prototyping Laboratory
- Bioengineering Instrumentation Laboratory
- Automated Information Processing Laboratory

A more detailed explanation of the equipment available in each of these laboratory facilities may be found in Appendix E. A more updated description can be found in the Internet at this address:

http://ece.uprm.edu/engineering/nelicom/pages/resources/computational_resources.htm

11.2 Program’s Impact on Existing Physical Installations

The existing laboratory infrastructure is adequate to provide the necessary resources to support the program. It is our expectation that the doctoral program will serve as a catalyst for obtaining resources that will contribute to the improvement and development of research laboratories. In addition, the construction of a new building to house the Department of Electrical and Computer Engineering as well as the proposed Department of Computing Sciences and Engineering will provide improved long-term facilities.

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

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

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

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

12 Student Services

12.1 Student Support and Service System

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

The ECE department has an ‘Oficial de Asuntos Estudiantiles II’ (Student Affairs Officer II) available from 7:45 am to 4:30 pm, which has the following student support duties:

- Coordinate preregistration and registration for graduate students. Register graduate students in collaboration with the Associate Director and work on adjustments to these as required. In coordination with the Associate Director, prepare and publish for use on university bulletin boards information and registration instructions. Serve the graduate students during registration and the adjustment periods.
- Work on orientation about the graduate program for graduate students and visitors, including program offerings, admission requirements and academic regulations.
- Counsel graduate students on their programs of study and academic regulations.
- Collaborate with the graduate committee on admission application evaluation and processing. Prepare the applicant profile and in area GPA. Maintain a digital database of applicants for report statistics. Communicate with admitted students to offer information about their admissions, assistantships and registration processes.
- Assist in the assignment of teaching and grader assistantships.
- Maintain a digital database of departmental graduate students for statistical reports and monitor their academic progress.
- Assist in the orientation of new graduate students.
- Assist the Associate Director and area coordinators in the preparing class schedules for newly admitted students and their registration.

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

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

12.2 Financial Aid

At present, the Department of Electrical Engineering and Computers has been able to provide a considerable number of graduate teaching assistantships. These aides fall into two categories: teaching assistantships and research assistantships. Funding for research assistantships stems primarily from external funds which have been allocated for research, while funding for teaching assistantships come from the general fund of the University of Puerto Rico. The department grants approximately 33% of all assistantships awarded to graduate and undergraduate students on campus. During the 2004-2005 academic year, including summer 2004, the department awarded $1,097,263 (40% of the assistantships in the school of engineering) in teaching assistantships of which $849,667 came from external funding sources.
The establishment of the new program will serve as the means to increase research efforts. It is our hope that this increase in research activity will serve, in turn, to increase external funding which, among other things, will result in our providing a higher number of assistantships for graduate students. Nevertheless, in order to facilitate research for newly hired professors, it is essential to provide seed money to fund, among other things, one graduate assistantship for the first two years. This is included in the proposal budget.

13 Catalogue and Promotion

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

**Doctoral Program in Electrical Engineering**

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

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

- 18 credits in graduate or advanced undergraduate courses within the area of specialization
- 6 credits in advanced courses (8000 or higher) in the area of specialization
- 6 credits in mathematics courses at the graduate or advanced undergraduate level. At least one course must be at the graduate level.
- 6 credits in elective courses outside the area of specialization.
- 1 credit in the doctoral seminar.

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

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

The doctoral program can be initiated with the existing departmental financial and physical infrastructure resources. Additional funding is requested to strengthen library resources, and for research assistantships in support of junior faculty in the department. The requested budget is described on Table 14.1.

There are $20k of recurrent funding for the library to purchase and fund bibliographical resources in support of the program. Additional non-recurrent funding is requested for student assistantships. In year 1, $18,340 are allocated for 2 student research assistantships and $20,000 for bibliographical resources. In years 2 to 5, funding for 4 assistantships per year has been allocated. The assistantships will be directed, primarily, towards junior faculty who are in the beginning of their academic careers and do not have funding to support graduate students. Students will receive $917/month for ten months and a tuition waiver for students that have not taken the qualifier exam. For students who have passed their qualifying exam, the monthly stipend is increased to $1,057.

### 15 Evaluation and Assessment Plan

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

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

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

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

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

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

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

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

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

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

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

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

In addition, during the first five years of the program, there will be an external advisory board (EAB) of four persons, composed of scientists and engineers from academia, industry and government who will assess the program based on visits every two years and statistical reports. The committee will produce a report and submit it to the Department. The graduate committee, along with the Associate Director, will have 90 days to respond to the report and establish a plan to solve any weaknesses or threats found by the committee. We are planning to have visits of the EAB in years 1, 3 and 5.

16 Development Plan

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

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

16.1 Budget Plan

The budget plan for the first five years of the program is described in Section 14.

16.2 New courses to create

New courses to be created as part of the program are described in Section 6.2.2.
16.3 Research Funding
Research activities already described in Section 8.1.2 and Table 8.3 lists sample research projects at the ECE Department.

At present, the exact amount of external funds available for the proposed program cannot be determined. Nevertheless, based on previous experience, it is expected that external funding for the program will be significant. The Department of Electrical Engineering and Computers has brought in an annual average of over $4,000,000 during recent years for research and development projects which constitutes over 20% of the total external funding received by UPRM. It is our understanding that the Department has the capability to maintain and increase the amount of external funds to be received during the next five years.

16.4 Faculty Development Plan

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

Presently, the department sponsors several professors on study leave who are being paid by UPRM to work towards their PhD degree. Their names and corresponding universities appear on Table 8.2. At the conclusion of their doctoral studies, these professors will become active participants in the program.

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

16.5 Plan for the Improvement of Existing Library Resources
What follows is a five-year plan aimed at continually improving existing library resources with the objective of addressing the proposed program’s needs during the next five years. The plan is divided in four principal parts: book acquisition, serial publication acquisition, audiovisual resources acquisition, and increased electronic access to documentation and databases.

16.5.1 Acquisition of Bibliographical and Audio Visual Resources
This proposal requests, from university administration, that $20,000 per year be assigned to the library to purchase bibliographical and audiovisual resources to support the doctoral program. A list of bibliographical and audiovisual resources for use by departmental students and faculty will be sent to the library. Once the funds are allocated to the program they will be transferred to the library. This will be coordinated by the departmental representative to the Library Committee of the Faculty of Engineering.
16.5.2 Acquisition of Serial Publications

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

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

16.5.3 Electronic Database Access

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

16.6 Proposed Program’s Demand

It is estimated that at least five students will be admitted to the program annually during the initial five years. At present, the department has the required physical infrastructure to accommodate these students.

Based on the number of applications vs. the number of admissions during the last five years for the Electrical and Computer Engineering master degrees, shown in Figures 2.1 and 2.2, we anticipate that the demand for a doctoral program will be significant. During the last five years, the number of applications to the department graduate programs has tripled. These come primarily from Puerto Rico and Latin America. For example, of the 30 students admitted to the Electrical Engineering masters program, 18 were from Puerto Rico, 9 from Colombia, one from Peru, one from Cuba and one from the Dominican Republic. Of the 11 admitted to the Computer Engineering masters program, 8 were from Puerto Rico and USA, 3 from Colombia, and one from Bolivia.

Figures 2.3 and 2.4 show the enrollment in the Electrical and Computer Engineering masters programs for the last 10 years. Our experience shows that a large number of these students would continue doctoral studies toward a PhD in Electrical Engineering if it was available.

In Puerto Rico, in addition to UPRM students, students from the undergraduate and graduate programs from Universidad Politécnica, Universidad Interamericana at Bayamón and Universidad del Turabo would be potential candidates for the proposed program. The program will be promoted in Puerto Rico, in the United States, and in Latin America in order to attract qualified candidates.

16.6.1 Employment Opportunities for Program Graduates

The program intends to develop professional engineers capable of contributing to the development of electrical engineering infrastructure in Puerto Rico, to industrial development and research, to academic research and education. This broad spectrum of possibilities provides all
program graduates with concrete and diverse employment options in Puerto Rico, the United States and Latin America.

According to existing statistics provided by the National Science Foundation, the job market for engineers with doctoral degrees in science and engineering for the past five years is a very healthy one with less than 1.5% unemployment rate. Of those electrical engineering PhD’s polled by NSF, approximately 70% had industry-related jobs, 21% were employed by academia and 6% by government agencies. With the creation of new industries dedicated to research and development, following the plans of the Government of Puerto Rico for economic transformation, the job market for engineers with Doctoral degrees in Puerto Rico is expected to be similar to the statistics quoted above. In addition, program graduates have the opportunity to join the electrical engineering faculties of the Polytechnic, Turabo, and Interamerican Universities.

**16.7 Evaluation and Assessment Plan**

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

![Graph: Applications and Admissions to the Electrical Engineering Masters Program](image)

Figure 16.1: Applications and Admissions to the Electrical Engineering Masters Program.
Figure 16.2: Applications and Admissions to the Computer Engineering Masters Program.

Figure 16.3: Students Registered in the Electrical Engineering Masters Program.
Figure 16.4: Students Registered in the Computer Engineering Masters Program.

17 References


Certification 97-21 of the UPRM Academic Senate: Normas que Rigen los Estudios Graduados en el Recinto Universitario de Mayagüez:
http://grad.uprm.edu/oeg/EstudiantesActivos/Normas/#La%20Oficina

Certification 05-62 of the UPRM Academic Senate: NORMAS PARA REGIR LAS AYUDANTÍAS DE ESTUDIANTES GRADUADOS EN EL RECINTO UNIVERSITARIO DE MAYAGÜEZ.
http://grad.uprm.edu/oeg/AyudasEconomicas/Certificaciones/0562.php


National Science Foundation, Science and Engineering Indicators

MIT EECS Graduate Research Areas. http://www.eecs.mit.edu/grad/areas.html

Appendix A:
Description of Electrical Engineering Graduate Program
Track Areas
Graduate Program in Electrical Engineering: Signal Processing Track  
Department of Electrical and Computer Engineering  
University of Puerto Rico at Mayagüez

Track Summary

Signal Processing is a broad field that encompasses:
- the acquisition of data from the world around us,
- manipulating or processing that data into a useful form,
- the extraction of information from that data, and
- the interpretation of that information.

The breadth and power of signal processing is what makes it one of the key enabling technologies of the information age.

Academic Background

Students entering the program should have the following background:
1. Calculus including differential equations
2. Circuits, Signals, and Systems (discrete and continuous)
3. Programming Languages
4. Probability
4. Linear Algebra

Any student requesting admission without this background will be required to take undergraduate courses to make up for these deficiencies.

Course Requirements for the Signal Processing Track

<table>
<thead>
<tr>
<th></th>
<th>Master of Science Plan I</th>
<th>Master of Engineering Plan II</th>
<th>Master of Engineering Plan III</th>
<th>Doctoral Program (proposed)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Core courses</strong></td>
<td>2-3 courses</td>
<td>6-9 crs</td>
<td>2-3 courses</td>
<td>6-9 crs</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Major courses</strong></td>
<td>3-4 courses</td>
<td>9-12 crs</td>
<td>3-5 courses</td>
<td>9-15 crs</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Elective courses</strong></td>
<td>2-3 courses</td>
<td>6-9 crs</td>
<td>2-3 courses</td>
<td>6-9 crs</td>
</tr>
<tr>
<td><strong>Thesis</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Doctoral Seminar</strong></td>
<td></td>
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<tr>
<td><strong>Advanced Mathematics</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Project</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>30 crs</td>
<td>30 crs</td>
<td>36 crs</td>
<td>49 crs</td>
</tr>
</tbody>
</table>

A-3
The course requirement distribution for each plan of studies for the MS, ME, and PhD (proposed) degrees are shown in the table above. There are 6-9 credits of core courses. If you did not take INEL 5309 or its equivalent at the undergraduate level, you have to take it as part of your graduate program. If you had INEL 5309 you can take an additional elective (major or outside the major). Students in MS Plan I or II need to work on thesis or project. Students in the doctoral program need to complete a doctoral dissertation, and pass the comprehensive and qualifying exams.

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

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

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

**Core Courses:**
- INEL 5309 Digital Signal Processing\(^1\)
- INEL 6076 Adaptive and Optimal Signal Processing
- INEL 6078 Estimation, Detection and Stochastic Processes

**Major Courses:**
- INEL 6007 Introduction to Remote Sensing
- INEL 6049 Multidimensional Signal Processing
- INEL 6050 Advanced Digital Signal Processing Algorithms
- INEL 6088 Computer Vision
- INEL 6995 Special Topics (with emphasis in Signal Processing)
- INEL 8395 Advanced Topics in Signal Processing
- INEL 8397 Advanced Topics in Communication Systems
- INEL 8997 Independent Study (with emphasis in Signal Processing)

- INEL 5046 Pattern Recognition
- INEL 5315 Communication Theory II
- INEL 5326 Communication System Design: Signal Processing
- INEL 5327 Image Processing
- INEL 5505 Linear Systems Theory

\(^1\) If equivalent not taken previously.


**Recommended Elective Courses:**

- MATE 5150 Linear Algebra
- MATE 6025 Numerical Linear Algebra
- MATE 6045 Optimization Theory
- MATE 6677 Elementary Partial Differential Equations
- ESMA 6600 Probability Theory
- ESMA 6661 Theory of Statistics I
- ESMA 6662 Theory of Statistics II
- ESMA 6788 Advanced Probability Theory
- ESMA 6789 Stochastic Processes

and other courses selected by the student graduate committee.
Graduate Program in Electrical Engineering: Applied Electromagnetics Track  
Department of Electrical and Computer Engineering  
University of Puerto Rico at Mayagüez

Introduction

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

Description of the Track and Research Facilities

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

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

The Radiation Laboratory is a research laboratory sponsored by NSF through a Major Research Instrumentation Grant, the Collaborative and Adaptive Sensing of the Atmosphere (CASA) Engineering Research Center, and a CAREER award, and by NASA through the Tropical Center for Earth and Space Science (TCESS). This state of the art laboratory houses microwave instrumentation for network testing from 45 MHz to 50 GHz, a near-field antenna measurement facility with a frequency range of 2 to 40 GHz, a milling machine for the fabrication of prototypes at microwave frequencies and several computer workstations for the simulation and modeling of microwave and millimeter-wave circuits and antennas. The CLiMMATE Laboratory has several computer workstations for the analysis of atmospheric phenomena and the development of models for atmospheric absorption of electromagnetic energy. The Applied Electromagnetics Laboratory is primarily an instructional facility, with microwave instrumentation up to 3 GHz. This laboratory is used for demonstrations and laboratory practices for undergraduate and graduate courses.
**Academic Background**

Students entering the program must have the following background:

1. Integral, differential and vector calculus, including differential equations
2. Plane-wave propagation in lossless and lossy media
3. Plane-wave reflection and transmission at normal and oblique incidence
4. Two-port networks
5. Transmission lines
6. Smith Chart
7. Basic radiation concepts and antenna theory
8. Fourier Transforms
9. Basic Electronics

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

**Track Courses:**

**Core Course**

INEL 6216, Advanced Electromagnetics, is the core course in the Applied Electromagnetics option. All students in the option must approve this course.

**Track Courses**

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

- INEL 5029: Telecommunication Electronics
- INEL 5305: Antenna Theory and Design
- INEL 5306: Microwave Engineering
- INEL 5316: Radiowave Propagation in Wireless Communications
- INEL 6068: Microwave Antenna Engineering
- INEL 6069: Microwave Remote Sensing
- INEL 6105: Active Remote Sensing Techniques
- INEL 6106: Introduction to Radar Systems
- INEL 6115: Active Microwave Circuits

**Doctoral Courses**

- INEL 8396: Advanced Topics in Applied Electromagnetics
- INEL 8397 Advanced Topics in Communication Systems
- INEL 8997: Independent Studies

**Recommended Courses**

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

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

Guidelines for Programs of Study

Students following the Applied Electromagnetics option must approve INEL 6216, Advanced Electromagnetics; this is the core course for the option. Master students in Electrical Engineering must approve 30 credits for Plan I (M.S., Thesis) and Plan II (M.E., Project), and 36 credits for Plan III (courses only). Students seeking a Master of Science (M.S.) degree must approve 6 credits of Master Thesis (INEL 6046) and pass an oral examination on their thesis; students seeking a Master of Engineering (M.E.) degree (Plan II) must approve 3-6 credits of Engineering Project (INEL 6045) and pass an oral examination on their project.

Ph.D. students in Electrical Engineering must approve 43 credits beyond their B.S. work. They must approve six (6) credits in Advanced Topics in Applied Electromagnetics (INEL 8396), six (6) credits in graduate (5000 and above) math courses, and 12 credits in Doctoral Dissertation (INEL 8999). In addition, students must register for INEL 8998, Doctoral Seminar, every semester, pass the Qualifying Exam and the Comprehensive Exam, and successfully defend their dissertation.

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

<table>
<thead>
<tr>
<th>Course Requirements for the Applied Electromagnetics Track</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree</td>
</tr>
<tr>
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<td>Doctoral seminar</td>
</tr>
<tr>
<td>Thesis or project</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>
Research

The Applied Electromagnetics faculty is very active in research and has received more than $3.85 million in research grants since 2000 and is participating in the NSF Engineering Research Center for Collaborative and Adaptive Sensing of the Atmosphere (CASA). Current research projects include the study of microwave atmospheric absorption in clean air and in the presence of clouds and rain, the development of microwave transceiver modules for phased arrays, the characterization and development of tunable microwave circuits and antennas using electroceramic materials, the validation of rain-rate measurements using NEXRAD data and rain gauges, the modeling of wireless communication channels, the characterization and development of novel slot-like antennas and the development of phased array antennas. Research is conducted mainly at the CLiMMATE Laboratory and the Radiation Laboratory facilities. Most of the research faculty are members of the Laboratory for Remote Sensing and Image Processing (LARSIP), the Center for Subsurface Sensing and Imaging Systems (CenSSIS) and CASA NSF Engineering Research Centers. In addition, the Applied Electromagnetics group has strong research ties with the National Astronomy and Ionosphere Center, the University of Massachusetts at Amherst, the Georgia Institute of Technology and the University of Colorado at Boulder.
Graduate Program in Electrical Engineering: Control Systems Track  
Department of Electrical and Computer Engineering  
University of Puerto Rico at Mayagüez  

1. Introduction  

This document describes the Control Systems option within the graduate program in Electrical and Computer Engineering at the University of Puerto Rico-Mayagüez (UPRM). Information regarding courses, graduation requirements, research areas, and facilities is provided. The information contained in this document is useful for both prospective students who are considering applying to the Control Systems graduate option, and to graduate students currently enrolled at UPRM.  

2. Academics  

The Department of Electrical and Computer Engineering at UPRM offers the following advanced undergraduate and graduate courses in control systems engineering:  

Advanced Undergraduate Courses  

INEL 5505 Linear Systems Analysis **  
INEL 5506 Process Instrumentation and Control Engineering  
INEL 5508 Digital Control Systems  
INEL 5516 Automation and Robotics  

Graduate Courses  

INEL 6000 Introduction to Nonlinear Control Systems  
INEL 6001 Feedback Control Systems I **  
INEL 6047 Advanced Control System Theory  
INEL 6059 Intelligent Control Systems  
INEL 6078 Estimation, Detection and Stochastic Processes  
INEL 6995 Special Topics in Electrical Engineering (with emphasis in Control Systems)  
INEL 8595: Advanced Topics in Control Systems  
INEL 8997: Independent Studies (with emphasis in Control Systems)  

** Core Courses. INEL 5505 is required to students who did not take it at the undergraduate level.  

The following Table describes the credit distribution for students in the control systems track.
### Course Requirements for the Control Systems Track

<table>
<thead>
<tr>
<th>Core courses</th>
<th>Master of Science Plan I</th>
<th>Master of Engineering Plan II</th>
<th>Master of Engineering Plan III</th>
<th>Doctoral Program (proposed)</th>
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<tbody>
<tr>
<td>1-2 courses</td>
<td>3-6 crs</td>
<td>1-2 courses</td>
<td>3-6 crs</td>
<td>1-2 courses</td>
</tr>
<tr>
<td>4-5 courses</td>
<td>12-15 crs</td>
<td>4-5 courses</td>
<td>12-15 crs</td>
<td>6-7 courses</td>
</tr>
<tr>
<td>2-3 courses</td>
<td>6-9 crs</td>
<td>2-3 courses</td>
<td>6-9 crs</td>
<td>6-7 courses</td>
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<tr>
<td>Thesis</td>
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<td></td>
<td>12 crs</td>
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<tr>
<td>Doctoral Seminar</td>
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<td></td>
<td></td>
<td>1 cr</td>
</tr>
<tr>
<td>Advanced Mathematics</td>
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<td></td>
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<td>2 courses</td>
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<tr>
<td>Project</td>
<td>3-6 crs</td>
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<td>30 crs</td>
<td>30 crs</td>
<td>36 crs</td>
<td>49 crs</td>
</tr>
</tbody>
</table>

### 3. Research

All faculty members within the control systems track are actively involved in research, which results in a diverse number of research topics available for graduate students to work on. Some of these tracks include: Fuzzy Logic Based Systems, Biomedical Engineering, Non-Linear Dynamic Systems, Computer Vision, Intelligent Systems, and System Identification.
1. INTRODUCTION

This document defines the graduate tracks within the Power Engineering Program at the University of Puerto Rico-Mayagüez (UPRM). Courses within each option are identified. The purpose of this document is to facilitate the admissions process by clearly stating which are the minimum requirements for power engineering. The information in this document is also useful to graduate students preparing their programs of study.

2. DEFINITION OF THE TRACK

Power Engineering deals with the efficient generation, transmission, distribution and utilization of energy. Recent technological advances in semiconductor technology have made possible the application of power electronics in all areas of power systems. Thus, our Power Engineering Graduate Program combines these two areas and offers students two Tracks: Power Systems and Power Electronics. Research areas include power electronic converters, modeling and control of electric drives, power quality, alternate energy sources, energy storage, atmospheric studies, electromagnetics applied to power engineering, commercial and industrial design, transient phenomena and insulation coordination, system protection (fault & short circuit), energy management, stability and dynamics, device and load modeling, power system analysis.

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

3. DEFINITION OF TRACKS

The Power Engineering Graduate Program has two Tracks: Power Systems and Power Electronics. When a person applies to the Power Engineering program, he/she must identify one track of interest within the program. If the person is admitted to the program, he/she must meet the minimum requirement for the selected option. These requirements are:

- Power Systems: INEL 4415 Power System Analysis or equivalent
- Power Electronics: Basic knowledge of polyphase circuits and electromechanical energy conversion
These requirements can be met if the student has taken such courses or their equivalent in their previous degree, through continuing education programs or relevant work experience (proof required). Otherwise, students must take such courses during their first year at UPRM. If a student wants to take courses in an option in power engineering different to the one for which he/she was admitted, it will be that student’s responsibility to meet the requirements for the second option in power engineering.

These Tracks are meant as guides, not as strict rules, or cages. All students will be considered Power Engineering students, some specializing in power system topics, others in power electronics applications. Students are encouraged to attend courses in both Tracks. This will give a better understanding of power engineering and would prepare students for the challenges of working in industry or continue Graduate School. Further guidelines are given in Section 4.

4. CORE COURSES AND TRACK COURSES

Each option has three core courses, all students must attend and pass at least two of these core courses within an option. These are:

For Power Systems (2 out of 3):
- INEL 6026 Computational Methods for Power System Analysis
- INEL 6027 Power System Dynamics and Control
- INEL 6028 Economic Operation of Power Systems

For Power Electronics (2 out of 3):
- INEL 6058 High Frequency Power Converters
- INEL 6066 Electric Drive Systems
- INEL 6085 Advanced Power Electronics

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

Power Systems
- INEL 5406 Transmission and Distribution
- INEL 5407 Computer Aided Power System Design
- INEL 5415 Power System Protection Design
- INEL 6025 Advanced Energy Conversion
- INEL 6077 Surge Phenomena
- INEL 6096 Power Quality
- INEL 8495 Advanced Topics in Electric Power Engineering
- INEL 8997 Independent Study (with emphasis in Power Engineering)
**Power Electronics**
INEL 5408 Motor Control  
INEL 6096 Power Quality  
INEL 6000 Introduction to Nonlinear Control Systems  
INEL 6001 Feedback Control Systems I  
INEL 8496 Advanced Topics in Electric Power Electronics  
INEL 8997 Independent Study (with emphasis in Power Electronics)

### Course Requirements for the Power Engineering Tracks

<table>
<thead>
<tr>
<th></th>
<th>Master of Science Plan I</th>
<th>Master of Engineering Plan II</th>
<th>Master of Engineering Plan III</th>
<th>Doctoral Program (proposed)</th>
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</thead>
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<tr>
<td>Core courses</td>
<td>2 courses 6 crs</td>
<td>2 courses 6 crs</td>
<td>2 courses 6 crs</td>
<td>2 courses 6 crs</td>
</tr>
<tr>
<td>Major courses</td>
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<td>3-5 courses 9-15 crs</td>
<td>7-8 courses 21-24 crs</td>
<td>6 courses 18 crs</td>
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<tr>
<td>Elective courses</td>
<td>2-3 courses 6-9 crs</td>
<td>2-3 courses 6-9 crs</td>
<td>2-3 courses 6-9 crs</td>
<td>2 courses 6 crs</td>
</tr>
<tr>
<td>Thesis</td>
<td>6 crs</td>
<td></td>
<td></td>
<td>12 crs</td>
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<td>Doctoral Seminar</td>
<td></td>
<td></td>
<td></td>
<td>1 cr</td>
</tr>
<tr>
<td>Advanced Mathematics</td>
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<td></td>
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</tr>
<tr>
<td>Project</td>
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<td>3-6 crs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>30 crs</td>
<td>30 crs</td>
<td>36 crs</td>
<td>49 crs</td>
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</tbody>
</table>
Graduate Program in Electrical Engineering: Electronics Track  
Department of Electrical and Computer Engineering  
University of Puerto Rico at Mayagüez

Introduction

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

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

Requirements

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

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

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

Coursework

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

Core Courses (6 crs)

Core courses in electronics include the following offerings:

- INEL 6009 Computer Systems Architecture
- INEL 6055 Solid State Electronics
- INEL 6080 VLSI Systems Design

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

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

- INEL 5205 Instrumentation
- INEL 5206 Digital Systems Design
- INEL 5207 Design with OpAmps and Analog ICs
- INEL 5065 Analog Integrated Circuit Design

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

- INEL 6048 Advanced Microprocessor Interfacing
- INEL 6075 Integrated Circuit Fabrication
- INEL 6085 Analysis and Design of Power Semiconductor Circuits
- INEL 6995 Special Topics in Electrical Engineering
- INEL 6079 Advanced IC Design Techniques
- INEL 8295 Advanced Topics in Electronics
- INEL 8296 Advanced Topics in Computer Engineering
- INEL 8997 Independent Study (with emphasis in Electronics)

<table>
<thead>
<tr>
<th>Course Requirements for the Electronics Track</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Table" /></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

**Research Areas**

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

Facilities

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

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

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

Recent Work

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

- Macromodeling of Sigma-Delata Modulators in Oversampled Converters
- 3D Scalability Analysis of Floating-Point Arithmetic Hardware
- Scalable Digital Fuzzy Controller on Reconfigurable Platforms
- Software Power Reduction in Embedded Systems Applications
- Automatic Layout Techniques for Power Electronics PCBs
- Wireless Smart Sensors
- Intelligent Traffic Systems
- Biomedical Devices for the Handicap
- Design of Communication Circuits Using BiCMOS Technology
- Electro Thermal Modeling of Power Electronic Modules
Appendix B: Applications for New Courses
UNIVERSIDAD DE PUERTO RICO
ADMINISTRACIÓN CENTRAL
VICEPRESIDENCIA PARA ASUNTOS ACADÉMICOS E INVESTIGACIÓN
SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A

Unidad: Recinto Universitario de Mayagüez
Facultad: Ingeniería

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

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

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

Título completo en español: Temas avanzados en electrónica
(Título abreviado a 26 espacios): Temas Avan. Electrónica

Título completo en inglés: Advanced Topics in Electronics
(Título abreviado a 26 espacios): Adv. Topics Electronics

Materia principal del curso (en clave alfa): INEL

Nivel del curso (marque con una X):

0 1 2 3 4 5
Subgraduado
Graduado

Curso de continuación: _____ Sí  _____ X No

Número de créditos: 1 a 3 por semestre y máximo de 6 crs en total

Codificación alfanumérica sugerida: INEL 8295

Tipo de créditos: Fijo
Variable

Puede repetirse con crédito: _____ X _____ Sí (máximo de créditos 6 en total)  _____ No

Horas semanales de:

1 a 3 Conferencia _____ Laboratorio _____ Tutorías
_____ Discusión _____ Taller _____ Investigación
_____ Seminario _____ Internado _____ Tesis o
_____ Estudio Independiente _____ Práctica Supervisada _____ Disertación

Modalidad de educación a distancia (si aplica):

Total de horas a reunirse por periodo lectivo: 1 a 3

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

Patrón académico en que se ofrece el curso:

_____ Semestre _____ Trimestre _____ Cuatrimestre _____ Año  _____ X Otro: Demanda
Secuencia Curricular (C = Cuatrimestre; T = Trimestre; S = Semestre)\(^3\)

Periodo: \_S1 \_S2 \_T1 \_T2 \_T3 \_C1 \_C2 \_C3 \_C4 \_Verano

Año: \_1\(^{\text{er}}\) \_2\(^{\text{do}}\) \_3\(^{\text{ro}}\) \_4\(^{\text{to}}\) \_5\(^{\text{to}}\) \_X Otro (especifique) \_Ph.D.

Tipo de curso:

\_Requisito \_X Electivo \_Educación Continua

\_Temporero o Experimental (fecha de inactivación: \_)

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

\_ Sí \_ X No

Cursos:

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

Número de estudiantes por sección: 1 Mínimo 15 Máximo

¿Conlleva cargos por laboratorios? \_ Sí \_ X No

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

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

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<th>Curso prerequisitos</th>
<th>Cursos corequisitos</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permiso del Director</td>
<td></td>
</tr>
</tbody>
</table>

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

____________________

Equipo o instalaciones mínimas requeridas: depende de los tópicos a discutirse ________________________________________

____________________

Sistema de calificación: \^6

\_X Letra (A, B, C, D ó F) \_ Aprobado (S), No aprobado (NS)

\_ Aprobado (p), No aprobado (NP) \_ Aprobado (PS, PN, PB), No aprobado (NP)

\_ Aprobado (P), Fracasado (F) \_ Otro (Especifique: _________________________________)

¿Comprende contenido temático de otros cursos?

\_ Sí \_ X No

Especifique: ______________________________________________________

____________________
¿Se inactivará o eliminará algún curso al crear éste?*

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Especifique: __________________________________________________________

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<td>Decano(a) de la Facultad:</td>
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<td>Decano(a) de Estudios Graduados:*</td>
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<td>Decano(a) de Asuntos Académicos:</td>
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<tr>
<td>Codificación:</td>
</tr>
<tr>
<td>Funcionario que procesó la solicitud:</td>
</tr>
</tbody>
</table>

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

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

3 Orden del curso según programa de estudios autorizados.

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

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

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

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

8 Cuando aplique.
1. **General Information:**
   - Alpha-numeric codification: INEL 8295
   - Course Title: ADVANCED TOPICS IN ELECTRONICS
   - Number of credits: One to six credit hours.
   - Contact Period: One to six hours of lecture per week.

2. **Course Description:**
   - English: Study of selected topics in electronics or related fields.
   - Spanish: Estudio de temas selectos en electrónica o áreas relacionadas.

3. **Pre/Co-requisites and other requirements:**
   - Permission of the Department Head.

4. **Course Objectives:**
   - To study current scientific literature in one or several advanced topics in electronics.
   - To gain understanding of the state of the art and identify gaps in the current state of knowledge.

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 serial publications available at the UPRM Library. Other depend on topics.

7. **Course time frame and thematic outline**

<table>
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<tr>
<th>Outline</th>
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<tbody>
<tr>
<td>Topics vary with faculty interests.</td>
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<tr>
<td><strong>Total hours: (equivalent to contact period)</strong></td>
<td>15 to 45</td>
</tr>
</tbody>
</table>

8. **Grading System**
   - □ Quantifiable (letters) □ Not Quantifiable

9. **Evaluation Strategies**
   - Depend on topics being discussed.

10. **Bibliography:**
    - Depend on topics being discussed.

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:**
ECE Graduate Committee, August 2007
SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A

Unidad: Recinto Universitario de Mayagüez
Facultad: Ingeniería

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

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

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

Título completo en español: Temas avanzados en Ingeniería de Computadoras
(Título abreviado a 26 espacios): Temas Avan. Ing Comp

Título completo en inglés: Advanced Topics in Computer Engineering
(Título abreviado a 26 espacios): Adv. Topics Comp Eng

Materia principal del curso (en clave alfa): INEL

Nivel del curso (marque con una X):

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

Curso de continuación: Sí X No

Número de créditos: 1 a 3 por semestre y máximo de 6 crs en total

Codificación alfanumérica sugerida: INEL 8296

Tipo de créditos: Fijo X Variable

Puede repetirse con crédito: Sí (máximo de créditos 6 en total) No

Horas semanales de:

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

Modalidad de educación a distancia (si aplica): ______________________________________________________________________
__________________________________________________________________________________________________
__________________________________________________________________________________________________

Total de horas a reunirse por periodo lectivo: 1 a 3

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

Patrón académico en que se ofrece el curso:

X Semestre Trimestre Cuatrimestre Año Otro: Demanda
Secuencia Curricular (C = Cuatrimestre; T = Trimestre; S = Semestre)

Periodo:

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</table>

Año: ___1ro ___2do ___3ro ___4to ___5to ___X___ Otro (especifique) ___ Ph.D.

Tipo de curso:

- _____Requisito
- _____Electivo
- _____Educación Continua
- Temporero o Experimental (fecha de inactivación: _____)

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

- _____Sí
- _____No

Cursos:

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

Número de estudiantes por sección: ___1___ Mínimo ___15___ Máximo

¿Conlleva cargos por laboratorios?

- _____Sí
- _____No

Descripción en español (que no exceda los 1,000 caracteres):

Estudio de temas selectos en sistemas de comunicaciones o áreas relacionadas.

Descripción en inglés (que no exceda los 1,000 caracteres):

Study of selected topics in communication systems or related fields.

<table>
<thead>
<tr>
<th>Curso prerequisitos</th>
<th>Cursos corequisitos</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permiso del Director</td>
<td></td>
</tr>
</tbody>
</table>

Requisitos especiales para tomar el curso (destreza, conocimientos, permisos especiales, equipos, materiales, conocimiento del uso de computadoras o programados específicos, otros):

- Dependiendo de los tópicos a discutirse

Equipo o instalaciones mínimas requeridas:

- Dependiendo de los tópicos a discutirse

Sistema de calificación:

- _____Letra (A, B, C, D ó F)
- _____Aprobado (S), No aprobado (NS)
- _____Aprobado (P), No aprobado (NP)
- _____Aprobado (PS, PN, PB), No aprobado (NP)
- _____Aprobado (P), Fracaso (F)
- _____Otro (Especifique: ____________________________ )

¿Comprende contenido temático de otros cursos?

- _____Sí
- _____No

Especifique: ____________________________________________

____________________________________________________________________________________________________________

____________________________________________________________________________________________________________
¿Se inactivará o eliminará algún curso al crear éste?  

- Sí  

- X No  

Especifique: ________________________________________________________________________________

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<tr>
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Para uso de la Vicепresidencia para Asuntos Académicos e Investigación . NO escriba bajo este renglón.

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

1. General Information:
   - Alpha-numeric codification: INEL 8296
   - Course Title: ADVANCED TOPICS IN COMPUTER ENGINEERING
   - Number of credits: One to six credit hours.
   - Contact Period: One to six hours of lecture per week.

2. Course Description:
   - English: Study of selected topics in computer engineering or related fields.
   - Spanish: Estudio de temas selectos ingeniería de computadoras o áreas relacionadas.

3. Pre/Co-requisites and other requirements:
   - Permission of the Department Head.

4. Course Objectives:
   - To study current scientific literature in one or several advanced topics in electronics.
   - To gain understanding of the state of the art and identify gaps in the current state of knowledge.

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 serial publications available at the UPRM Library. Other depend on topics.

7. Course time frame and thematic outline

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<th>Outline</th>
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8. Grading System
   - Quantifiable (letters)
   - Not Quantifiable

9. Evaluation Strategies
   - Depend on topics being discussed.

10. Bibliography:
    - Depend on topics being discussed.

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:
ECE Graduate Committee, August 2007
UNIVERSIDAD DE PUERTO RICO
ADMINISTRACIÓN CENTRAL
VICEPRESIDENCIA PARA ASUNTOS ACADÉMICOS E INVESTIGACIÓN
SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A

Unidad: Recinto Universitario de Mayagüez
Facultad: Ingeniería

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

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

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

Título completo en español: Temas avanzados en procesamiento de señales
(Título abreviado a 26 espacios): Temas Avan. Proc Señales

Título completo en inglés: Advanced Topics in Signal Processing
(Título abreviado a 26 espacios): Adv Topics Signal Proc

Materia principal del curso (en clave alfa): INEL

Nivel del curso (marque con una X):

0 1 2 3 4 5 6 7 8 9

Subgraduado Graduado

Curso de continuación: _____ Sí _____ X No

Número de créditos: 1 a 3 por semestre y máximo de 6 crs en total.

Codificación alfanumérica sugerida: INEL 8395

Tipo de créditos: _______ Fijo _____ X Variable

Puede repetirse con crédito: _____ X _____ Sí (máximo de créditos 6 en total) _____ No

Horas semanales de:

1 a 3 Conferencia 2 Laboratorio 3 Tutorías
4 Discusión 5 Taller 6 Investigación
7 Seminario 8 Internado 9 Tesis o
10 Estudio Independiente 11 Práctica Supervisada 12 Disertación

Modalidad de educación a distancia (si aplica):

Total de horas a reunirse por periodo lectivo: _____ 1 a 3

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

Patrón académico en que se ofrece el curso:

_____ Semestre _____ Trimestre _____ Cuatrimestre _____ Año _____ X Otro: Demanda
Secuencia Curricular (C = Cuatrimestre;  T = Trimestre;  S = Semestre)³

Periodo:  _S1  _S2  _T1  _T2  _T3  _C1  _C2  _C3  _C4  Verano
Año:  _1ero  _2ndo  _3ero  _4to  _5to  _X  Otro (especifique) __Ph.D__.

Tipo de curso:
____ Requisito  _____ Electivo  _____ Educación Continua
____ Temporero o Experimental (fecha de inactivación: ______)

Posibilidad de equivalencia (en la unidad o en otras unidades del sistema):
____ Sí  _______ X No

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

Número de estudiantes por sección:  ___1___ Mínimo  ___15___ Máximo

¿Conlleva cargos por laboratorios?  _____ Sí  _______ X No

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

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

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

Equipo o instalaciones mínimas requeridas:  _______ Depende de los tópicos a discutirse

Sistema de calificación:^
____ Letra (A, B, C, D ó F)  _____ Aprobado (S), No aprobado (NS)
_____ Aprobado (p), No aprobado (NP)  _____ Aprobado (PS, PN, PB), No aprobado (NP)
_____ Aprobado (P), Fracasado (F)  _____ Otro (Especifique: ____________________________)

¿Comprende contenido temático de otros cursos?
____ Sí  _______ X No

Especifique: __________________________________________________________

________________________________________________________

________________________________________________________
¿Se inactivará o eliminará algún curso al crear éste? 

Sí  X No

Especifique: ______________________________________________________________________________________
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2Según establecido por la Junta Universitaria en la Certificación Núm. 8, 1986-87.

3Orden del curso según programa de estudios autorizados.

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

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

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

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

8Cuando aplique.
# Course Syllabus

1. **General Information:**
   -Alpha-numeric codification: INEL 8395
   -Course Title: ADVANCED TOPICS IN SIGNAL PROCESSING
   -Number of credits: One to six credit hours.
   -Contact Period: One to six hours of lecture per week.

2. **Course Description:**
   -English: Study of selected topics in signal processing or related fields.
   -Spanish: Estudio de temas selectos en procesamiento de señales o áreas relacionadas.

3. **Pre/Co-requisites and other requirements:**
   -Permission of the Department Head.

4. **Course Objectives:**
   -To study current scientific literature in one or several advanced topics in signal processing.
   -To gain understanding of the state of the art and identify gaps in the current state of knowledge.

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 serial publications available at the UPRM Library. Other depend on topics.

7. **Course time frame and thematic outline**

<table>
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<th>Outline</th>
<th>Contact Hours</th>
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<td>15 to 45</td>
</tr>
</tbody>
</table>

8. **Grading System**
   -Quantifiable (letters)  Not Quantifiable

9. **Evaluation Strategies**
   -Depend on topics being studied.

10. **Bibliography:**
    -N/A

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:
ECE Graduate Committee, August 2007
UNIVERSIDAD DE PUERTO RICO
ADMINISTRACIÓN CENTRAL
VICEPRESIDENCIA PARA ASUNTOS ACADÉMICOS E INVESTIGACIÓN
SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A

Unidad: Recinto Universitario de Mayagüez
Facultad: Ingeniería

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

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

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

Título completo en español: Temas avanzados en electromagnética aplicada
(Título abreviado a 26 espacios): Temas Avan. Electromag Ap

Título completo en inglés: Advanced Topics in Applied Electromagnetics
(Título abreviado a 26 espacios): Adv Topics Appl Electromag

Materia principal del curso (en clave alfa): INEL

Nivel del curso ( marque con una X)

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Curso de continuación: _____ Sí   _____ X No

Número de créditos: 1 a 3 por semestre y máximo de 6 crs en total.

Codificación alfanumérica sugerida: INEL 8396

Tipo de créditos: _______ Fijo   _____ X Variable

Puede repetirse con crédito: _____ X _____ Sí (máximo de créditos 6 en total)   _____ No

Horas semanales de:

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<th>1 a 3</th>
<th>Conferencia</th>
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<th>Tutorías</th>
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<td>_____</td>
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<td>_____ Tesis o</td>
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<tr>
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<td>_____ Práctica Supervisada</td>
<td>_____ Disertación</td>
</tr>
</tbody>
</table>

Modalidad de educación a distancia (si aplica):

Total de horas a reunirse por periodo lectivo: _____ 1 a 3

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

Patrón académico en que se ofrece el curso:

| _____ Semestre | _____ Trimestre | _____ Cuatrimestre | _____ Año | _____ X Otro: Demanda |

^2 Patrón académico en que se ofrece el curso
Secuencia Curricular (C = Cuatrimestre; T = Trimestre; S = Semestre)

Periodo: _S1 _S2 _T1 _T2 _T3 _C1 _C2 _C3 _C4 ___Verano
Año: _1er_ _2do_ _3er_ _4to_ _5to_ _X_ Otro (especifique)_ _Ph.D._

Tipo de curso:

X Requisito _______X Electivo _______Educación Continua

___Temporero o Experimental (fecha de inactivación: ______)

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

X Sí _______No

Cursos:

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

Número de estudiantes por sección: 1 Mínimo _______15 Máximo

¿Conlleva cargos por laboratorios? X Sí _______No

Descripción en español (que no exceda los 1,000 caracteres):

4 Estudio de temas selectos en electromagnética aplicada o áreas relacionadas.

Descripción en inglés (que no exceda los 1,000 caracteres):

5 Study of selected topics in Applied Electromagnetics or related fields.

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

Depende de los tópicos a discutirse

____________________________________________________________________________________________________________

Equipo o instalaciones mínimas requeridas:

Depende de los tópicos a discutirse

____________________________________________________________________________________________________________

Sistema de calificación:

X Letra (A, B, C, D ó F) _______Aprobado (S), No aprobado (NS)

Aprobado (p), No aprobado (NP) _______Aprobado (PS, PN, PB), No aprobado (NP)

Aprobado (P), Fracaso (F) _______Otro (Especifique: _________________________________)

¿Comprende contenido temático de otros cursos?

X Sí _______No

Especifique: _________________________________________________________________

______________________________________________________________________________________________
¿Se inactivará o eliminará algún curso al crear éste?*

_________ Sí  _________ X_________ No

Especifique: _____________________________________________________________

________________________________________________________________________

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*Cuando aplique.
1. **General Information:**
   - Alpha-numeric codification: INEL 8396
   - Course Title: ADVANCED TOPICS IN APPLIED ELECTROMAGNETICS
   - Number of credits: One to six credit hours.
   - Contact Period: One to six hours of lecture per week.

2. **Course Description:**
   - English: Study of selected topics in applied electromagnetic or related fields.
   - Spanish: Estudio de temas selectos en electromagnética aplicada o áreas relacionadas.

3. **Pre/Co-requisites and other requirements:**
   - Permission of the Department Head.

4. **Course Objectives:**
   - To study current scientific literature in one or several advanced topics in applied electromagnetic.
   - To gain understanding of the state of the art and identify gaps in the current state of knowledge.

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 serial publications available at the UPRM Library. Other depend on topics.

7. **Course time frame and thematic outline**

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8. **Grading System**
   - ☒ Quantifiable (letters)  ☐ Not Quantifiable

9. **Evaluation Strategies**
   - Depend on topics.

10. **Bibliography:**
    - N/A

11. **According to Law 51**
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**Person who prepared this description and date of preparation:**
- ECE Graduate Committee, August 2007
Unidad: Recinto Universitario de Mayagüez
Facultad: Ingeniería

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

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

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

Título completo en español: Temas avanzados en Sistemas de Comunicaciones
(Título abreviado a 26 espacios): Temas Avan. Sist Com

Título completo en inglés: Advanced Topics in Communication Systems
(Título abreviado a 26 espacios): Adv. Topics Comm Syst

Materia principal del curso (en clave alfa): INEL

Nivel del curso (marque con una X):

0 1 2 3 4 5
Subgraduado
Graduado

Curso de continuación: Sí X No
Número de créditos: 1 a 3 por semestre y máximo de 6 crs en total

Codificación alfanumérica sugerida: INEL 8397

Tipo de créditos: Fijo X Variable

Puede repetirse con crédito: X Sí (máximo de créditos 6 en total) No

Horas semanales de:

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

Modalidad de educación a distancia (si aplica):

Total de horas a reunirse por periodo lectivo: 1 a 3

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

Patrón académico en que se ofrece el curso:

Semestre Trimestre Cuatrimestre Año Otro: Demanda
Secuencia Curricular (C = Cuatrimestre; T = Trimestre; S = Semestre)³

Periodo: __S1 __S2 __T1 __T2 __T3 __C1 __C2 __C3 __C4 __Verano

Año: __1er_ __2do_ __3ro_ __4to_ __5to_ __X Otro (especifique) __Ph.D.

Tipo de curso:

_____ Requisito    _____ Electivo    _____ Educación Continua

_____ Temporero o Experimental (fecha de inactivación: ______)

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

_____ Sí    _____ X No

Cursos:

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

Número de estudiantes por sección: 1 Mínimo  15 Máximo

¿Conlleva cargos por laboratorios? _____ Sí    _____ X No

Descripción en español (que no exceda los 1.000 caracteres):⁴ Estudio de temas selectos en sistemas de comunicaciones o áreas relacionadas.

Descripción en inglés (que no exceda los 1.000 caracteres):⁵ Study of selected topics in communication systems or related fields.

<table>
<thead>
<tr>
<th>Curso prerequisitos</th>
<th>Cursos corequisitos</th>
</tr>
</thead>
<tbody>
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<td>Permiso del Director</td>
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Requisitos especiales para tomar el curso (destrezas, conocimientos, permisos especiales, equipos, materiales, conocimientos del uso de computadoras o programados específicos, otros): Dependiendo de los tópicos a discutirse_____________________________________

Depende de los tópicos a discutirse_____________________________________

Equipo o instalaciones mínimas requeridas: Dependiendo de los tópicos a discutirse_____________________________________

Sistema de calificación:⁶

_____ X Letra (A, B, C, D ó F)    _____ Aprobado (S), No aprobado (NS)

_____ Aprobado (p), No aprobado (NP)    _____ Aprobado (PS, PN, PB), No aprobado (NP)

_____ Aprobado (P), Fracasado (F)    _____ Otro (Especifique: ______________________________________)

¿Comprende contenido temático de otros cursos?

_____ Sí    _____ X No

Especifique: ______________________________________

________________________________________________________________________
¿Se inactivará o eliminará algún curso al crear éste?  

    Sí      X  No

Especifique: __________________________________________________________________________
_____________________________________________________________________________________

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

## Course Syllabus

### 1. General Information:

- **Alpha-numeric codification:** INEL 8397
- **Course Title:** ADVANCED TOPICS IN COMMUNICATION SYSTEMS
- **Number of credits:** One to six credit hours.
- **Contact Period:** One to six hours of lecture per week.

### 2. Course Description:

**English:** Study of selected topics in communications systems or related fields.

**Spanish:** Estudio de temas selectos en sistemas de comunicaciónes o áreas relacionadas.

### 3. Pre/Co-requisites and other requirements:

Permission of the Department Head.

### 4. Course Objectives:

To study current scientific literature in one or several advanced topics in electronics.

To gain understanding of the state of the art and identify gaps in the current state of knowledge.

### 5. Instructional Strategies:

- [x] conference
- [x] 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 serial publications available at the UPRM Library. Other depend on topics.

### 7. Course time frame and thematic outline

<table>
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<tr>
<th>Outline</th>
<th>Contact Hours</th>
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<tbody>
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</tr>
<tr>
<td><strong>Total hours:</strong> (equivalent to contact period)</td>
<td>15 to 45</td>
</tr>
</tbody>
</table>

### 8. Grading System

- [x] Quantifiable (letters)
- [ ] Not Quantifiable

### 9. Evaluation Strategies

Depend on topics being discussed.

### 10. Bibliography:

Depend on topics being discussed.

### 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:**

ECE Graduate Committee, August 2007
SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A

Unidad: Recinto Universitario de Mayagüez
Facultad: Ingeniería

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

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

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

Título completo en español: Temas avanzados en ingeniería de potencia eléctrica
(Título abreviado a 26 espacios): Temas Avan Ing Pot Elect

Título completo en inglés: Advanced Topics in Electric Power Engineering
(Título abreviado a 26 espacios): Adv Topics Elec Power Eng

Materia principal del curso (en clave alfa): INEL

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

Curso de continuación: ______ Sí ______ X ______ No
Número de créditos: 1 a 3 por semestre y máximo de 6 crs en total

Codificación alfanumérica sugerida: INEL 8495

Tipo de créditos: Fijo ______ X ______ Variable

Puede repetirse con crédito: ______ X ______ Sí (máximo de créditos 6 en total) ______ No

Horas semanales de:
1 a 3 Conferencia ______ Laboratorio ______ Tutorías
Discusión ______ Taller ______ Investigación
Seminario ______ Internado ______ Tesis o
Estudio Independiente ______ Práctica Supervisada ______ Disertación

Modalidad de educación a distancia (si aplica):

Total de horas a reunirse por periodo lectivo: ______ 1 a 3 ___________

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

Patrón académico en que se ofrece el curso:
____ Semestre ______ Trimestre ______ Cuatrimestre ______ Año ______ X ______ Otro: Demanda
Secuencia Curricular (C = Cuatrimestre; T = Trimestre; S = Semestre)³

Periodo: _S1_ _S2_ _T1_ _T2_ _T3_ _C1_ _C2_ _C3_ _C4_ _Verano_
Año: __1er__ __2ndo__ __3er__ __4to__ __5to__ _X_ Otro (especifique) _Ph.D._

Tipo de curso:
___ Requisito ___ X Electivo ___ Educación Continua
___ Temporero o Experimental (fecha de inactivación: _____)

Posibilidad de equivalencia (en la unidad o en otras unidades del sistema):
___ Sí ___ X No

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

Número de estudiantes por sección: __1__ Mínimo __25__ Máximo

¿Conlleva cargos por laboratorios? ___ Sí ___ X No

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

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

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

__________________________

Equipo o instalaciones mínimas requeridas: ___ Dependente de los tópicos a discutirse _____________________________

Sistema de calificación: ⁶
___ X Letra (A, B, C, D ó F) ___ Aprobado (S), No aprobado (NS)
___ Aprobado (p), No aprobado (NP) ___ Aprobado (PS, PN, PB), No aprobado (NP)
___ Aprobado (P), Fracaseado (F) ___ Otro (Especifique: _____________________________)

¿Comprende contenido temático de otros cursos?
___ Sí ___ X No

Especifique: ____________________________________________________________

______________________________________________________________________
¿Se inactivará o eliminará algún curso al crear éste? \(^7\)

- [ ] Sí
- [x] No

Especifique: __________________________________________________________

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\(^2\) Segundo establecido por la Junta Universitaria en la Certificación Núm. 8, 1986-87.

\(^3\) Orden del curso según programa de estudios autorizados.

\(^4\) Debe coincidir con la descripción del curso en el Prontuario del mismo.

\(^5\) Debe coincidir con la descripción del curso en el Prontuario del mismo.

\(^6\) Deberá consultarse a la Oficina del Registrador de la unidad para constatar sistemas permitidos.

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

\(^8\) Cuando aplique.
## Course Syllabus

### 1. General Information:
- **Alpha-numeric codification:** INEL 8495  
- **Course Title:** ADVANCED TOPICS IN ELECTRIC POWER ENGINEERING  
- **Number of credits:** One to six credit hours.  
- **Contact Period:** One to six hours of lecture per week.

### 2. Course Description:
- **English:** Study of selected topics in electric power engineering or related fields.  
- **Spanish:** Estudio de temas selectos en potencia eléctrica o áreas relacionadas.

### 3. Pre/Co-requisites and other requirements:
- Permission of the Department Head.

### 4. Course Objectives:
- To study current scientific literature in one or several advanced topics in power systems.  
- To gain understanding of the state of the art and identify gaps in the current state of knowledge.

### 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 serial publications available at the UPRM Library. Other depend on topics.

### 7. Course time frame and thematic outline

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<td>15 to 45</td>
</tr>
</tbody>
</table>

### 8. Grading System
- [X] Quantifiable (letters)  
- [ ] Not Quantifiable

### 9. Evaluation Strategies
- Depend on topics

### 10. Bibliography:
- N/A

### 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:**  
ECE Graduate Committee, August 2007
SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A

Unidad: Recinto Universitario de Mayagüez
Facultad: Ingeniería

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

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

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

Título completo en español: Temas avanzados en electrónica de potencia
(Título abreviado a 26 espacios): Temas Avan. Elect Potencia

Título completo en inglés: Advanced Topics in Power Electronics
(Título abreviado a 26 espacios): Adv Topics Power Elect

Materia principal del curso (en clave alfa): _______

Nivel del curso (marque con una X):

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

Curso de continuación: _______ Sí  _______ X No

Número de créditos: _______ 1 a 3 por semestre y máximo de 6 crs en total

Codificación alfanumérica sugerida: INEL 8496

Tipo de créditos: _______ Fijo  _______ X Variable

Puede repetirse con crédito: _______ X Sí (máximo de créditos 6 en total)  _______ No

Horas semanales de:

- 1 a 3 Conferencia
- _______ Laboratorio
- _______ Tutorías
- _______ Discusión
- _______ Taller
- _______ Investigación
- _______ Seminario
- _______ Internado
- _______ Tesis o
- _______ Estudio Independiente
- _______ Práctica Supervisada
- _______ Disertación

Modalidad de educación a distancia (si aplica): ________________________________

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

Patrón académico en que se ofrece el curso:

- _______ X Semestre
- _______ Trimestre
- _______ Cuatrimestre
- _______ Año
- _______ Otro: Demanda
Secuencia Curricular (C = Cuatrimestre; T = Trimestre; S = Semestre)

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<tr>
<th>Periodo:</th>
<th>S1</th>
<th>S2</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>Verano</th>
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</thead>
<tbody>
<tr>
<td>Año:</td>
<td>1°</td>
<td>2do</td>
<td>3do</td>
<td>4to</td>
<td>5to</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Otro (especifique) X Ph.D.</td>
</tr>
</tbody>
</table>

Tipo de curso:

- Requisito
- X Electivo
- Educación Continua

- Temporero o Experimental (fecha de inactivación: ______)

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

- Sí
- X No

Cursos:

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

Número de estudiantes por sección: 1 Mínimo 25 Máximo

¿Conlleva cargos por laboratorios? ______ Sí ______ X No

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

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

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Permiso del Director

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

- Dependiendo de los tópicos a discutirse:

  - ______

  - ______

Equipo o instalaciones mínimas requeridas:

- Dependiendo de los tópicos a discutirse:

  - ______

Sistema de calificación:

- X Letra (A, B, C, D ó F)
- ______ Aprobado (S), No aprobado (NS)
- ______ Aprobado (P), No aprobado (NP)
- ______ Aprobado (PS, PN, PB), No aprobado (NP)

- ______ Aprobado (P), Fracaso (F)
- ______ Aprobado (PS, PN, PB), No aprobado (NP)

- ______ Aprobado (S), No aprobado (NS)

¿Comprende contenido temático de otros cursos?

- Sí
- X No

Especifique:

- ______

- ______

Sistema de calificación:

- X Letra (A, B, C, D ó F)
- ______ Aprobado (S), No aprobado (NS)
- ______ Aprobado (P), No aprobado (NP)
- ______ Aprobado (PS, PN, PB), No aprobado (NP)
- ______ Aprobado (P), Fracaso (F)
- ______ Aprobado (PS, PN, PB), No aprobado (NP)

¿Comprende contenido temático de otros cursos?

- Sí
- X No

Especifique:

- ______

- ______
¿Se inactivará o eliminará algún curso al crear éste?  

<p>| | |</p>
<table>
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<tr>
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<td>Sí</td>
<td>X No</td>
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Especifique: ________________________________________________________________

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

3 Orden del curso según programa de estudios autorizados.

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

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

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

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

8 Cuando aplique.
1. General Information:
   - Alpha-numeric codification: INEL 8496
   - Course Title: ADVANCED TOPICS IN POWER ELECTRONICS
   - Number of credits: 1-3 per semester and a maximum of 6 in total.
   - Contact Period: 1-3 hours per week.

2. Course Description:
   - English: Study of selected topics in power electronics or related fields.
   - Spanish: Estudio de temas selectos en electrónica de potencia o áreas relacionadas.

3. Pre/Co-requisites and other requirements:
   - Permission of the Department Head.

4. Course Objectives:
   - To study current scientific literature in one or several advanced topics in power electronics.
   - To gain understanding of the state of the art and identify gaps in the current state of knowledge.

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 serial publications available at the UPRM Library. Other depend on topics.

7. Course time frame and thematic outline
   - Outline
     - Topics vary with faculty interests.
   - Contact Hours
     - 15-45
   - Total hours: (equivalent to contact period)
     - 15-45

8. Grading System
   - Quantifiable (letters)
   - Not Quantifiable

9. Evaluation Strategies
   - Depend on topics

10. Bibliography:
    - N/A

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:
ECE Graduate Committee, August 2007
UNIVERSIDAD DE PUERTO RICO
ADMINISTRACIÓN CENTRAL
VICEPRESIDENCIA PARA ASUNTOS ACADÉMICOS E INVESTIGACIÓN
SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A

Unidad: Recinto Universitario de Mayagüez
Facultad: Ingeniería

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

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

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

Título completo en español Temas avanzados en sistemas de control
(Título abreviado a 26 espacios): Temas Avan. Sist Control

Título completo en inglés Advanced Topics in Control Systems
(Título abreviado a 26 espacios): Adv Topics Control Syst

Materia principal del curso (en clave alfa): INEL

Nivel del curso (marque con una X):

0 1 2 3 4 5
Subgraduado
Graduado

Curso de continuación: _____ Sí _____ No
Númerode créditos: 1 a 3 por semestre y máximo de 6 crs en total.

Codificación alfanumérica sugerida: INEL 8595

Tipo de créditos: _____ Fijo _____ Variable
Puede repetirse con crédito: _____ X _____ Sí (máximo de créditos 6 en total) _____ No

Horas semanales de:

1 a 3 Conferencia _____ Laboratorio _____ Tutorías
Discusión _____ Taller _____ Investigación
Seminario _____ Internado _____ Tesis o
Estudio Independiente _____ Práctica Supervisada _____ Disertación

Modalidad de educación a distancia (si aplica):

Total de horas a reunirse por periodo lectivo: _____ 1 a 3

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

Patrón académico en que se ofrece el curso:

__ Semestre _____ Trimestre _____ Cuatrimestre _____ Año _____ Otro: Demanda
Secuencia Curricular (C = Cuatrimestre; T = Trimestre; S = Semestre)

Periodo: _S1 _S2 _T1 _T2 _T3 _C1 _C2 _C3 _C4 _Verano
Año: _1er _2do _3ro _4to _5to _X Otro (especifique) _Ph.D.

Tipo de curso:

_____ Requisito _____ Electivo _____ Educación Continua

____ Temporero o Experimental (fecha de inactivación: ______)

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

_____ Sí _____ X No

Cursos:

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

Número de estudiantes por sección: 1 Mínimo 25 Máximo

¿Conlleva cargos por laboratorios? _____ Sí _____ X No

Descripción en español (que no exceda los 1,000 caracteres):

4 Estudio de temas selectos en sistemas de control o áreas relacionadas.

Descripción en inglés (que no exceda los 1,000 caracteres):

5 Study of selected topics in control systems or related fields.

<table>
<thead>
<tr>
<th>Curso prerequisites</th>
<th>Cursos corequisitos</th>
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</table>

Permiso del Director

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

____ Depende de los tópicos a discutirse

____ __________________________

___ __________________________

Equipo o instalaciones mínimas requeridas:

____ Depende de los tópicos a discutirse

____ __________________________

___ __________________________

Sistema de calificación:

_____ X Letra (A, B, C, D ó F) _____ Aprobado (S), No aprobado (NS)

_____ Aprobado (p), No aprobado (NP) _____ Aprobado (PS, PN, PB), No aprobado (NP)

_____ Aprobado (P), Fracaso (F) _____ Otro (Especifique: ____________________________)

¿Comprende contenido temático de otros cursos?

_____ Sí _____ X No

Especifique: ____________________________

____ __________________________

___ __________________________
¿Se inactivará o eliminará algún curso al crear éste?

Sí    X No

Especifique: __________________________________________________________________________________________

____________________________________________________________________________________________

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<td>Decano(a) de Asuntos Académicos:</td>
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Para uso de la Vicepresidencia para Asuntos Académicos e Investigación. NO escriba bajo este renglón.

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

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

3 Orden del curso según programa de estudios autorizados.

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

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

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

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

8 Cuando aplique.
1. **General Information:**
   - Alpha-numeric codification: INEL 8595
   - Course Title: Advanced Topics in Control Systems
   - Number of credits: One to six credit hours.
   - Contact Period: One to six hours of lecture per week.

2. **Course Description:**
   - English: Study of selected topics in control systems or related fields.
   - Spanish: Estudio de temas selectos en sistemas de control o áreas relacionadas.

3. **Pre/Co-requisites and other requirements:**
   - Permission of the Director.

4. **Course Objectives:**
   - To study current scientific literature in one or several advanced topics in control systems.
   - To gain understanding of the state of the art and identify gaps in the current state of knowledge.

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:**
   - Depend on the topics.

7. **Course time frame and thematic outline**
   - **Outline**
     - Topics vary with faculty interests.
   - **Contact Hours**
     - Total hours: (equivalent to contact period)
     - 15-45

8. **Grading System**
   - ✗ Quantifiable (letters)
   - □ Not Quantifiable

9. **Evaluation Strategies**
   - Depend on the topics

10. **Bibliography:**
    - N/A

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:**
- ECE Graduate Committee, August 2007
SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

Unidad: Recinto Universitario de Mayagüez
Facultad: Ingeniería

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

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

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

Título completo en español: Temas Avanzados
(Título abreviado a 26 espacios): Temas Avanzados

Título completo en inglés: Advanced Topics
(Título abreviado a 26 espacios): Advanced Topics

Materia principal del curso (en clave alfa): INEL

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

Curso de continuación: X No
Número de créditos: 1 a 3 por semestre y máximo de 6 crs en total

Codificación alfanumérica sugerida: INEL 8995

Tipo de créditos: X Variable

Puede repetirse con crédito: X Sí (máximo de créditos 6 en total) No

Horas semanales de:
1 a 3 Conferencia Laboratorio Tutorías
Discusión Taller Investigación
Seminario Internado Tesis o
Estudio Independiente Práctica Supervisada Disertación

Modalidad de educación a distancia (si aplica):__________________________

Total de horas a reunirse por periodo lectivo: 1 a 3

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

Patrón académico en que se ofrece el curso:
Semestre Trimestre Cuatrimestre Año Otro: Demanda
Secuencia Curricular (C = Cuatrimestre; T = Trimestre; S = Semestre)

Periodo: _S1_ _S2_ _T1_ _T2_ _T3_ _C1_ _C2_ _C3_ _C4_ _Verano_
Año: __1ero__ __2ndo__ __3ero__ __4to__ __5to__ _X_ Otro (especifique) _Ph.D._

Tipo de curso:
- ___Requisito___
- ___X__ Electivo___
- ___Educación Continua___

___Sí___

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

Cursos:

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

Número de estudiantes por sección: __1__ Mínimo __25__ Máximo

¿Conlleva cargos por laboratorios?
- ___Sí___
- ___X__ No___

Descripción en español (que no exceda los 1,000 caracteres):

Estudio de temas selectos en ingeniería eléctrica o áreas relacionadas.

Descripción en inglés (que no exceda los 1,000 caracteres):

Study of selected topics in electrical engineering or related areas.

<table>
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<tr>
<th>Curso prerequisitos</th>
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Requisitos especiales para tomar el curso (destrezas, conocimientos, permisos especiales, equipos, materiales, conocimientos del uso de computadoras o programados específicos, otros):

___Depende de los tópicos a discutirse__________________________

Equipo o instalaciones mínimas requeridas:

___Depende de los tópicos a discutirse__________________________

Sistema de calificación:

- ___X__ Letra (A, B, C, D ó F)
- ___Aprobado (S), No aprobado (NS)
- ___Aprobado (p), No aprobado (NP)
- ___Aprobado (PS, PN, PB), No aprobado (NP)
- ___Aprobado (P), Fracasado (F)
- ___Otro (Especifique: ________________________________)

¿Comprende contenido temático de otros cursos?

- ___Sí___
- ___X__ No___

Especifique: ________________________________

Sistema de calificación:

- ___X__ Letra (A, B, C, D ó F)
- ___Aprobado (S), No aprobado (NS)
- ___Aprobado (p), No aprobado (NP)
- ___Aprobado (PS, PN, PB), No aprobado (NP)
- ___Aprobado (P), Fracasado (F)
- ___Otro (Especifique: ________________________________)

¿Comprende contenido temático de otros cursos?

- ___Sí___
- ___X__ No___

Especifique: ________________________________
¿Se inactivará o eliminará algún curso al crear éste? 

[ ] Sí       [X] No

Especifique: 
________________________________________________________________________________________
__________________________________________________________________

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

3 Orden del curso según programa de estudios autorizados.

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

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

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

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

8 Cuando aplique.
1. **General Information:**
   - Alpha-numeric codification: INEL 8995
   - Course Title: ADVANCED TOPICS
   - Number of credits: One to six credit hours.
   - Contact Period: One to six hours of lecture per week.

2. **Course Description:**
   - English: Study of selected topics in electrical engineering or related fields.
   - Spanish: Estudio de temas selectos en ingeniería eléctrica o áreas relacionadas.

3. **Pre/Co-requisites and other requirements:**
   - Permission of the Department Head.

4. **Course Objectives:**
   - To study current scientific literature in one or several advanced topics in electrical engineering.
   - To gain understanding of the state of the art and identify gaps in the current state of knowledge.

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 serial publications available at the UPRM Library. Other depend on topics.

7. **Course time frame and thematic outline**
   - **Outline**  
     - Depend on topics being studied  
   - **Contact Hours**  
     - 15-45  
   - **Total hours: (equivalent to contact period)**  
     - 15-45

8. **Grading System**
   - ☑ Quantifiable (letters)  
   - ☐ Not Quantifiable

9. **Evaluation Strategies**
   - Depend on the topics

10. **Bibliography:**
    - N/A

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:**
ECE Graduate Committee, August 2007
UNIVERSIDAD DE PUERTO RICO
ADMINISTRACIÓN CENTRAL
VICEPRESIDENCIA PARA ASUNTOS ACADÉMICOS E INVESTIGACIÓN
SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A

Unidad: Recinto Universitario de Mayagüez
Facultad: Ingeniería

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

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

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

Título completo en español: Estudio Independiente
(Título abreviado a 26 espacios): Estudio Independiente

Título completo en inglés: Independent Study
(Título abreviado a 26 espacios): Independent Study

Materia principal del curso (en clave alfa): INEL

Nivel del curso (marque con una X):

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

Curso de continuación: _____ Sí     X No

Número de créditos: 1 a 3 por semestre.

Codificación alfanumérica sugerida: INEL 8997

Tipo de créditos: ______ Fijo      X Variable

Puede repetirse con crédito: _____ X Sí (máximo de créditos 3 en total)      _____ No

Horas semanales de:

_________ Conferencia _______ Laboratorio _______ Tutorías
_________ Discusión _______ Taller _______ Investigación
_________ Seminario _______ Internado _______ Tesis o

1 a 3 Estudio Independiente _______ Práctica Supervisada _______ Disertación

Modalidad de educación a distancia (si aplica): ________________________________

Total de horas a reunirse por periodo lectivo: _______ 1 a 3

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

Patrón académico en que se ofrece el curso:

____ Semestre      ____ Trimestre      ____ Cuatrimestre      ____ Año      X Otro: Demanda
Secuencia Curricular (C = Cuatrimestre; T = Trimestre; S = Semestre)

Periodo: _S1_ _S2_ _T1_ _T2_ _T3_ _C1_ _C2_ _C3_ _C4_ Verano
Año: ___1ºo___ 2ºo  ___3ºo___ _4ºo_ _5ºo_ X Otro (especifique) __Ph.D.

Tipo de curso:
- Requisito
- X Electivo
- Educación Continua
- _Temporero o Experimental (fecha de inactivación: _______)

Posibilidad de equivalencia (en la unidad o en otras unidades del sistema):
- Sí
- X No

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

Número de estudiantes por sección: _1_ Mínimo _25_ Máximo

¿Conlleva cargos por laboratorios? _Sí_ _X_ No

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

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

<table>
<thead>
<tr>
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Requisitos especiales para tomar el curso (destrezas, conocimientos, permisos especiales, equipos, materiales, conocimientos del uso de computadoras o programados específicos, otros):
- Dependiendo de los tópicos a investigar

Equipo o instalaciones mínimas requeridas:
- Dependiendo de los tópicos a investigar

Sistema de calificación:
- X Letra (A, B, C, D ó F)
- Aprobado (P), No aprobado (NP)
- Aprobado (P), Fraculado (F)
- Aprobado (S), No aprobado (NS)
- Aprobado (PS, PN, PB), No aprobado (NP)
- Aprobado (P), No aprobado (NP)
- Otro (Especifique: ________________)

¿Comprende contenido temático de otros cursos?
- Sí
- _X_ No

Especifique: __________________________________________________________________________________________

____________________________________________________________________________________________________
¿Se inactivará o eliminará algún curso al crear éste?  

X No

Especifique: __________________________________________________________________________________________
_____________________________________________________________________
_____________________________

Aprobación a nivel de la unidad

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

1. **General Information:**
   - Alpha-numeric codification: INEL 8997
   - Course Title: INDEPENDENT STUDY
   - Number of credits: One to three credit hours
   - Contact Period: 1-3 hours per week.

2. **Course Description:**
   - English: Individual student research in electrical engineering and related fields.
   - Spanish: Investigación independiente del estudiante en ingeniería eléctrica y áreas afines.

3. **Pre/Co-requisites and other requirements:**
   - Permission of the Department Head.

4. **Course Objectives:**
   - To conduct independent work in topics in electrical engineering and related areas.
   - To gain understanding of the state of the art and identify gaps in the current state of knowledge in electrical engineering or related area.
   - To develop the skills to perform independent research work.
   - Search and analyze the technical literature.

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 serial publications available at the UPRM Library. Other depend on topics.

7. **Course time frame and thematic outline**

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
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<tbody>
<tr>
<td>Topics vary with faculty interests.</td>
<td>Variable</td>
</tr>
<tr>
<td><strong>Total hours: (equivalent to contact period)</strong></td>
<td>Variable</td>
</tr>
</tbody>
</table>

8. **Grading System**
   - ✔ Quantifiable (letters)
   - ❌ Not Quantifiable

9. **Evaluation Strategies**
   - Depend on the topics being studies and activities being performed.

10. **Bibliography:**
    - N/A

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:**
- ECE Graduate Committee, August 2007
UNIVERSIDAD DE PUERTO RICO
ADMINISTRACIÓN CENTRAL
VICEPRESIDENCIA PARA ASUNTOS ACADÉMICOS E INVESTIGACIÓN
SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A

Unidad: Recinto Universitario de Mayagüez
Facultad: Ingeniería

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

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

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

Título completo en español: Seminario Doctoral
(Título abreviado a 26 espacios): Seminario Doctoral

Título completo en inglés: Doctoral Seminar
(Título abreviado a 26 espacios): Doctoral Seminar

Materia principal del curso (en clave alfa): INEL

Nivel del curso (marque con una X):
0 1 2 3 4 5
Subgraduado
Graduado

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

Codificación alfanumérica sugerida: INEL 8998

Tipo de créditos: Fijo Variable

Puede repetirse con crédito: Sí (máximo de créditos 1 en total) No

Horas semanales de:
Conferencia Laboratorio Tutorías
Discusión Taller Investigación
Seminario Internado Tesis o
Estudio Independiente Práctica Supervisada Disertación

Modalidad de educación a distancia (si aplica):

Total de horas a reunirse por periodo lectivo: 1

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

Patrón académico en que se ofrece el curso:

Semestre Trimestre Cuatrimestre Año Otro: Demandas
Secuencia Curricular (C = Cuatrimestre; T = Trimestre; S = Semestre)³

Periodo: _S1_ _S2_ _T1_ _T2_ _T3_ _C1_ _C2_ _C3_ _C4_ _Verano_

Año: _1°_ _2°_ _3°_ _4°_ _5°_ X Otro (especifique) Ph.D.

Tipo de curso:

_X_ Requisito  ___ Electivo  _____ Educación Continua

_Temporero o Experimental (fecha de inactivación: ______)

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

___ Sí  ___ No

Cursos:

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

Número de estudiantes por sección: _1_ Mínimo   _25_ Máximo

¿Conlleva cargos por laboratorios? ___ Sí  ___ No

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

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

<table>
<thead>
<tr>
<th>Curso requisitos</th>
<th>Cursos corequisitos</th>
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</thead>
<tbody>
<tr>
<td>Permiso del director</td>
<td></td>
</tr>
</tbody>
</table>

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

__________________________

Equipo o instalaciones mínimas requeridas: ______ Sala para reuniones con equipo audiovisual

______________________________

Sistema de calificación:⁶

_X_ Letra (A, B, C, D ó F)  ___ Aprobado (S), No aprobado (NS)

_Aprobado (p), No aprobado (NP)  ___ Aprobado (PS, PN, PB), No aprobado (NP)

_Aprobado (P), Fracasado (F)  ___ Otro (Especifique: ____________________________)

¿Comprende contenido temático de otros cursos?

___ Sí  ___ No

Especifique: ____________________________________________________________________________

_______________________________________________________________________________________

Sala para reuniones con equipo audiovisual

______________________________

Sistema de calificación:⁶

_X_ Letra (A, B, C, D ó F)  ___ Aprobado (S), No aprobado (NS)

_Aprobado (p), No aprobado (NP)  ___ Aprobado (PS, PN, PB), No aprobado (NP)

_Aprobado (P), Fracasado (F)  ___ Otro (Especifique: ____________________________)

¿Comprende contenido temático de otros cursos?

___ Sí  ___ No

Especifique: ____________________________________________________________________________

_______________________________________________________________________________________

Sala para reuniones con equipo audiovisual
¿Se inactivará o eliminará algún curso al crear éste?

Sí  X No

Especifique: ____________________________________________________________

________________________________________________________________________

________________________________________________________________________

Aprobación a nivel de la unidad

<table>
<thead>
<tr>
<th>Director(a) del Departamento:</th>
<th>Fecha:</th>
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<tr>
<td>Decano(a) de la Facultad:</td>
<td>Fecha:</td>
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<tr>
<td>Decano(a) de Estudios Graduados:</td>
<td>Fecha:</td>
</tr>
<tr>
<td>Decano(a) de Asuntos Académicos:</td>
<td>Fecha:</td>
</tr>
</tbody>
</table>

Para uso de la Vicepresidencia para Asuntos Académicos e Investigación. NO escriba bajo este renglón.

<table>
<thead>
<tr>
<th>Codificación:</th>
<th>Fecha de codificación:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Funcionario que procesó la solicitud:</td>
<td>Fecha de envío a unidad:</td>
</tr>
</tbody>
</table>

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

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

3Orden del curso según programa de estudios autorizados.

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

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

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

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

8Cuando aplique.
1. **General Information:**
   - Alpha-numeric codification: INEL 8998
   - Course Title: DOCTORAL SEMINAR
   - Number of credits: 0-1 CREDIT HOURS.
   - Contact Period:

2. **Course Description:**
   - English: Oral presentations in research topics in electrical engineering.
   - Spanish: Presentaciones orales sobre temas de investigación en ingeniería eléctrica.

3. **Pre/Co-requisites and other requirements:**
   - Permission of the Department Head.

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

5. **Instructional Strategies:**
   - □ conference □ discussion □ computation □ laboratory
   - □ seminar with formal presentation □ seminar without formal presentation □ workshop
   - □ art workshop □ practice □ trip □ thesis □ special problems □ tutoring
   - □ research □ other, please specify:

6. **Minimum or Required Resources Available:**
   - Materials, equipment, and physical facilities needed to fulfill the course objectives.

7. **Course time frame and thematic outline**

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
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<tr>
<td>Topics vary with faculty interests but examples of topics might include:</td>
<td></td>
</tr>
<tr>
<td>How to give effective oral presentations.</td>
<td>2</td>
</tr>
<tr>
<td>Proposal preparation.</td>
<td>2</td>
</tr>
<tr>
<td>Thesis preparation.</td>
<td>2</td>
</tr>
<tr>
<td>How to present and publish your research work.</td>
<td>2</td>
</tr>
<tr>
<td>Academic careers in electrical engineering.</td>
<td>2</td>
</tr>
<tr>
<td>How to use electronic resources and the WEB to conduct literature searches.</td>
<td>2</td>
</tr>
</tbody>
</table>
How to conduct research.

1. Requirements for the doctoral program: Qualifying exam, Comprehensive exam
2. Academic Progress
3. Total hours: (equivalent to contact period) 15

8. Grading System
☐ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

<table>
<thead>
<tr>
<th></th>
<th>Quantity</th>
<th>Percent</th>
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<tbody>
<tr>
<td>Exams</td>
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<td>Final Exam</td>
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<tr>
<td>Short Quizzes</td>
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<tr>
<td>Oral Reports</td>
<td>Variable</td>
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<tr>
<td>Monographies</td>
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<tr>
<td>Portfolio</td>
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<tr>
<td>Projects</td>
<td>Variable</td>
<td>0-100</td>
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<tr>
<td>Journals</td>
<td>Variable</td>
<td>0-100</td>
</tr>
<tr>
<td>Other, specify:</td>
<td></td>
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</tbody>
</table>

    TOTAL: 100%

10. Bibliography:
N/A

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:
ECE Graduate Committee, August 2007
UNIVERSIDAD DE PUERTO RICO
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PARTE A

Unidad: Recinto Universitario de Mayagüez
Facultad: Ingeniería

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

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

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

Título completo en español: Disertación Doctoral
(Título abreviado a 26 espacios): Disertación Doctoral

Título completo en inglés: Doctoral Dissertation
(Título abreviado a 26 espacios): Doctoral Dissertation

Materia principal del curso (en clave alfa): INEL

Nivel del curso (marque con una X):

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

Curso de continuación: Sí X No
Número de créditos: 0 a 12 por semestre y máximo de 12 crs en total.

Codificación alfanumérica sugerida: INEL 8999

Tipo de créditos: Fijo X Variable

Puede repetirse con crédito: X Sí (máximo de créditos 12 en total) No

Horas semanales de:

Conferencia Laboratorio Tutorías
Discusión Taller Investigación
Seminario Internado Tesis o
Estudio Independiente Práctica Supervisada Disertación

Modalidad de educación a distancia (si aplica):

Total de horas a reunirse por periodo lectivo: N/A

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

Patrón académico en que se ofrece el curso:

Semestre Trimestre Cuatrimestre Año Otro: Demanda
Secuencia Curricular (C = Cuatrimestre; T = Trimestre; S = Semestre)³
Periodo: ___S1 ___S2 ___T1 ___T2 ___T3 ___C1 ___C2 ___C3 ___C4 ___Verano
Año: ___1er ___2do ___3ro ___4to ___5to ___X Otro (especifique) ___Ph.D.

Tipo de curso:
___X Requisito ___ Electivo ___ Educación Continua
___ Temporero o Experimental (fecha de inactivación: ___)

Posibilidad de equivalencia (en la unidad o en otras unidades del sistema):
___ Sí ___ X No

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

Número de estudiantes por sección: ___1 ___ Mínimo ___ N/A ___ Máximo

¿Conlleva cargos por laboratorios? ___ Sí ___ X No

Descripción en español (que no exceda los 1,000 caracteres): El desarrollo, preparación y defensa de una disertación basada en un proyecto de investigación original en ingeniería eléctrica que constituya un adelanto en el área de especialización.

Descripción en inglés (que no exceda los 1,000 caracteres): Development, preparation, and defense of a dissertation based on an original research project in electrical engineering that represents a significant contribution in the area of specialization.

<table>
<thead>
<tr>
<th>Curso prequisitos</th>
<th>Cursos corequisitos</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aprobación del examen calificador del programa doctoral.</td>
<td></td>
</tr>
</tbody>
</table>

Requisitos especiales para tomar el curso (destrezas, conocimientos, permisos especiales, equipos, materiales, conocimientos del uso de computadoras o programados específicos, otros): ___Haber aprobado el examen calificador del programa doctoral___

Equipo o instalaciones mínimas requeridas: ___ Depende del trabajo a realizarse ___

Sistema de calificación:⁶
___ Letra (A, B, C, D o F) ___ Aprobado (S), No aprobado (NS)
___ X Aprobado (p), No aprobado (NP) ___ Aprobado (PS, PN, PB), No aprobado (NP)
___ Aprobado (P), Fracasado (F) ___ Otro (Especifique: )

¿Comprende contenido temático de otros cursos? ___ Sí ___ X No

Especifique: ___

________________________________________________________________________________________
¿Se inactivará o eliminará algún curso al crear éste?  

Sí   X  No

Especifique: __________________________________________________________________________________________  

____________________________________________________________________________________  

<table>
<thead>
<tr>
<th>Aprobación a nivel de la unidad</th>
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<tbody>
<tr>
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<td>Decano(a) de Asuntos Académicos:</td>
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</tbody>
</table>

Para uso de la Vicepresidencia para Asuntos Académicos e Investigación . NO escriba bajo este renglón.

<table>
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<tr>
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<td>Fecha de envío a unidad:</td>
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</table>

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

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

3Orden del curso según programa de estudios autorizados.

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

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

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

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

8Cuando aplique.
1. **General Information:**
   - Alpha-numeric codification: INEL 8999
   - Course Title: DOCTORAL DISSERTATION
   - Number of credits: 0-12 CREDIT HOURS.
   - Contact Period: Variable

2. **Course Description:**
   - **English:** Development, preparation, and defense of a dissertation based on an original research project in electrical engineering which represents a significant contribution in the area of specialization.
   - **Spanish:** Desarrollo, preparación y defensa de una disertación basada en un proyecto de investigación original en ingeniería eléctrica que constituya un adelanto significativo en el área de especialización.

3. **Pre/Co-requisites and other requirements:**
   - Permission of the Department Head.

4. **Course Objectives:**
   - To develop a dissertation that represents a novel and significant contribution to the state knowledge in Electrical Engineering.
   - To present a report documenting the findings of the research.

5. **Instructional Strategies:**
   - Conference
   - Discussion
   - Computation
   - Laboratory
   - Seminar with formal presentation
   - Seminar without formal presentation
   - Workshop
   - Art workshop
   - Practice
   - Trip
   - Thesis
   - Special problems
   - Tutoring
   - Research
   - Other, please specify:

6. **Minimum or Required Resources Available:**
   - UPRM Library bibliographic collection. Research laboratory facilities at the ECE Department

7. **Course time frame and thematic outline**
   - This is not a lecture based course. Students will meet with faculty advisor and faculty in their graduate committee as needed to advance the research project.

8. **Grading System**
   - [ ] Quantifiable (letters) [ ] Not Quantifiable

9. **Evaluation Strategies**

<table>
<thead>
<tr>
<th></th>
<th>Quantity</th>
<th>Percent</th>
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<tbody>
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<td>[ ] Exams</td>
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<td>[ ] Final Exam</td>
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</table>

10. Bibliography:
N/A

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:**
ECE Graduate Committee, August 2007
Appendix C: Faculty Biosketches
APONTE, ERICK

Academic rank: Assistant Professor

Degrees with fields, institution, and date:

<table>
<thead>
<tr>
<th>Degree</th>
<th>Field</th>
<th>Institution</th>
<th>Location</th>
<th>Date</th>
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</thead>
<tbody>
<tr>
<td>BE</td>
<td>Electrical Engineering</td>
<td>University of Puerto Rico, Mayaguez</td>
<td>P.R.</td>
<td>94-97</td>
</tr>
<tr>
<td>DENG</td>
<td>Electric Power Eng.</td>
<td>Rensselaer Polytechnic Institute</td>
<td>Troy, NY</td>
<td>00-05</td>
</tr>
</tbody>
</table>

Faculty service at UPRM:

Date of original appointment: January 1999

Dates of advancement in rank:

- Instructor: 1998-2000
- Assistant Professor: 2006 to present
- Total years of service: 2.5

Areas of professional expertise:

Distributed Generation, Islanding, DG Systems Dynamics, Optimization Techniques

Other related experience—academic or industrial:

Consulting, patents:

State(s) in which registered:

Principal publications of last five years: (FY 2002-2003-2006-2007)

Time Optimal Load Shedding for Distributed Power Systems [IEEE TPRWS], 02/2006
Time Optimal Load Shedding for Power Systems with Distributed Resources [Doctoral Thesis]

Grants or externally funded project active during the last five years: (FY2002-2003-2006-2007):

DOE Solar Decathlon 2007

Scientific and professional societies of which a member:

IEEE

Honors and awards:

Gates Millennium Scholarship Program [2000-2004]

Institutional and professional service in the last five years: (FY2002-2003-2006-2007)

UPRM Committees: EPOW, Graduate Committee.

Professional development activities in the last five years: (FY2002-2003-2006-2007)

Career Development for New Engineering Faculty [2/2007]
Professional Development Center New Faculty Orientation [8/2006]
ABET Accreditation Workshop [4/2006]
Offered Courses in the past two years


Community service activities: (FY2002-2003-2006-2007)
Dr. Javier A. Arroyo-Figueroa, Associate Professor
Electrical and Computer Engineering Department
University of Puerto Rico at Mayagüez
Ph. 787-832-4040 x2369, FAX 787-831-7564
E-mail: jarroyo@ece.uprm.edu

Professional Preparation:
Ph.D. University of Florida, 1997
M.E.E. University of Florida, 1992
B.S.Cp.E. University of Puerto Rico Mayagüez Campus, 1990

Appointments:
Department of Electrical and Computer Engineering,
University of Puerto Rico Mayagüez Campus, Mayagüez, P.R.
Associate Professor 2001-Present.
Assistant Professor 1997-2001


Current Professional Memberships and Affiliations:
Licensed Engineer in Training (EIT) in Puerto Rico since 2005
Colegio de Ingenieros y Agrimensores de Puerto Rico
Institute for Electrical and Electronics Engineers (IEEE)

Academic Service Activities:
Panelist, Science Foundation of Ireland, 2001.
Served in several National Science Foundation Proposal Review Panels

Patents:

Other Professional Activities:
Senior Member of the Technical Staff, Commoca, Inc., Mayagüez, Puerto Rico, 2005-2006.
President, Entevia Corporation, Mayagüez, Puerto Rico, 2001-present.
Consulting on software development and software process improvement, PRSoft, Inc. 2001-2002.
Consulting on hardware/software acquisition, Party City of Puerto Rico, San Juan, P.R., 1992-1997
GERSON BEAUCHAMP
Professor of Electrical Engineering
College of Engineering
Electrical and Computer Engineering Department
University of Puerto Rico – Mayagüez Campus
P.O. Box 9042
Mayagüez, PR 00681-9042

EDUCATION
Ph.D., Electrical Engineering, Georgia Institute of Technology, Atlanta, Georgia, March, 1990.
M.S. in Electrical Engineering, Georgia Institute of Technology, Atlanta, Georgia, December, 1985.

RESEARCH INTERESTS
Engineering Education, Pre-College Outreach Programs. Control Systems Design and Simulation. Instrumentation Systems. Optimal Control and its applications. Alternative energy systems. The analysis and control of implicit (singular) linear systems, specifically the use of computational algorithms to solve several problems regarding these systems.

ACADEMIC EXPERIENCE
July 1998 – Present, Professor, College of Engineering, Electrical and Computer Engineering Department, University of Puerto Rico at Mayagüez
August 1993 – May 1994, Special Assistant to the Engineering Dean, UPRM
July 1993 – June 1998, Associate Professor, College of Engineering, Electrical and Computer Engineering Department, University of Puerto Rico at Mayagüez
December 1991 – July 1997, Project Coordinator, PR-AMP Pre-College Engineering Program
January 1990 - June 1993, Assistant Professor, College of Engineering, Electrical and Computer Engineering Department, University of Puerto Rico at Mayagüez

PUBLICATIONS


THESES SUPERVISED


PROFESSIONAL WORK EXPERIENCE
-Technical Support Engineer, Photosystems and Electronic Products Department, E.I. DuPont de Nemours and Company, Parlin, NJ, Summer 1986
-Technical Support Engineer, Photosystems and Electronic Products Department, E.I. DuPont de Nemours and Company, Parlin, NJ (GEM Summer Intern), Summer 1985
-Technical Support Engineer, Engineering Development Laboratory, E.I. DuPont de Nemours and Company, Wilmington, DE (GEM Summer Intern), Summer 1984

COLLABORATORS
Iván Baigés, Mechanical Engineering Department, UPR-Mayagüez
José L. Cruz-Rivera, Electrical and Computer Engineering Department, UPR-Mayagüez
Antonio A. González, Civil Engineering Department, UPR-Mayagüez
Jorge E. González, Mechanical Engineering Department, UPR-Mayagüez
Lueny Morell, Chemical Engineering Department, UPR-Mayagüez

GRADUATE ADVISEES
Luis I. García-Cabrera
Luis V. Meléndez-González, GE, Florida
Enid L. Muñiz-Marrero, Kodak, New Jersey
Edilberto Rodríguez-Morales, PEC Technologies, San Juan, PR

GRADUATE ADVISOR
Frank L. Lewis, Automation and Robotics Research Institute, The University of Texas at Arlington
Education:
- Ph.D. in Electrical Engineering, August 2007, Howard University, Washington DC, USA.
- B.Sc. in Electrical Engineering, June 2000, University of Puerto Rico, Mayagüez, Puerto Rico.

Professional Experience:
- Assistant Professor, Department of Electrical and Computer Engineering, University of Puerto Rico, Mayagüez, Puerto Rico, 2008-present.
- Teaching Assistant, Department of Electrical and Computer Engineering, Howard University, Washington DC, spring 2007.
- Summer Researcher, System Identification and Controls Laboratory, Department of Electrical and Computer Engineering, University of California, Santa Barbara, California, summer 2004.
- Summer Researcher, Center for Information Technology and Society, University of California, Santa Barbara, California, summer 2004.
- Lecturer, Department of Philosophy, Howard University, Washington DC, Fall 2004.
- Summer Researcher, Neural Engineering Center, Department of Biomedical Engineering, Case Western Reserve University, Cleveland, Ohio, summer 2002.

Research Interests:
- Electric Drives, Power Electronics, Neural Networks, Fuzzy Logic, Appropriate Technology, Public Policy, Social Implications of Technology, Philosophy of Technology, Education.

Honors and awards:
- First Place, Ph.D. oral presentation in the area of Engineering and Physical Sciences. “dSPACE DSP-Based Rapid Prototyping of Fuzzy PID Controls for High Performance Brushless Servo Drives”; Howard University Graduate Research Symposium, April 2007.
- First Place, Ph.D. oral presentation in the area of Engineering and Physical Sciences. “Experimental Implementation of an Indirect Adaptive Neural Network Controller for Precise Motion Control of Step Motors”; Howard University Graduate Research Symposium, April 2005.
Scientific and professional societies of which a member:

Institute of Electrical and Electronics Engineers (IEEE)
    Industry Applications Society, Power Electronics Society, Industrial Electronics Society, Computational Intelligence Society, Control System Society, Education Society, Society on Social Implications of Technology.

Recent Publications:


External Collaborators:

Pedro Capó-Lugo, NASA Marshall Space Flight Center, Huntsville, AL.

John Tharakan, Howard University, Washington DC.

Abdul R. Ofoli, Cummins, Columbus, IN.

Graduate Advisor:

Ahmed Rubaai (Howard University, Washington, DC) – PhD.

Professional Preparation
Ph.D. Electrical Engineering The Ohio State University 2002
M.S. Electrical Engineering The Ohio State University 1996
B.S. Electrical Engineering University of Puerto Rico 1991

Appointments
Associate Professor
Department of Electrical and Computer Engineering
University of Puerto Rico, Mayagüez, Puerto Rico
August 2001 – present

Teaching Assistant
Department of Electrical and Computer Engineering
The Ohio State University, Columbus, Ohio
January 1997 – May 2001

Research Assistant
Department of Electrical and Computer Engineering
The Ohio State University, Columbus, Ohio
September 1994 – December 1996

Instructor
Department of Electrical Engineering
Polytechnic University of Puerto Rico, Hato Rey, Puerto Rico
February 1992 – August 1993

Electrical Engineer
Puerto Rico Electric Power Authority – Planning & Research Division
San Juan, Puerto Rico
June 1991 – August 1993

Recent Publications


• Angel Aquino, Atzel Santiago, José R. Cedeño and Efrain O'Neill, "Optimal Location of Distributed Generation Units on Radial Distribution Feeders", In *Proceedings of the Power Systems


Professional Activities and Honors
Registered Professional Electrical Engineer in Puerto Rico – Lic. No. 12191
Director, Pre-College Engineering Program, UPRM (2002 – present)
Secretary-Treasurer, Caribbean Colloquium on Power Quality (CCPQ 2003)
Member, Institute of Electrical and Electronic Engineers (IEEE) - Power Engineering Society
Faculty Advisor, IEEE Student Chapter, UPRM (2002 – present)
Member, Illuminating Engineering Society of North America (2005 – present)
Member, “Colegio de Ingenieros y Agrimensores de Puerto Rico”
Member, Tau Beta Pi National Engineering Honor Society
Member, Phi Kappa Phi Honor Society
Recipient, Dean’s Fellowship, The Ohio State University (1993)
Magna Cum Laude – BSEE, University of Puerto Rico, 1991

Awards and Grant Support
Dr. Jose G. Colom-Ustariz, Professor
Electrical and Computer Engineering Department
University of Puerto Rico at Mayagüez
Ph. 787-832-4040 x2448, FAX 787-832-2485
E-mail: colom@ece.uprm.edu

Professional Preparation:
Ph.D. Penn State University, 1998
Electrical Engineer University of Massachusetts ,1991
B.S.E.E. University of Puerto Rico Mayagüez Campus, June 1988

Appointments:
Department of Electrical and Computer Engineering,
University of Puerto Rico Mayagüez Campus, Mayagüez, P.R.
Instructor: 1991 to 1994
Assistant Professor: 1998 to 2001
Associate Professor: 2001 to 2006
Professor 2006-present

5 Recent Journal Publications


5 Recent Conference Proceedings


Current Grants:
UPRM Project Co-Director in Collaborative Adaptive Sensing of the Atmosphere. NSF ERC in collaboration with UMASS, OU, and CSU. 2002-2012.

Current Professional Memberships and Affiliations:
Institute for Electrical and Electronics Engineers (IEEE)
Tau Beta PI

Number of graduate students supervised in the past 5 years: 8
COUVERTIER, ISIDORO

Academic rank: Professor

Degrees with fields, institution, and date:

- BS Electrical Engineering University of Puerto Rico, Mayagüez Campus 1981
- MS Electrical Engineering University of Wisconsin-Madison 1983
- Ph. D. Electrical Engineering Louisiana State University-Baton Rouge 1996

Faculty service at UPRM:

Date of original appointment: August 1985

Dates of advancement in rank:

- Instructor: 1985
- Assistant Professor: 1989
- Associate Professor: 1999
- Professor: 2004

Total years of service: 21 (Five Year Leave)

Areas of professional expertise:

Computer Networking, Embedded Systems

Other related experience — academic or industrial:

- Product/Design Engineer, Hewlett Packard Co. 2.5 years
- Computer Center Director, UPR-Arecibo, 4 years
- Computer Science Department Head, UPR-Arecibo, 1.5 years

Consulting, patents:

- Consulting for Hewlett Packard – Aguadilla in 1997, C Programming
- Atlantea Project UPR Central Administration – Haiti in 1998, C and C++

State(s) in which registered:

Puerto Rico

Principal publications of last four years: (FY 2002-2003-2006-2007)


Grants or externally funded project active during the last four years: (FY 2002-2003-2006-2007)

Scientific and professional societies of which a member:
Institute of Electrical and Electronics Engineers, Senior Member
Colegio de Ingenieros y Agrimensores, Member

Honors
IEEE Senior Member, Graduate Student Association Recognition, UPRM’s IEEE Student Chapter Recognition

Institutional and professional service in the last four years: (FY 2002-2003-2006-2007)

Professional development activities in the last four years: (FY 2002-2003-2006-2007)
Gerencia Academica, CCNA, CCNP

Offered Courses in the past two years (2005-2007)

Community service activities: (FY 2002-2003-2006-2007)
Cruz-Rivera, José L.

**Academic rank:** Professor

**Degrees with fields, institution, and date:**

<table>
<thead>
<tr>
<th>Degree</th>
<th>Field</th>
<th>Institution</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS</td>
<td>Electrical Engineering</td>
<td>University of Puerto Rico, Mayagüez Campus</td>
<td>1991</td>
</tr>
<tr>
<td>MS</td>
<td>Electrical Engineering</td>
<td>Georgia Institute of Technology</td>
<td>1992</td>
</tr>
<tr>
<td>Ph. D.</td>
<td>Electrical Engineering</td>
<td>Georgia Institute of Technology</td>
<td>1996</td>
</tr>
</tbody>
</table>

**Faculty service at UPRM:**

Date of original appointment: July 1996

Dates of advancement in rank:

- Assistant Professor: 1996 to 1999
- Associate Professor: 1999 to 2001
- Professor: 2001 to Present
- Total years of service: 1

**Areas of professional expertise:**

Digital Systems, Parallel Processing, Optoelectronics

**Other related experience—academic or industrial:**

**University of Puerto Rico System – Central Administration**

- July 2006 – Present: Associate Vice-President for Student Affairs

**University of Puerto Rico – Mayagüez Campus**

- July 98-July 99: Associate Director for Research and Academic Affairs ECE Department

**Commoca – Mayagüez, PR**


**International Business Machines (IBM), Poughkeepsie, New York.**

- 1991: Design Engineer: Summer internship

**Amper, Madrid, Spain -- R&D Engineer: Summer internship**


**Consulting, patents:**

- 1996 – Present: Consulting in areas of higher education issues, engineering technology, and research and development management.

**State(s) in which registered:**

- EIT, Georgia. 1996.
Grants or externally funded projects active during the last five years: (FY 2002 -- 2007)


L. Jiménez, Dr. Miguel Vélez, S. Hunt, S. Cruz Pol, R. Vásquez, and J. L. Cruz Rivera, Center for Subsurface Sensing and Imaging, National Science Foundation, $1,770,000 (+ $639,502 UPRM Matching Funds), January 2000 to December 2004

Scientific and professional societies of which a member:

Institute of Electrical and Electronics Engineers, (Senior Member)

Honors and awards:

1997 National Science Foundation Career Award

1999 Distinguished Professor: Electrical and Computer Engineering. UPRM College of Engineering

1999 Frontiers in Education Fellow, given by the Executive Committee of the 1999 Frontiers in Education International Conference.

Institutional and professional service in the last five years: (FY 2002 -- 2007)

Associate Vice-Presidente for Student Affairs, UPR System (July 2006-Present)

Chairman, ECE Department (Jan-Dec 2003)
CRUZ-POL, SANDRA L

SandraCruzPol@ieee.org http://ece.uprm.edu/~pol

Academic Rank: Professor

Degrees with fields, institution, and date:

<table>
<thead>
<tr>
<th>Degree</th>
<th>Field</th>
<th>Institution</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS</td>
<td>Engineering</td>
<td>University of Puerto Rico, Mayagüez Campus</td>
<td>1987</td>
</tr>
<tr>
<td>MS</td>
<td>Engineering</td>
<td>University of Massachusetts at Amherst</td>
<td>1991</td>
</tr>
<tr>
<td>Ph. D.</td>
<td>Engineering</td>
<td>The Pennsylvania State University</td>
<td>1998</td>
</tr>
</tbody>
</table>

Faculty service at UPRM: Dates of advancement in rank:

<table>
<thead>
<tr>
<th>Position</th>
<th>Dates of Advancement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructor</td>
<td>1991 to 1998</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>1998 to 2001</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>2001 to 2005</td>
</tr>
<tr>
<td>Professor</td>
<td>2005 to Present</td>
</tr>
<tr>
<td>Total years of service</td>
<td>17 (4 on leave)</td>
</tr>
</tbody>
</table>

Areas of professional expertise:

Microwave Remote Sensing, Atmospheric Absorption Modeling, Microwave Ocean Emissivity

Other related experience—academic or industrial:

IEEE Geoscience and Remote Sensing Newsletter- Associate Editor for University Profiles

Principal publications of last 10 years: (until-2007)


Cruz Pol, S. L., José Maeso, Margarita Baquero “DSD characterization and computations of expected reflectivity using data from a Two-Dimensional Video Disdrometer deployed in a Tropical Environment”, IEEE IGARSS 05, Korea., 2005.


Externally funded project active during the last five years: (FY up to 2007)

<table>
<thead>
<tr>
<th>Project Title</th>
<th>Source of Support</th>
<th>Total Award Amount</th>
<th>Total Award Period Covered</th>
</tr>
</thead>
<tbody>
<tr>
<td>An engineering Research Center (ERC) for Subsurface Sensing and Imaging Systems.(CenSSIS)</td>
<td>National Science Foundation (NSF)</td>
<td>$12,500,000 (Joint)</td>
<td>07/01/2000-06/30/2010</td>
</tr>
<tr>
<td>Collaborative Adaptive Sensing of the Atmosphere (CASA)</td>
<td>NSF</td>
<td>$17,000,000 (Joint)</td>
<td>09/01/2003-08/31/2008</td>
</tr>
<tr>
<td>Statistcal techniques to improve the Hydro-Estimator rainfall algorithm during heavy storms over Puerto Rico</td>
<td>NOAA</td>
<td>$100,000</td>
<td>2 yr Started Sept 2006</td>
</tr>
<tr>
<td>Project Title: Tropical Center for Earth and Space Science Studies</td>
<td>NASA</td>
<td>$4,999,513</td>
<td>7/2000 to 7/2005</td>
</tr>
</tbody>
</table>
Scientific and professional societies of which a member:

Institute of Electrical and Electronics Engineers, Senior Member
IEEE Geoscience and Remote Sensing Society, member
Phi Kappa Phi, Member

Honors and awards:

May 2001 Excellence in Mentoring Award, The National GEM Consortium, San Diego CA.
December 2000, Recognition as IEEE Student Branch Advisor, IEEE Student Branch
March 1992, Recognition, Society of Women Engineers (SWE) Student Chapter, Served as panelist for the National Science Foundation, 2002.

Institutional and professional service in the last five years: (FY 2002-2003 - 2006-2007)

- MicroRad06 Specialist Meeting on Microwave Radiometry and Remote Sensing Applications, held in San Juan, Puerto Rico, from 28 February to 03 March 2006. MicroRad’06 is sponsored by the IEEE Geoscience and Remote Sensing Society, NASA, NOAA, NCAR, URSI, UPRM, and Colorado State University. Local Arrangement Chair; Dr. Sandra Cruz-Pol, Local Arrangement Co-chair; Dr. José Colom.


Offered Courses in the past 3 years (2005-2007)

INEL 5305 Antenna Theory and Design,
INEL 4102 Electric Circuit Analysis II,
INEL 4075 Fundamentals of Electrical Engineering,
INEL 4152 Electromagnetics II,
INEL 4998 Undergraduate Research,
INEL 5995 Special Problems,
INTD 8995 PhD Collaborative Research
INEL 6069 Microwave remote Sensing,
INEL 6046 Master’s Thesis

Community service activities: (FY 2002-2003 - 2006-2007)

Judge for several Science Fairs in local High schools
Coordinator of UNICEF TOT fundraiser and Talent For Life activity for UNICEF and UNWFP

Academic Workshops and Seminars

Dr. Cruz-Pol has attended numerous seminars and workshops on education/learning methods and technical professional development. She was selected Outstanding Professor of the Year at her department at UPRM, received the NASA Faculty Award for Research and has offered hundreds of presentations, workshops and seminars in her areas of research, in community outreach and education.
DIAZ CASTILLO, ANDRES J.

Academic rank: Assistant Professor

Degrees with fields, institution, and date:

<table>
<thead>
<tr>
<th>Degree</th>
<th>Field</th>
<th>Institution</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS</td>
<td>Computer Science</td>
<td>Universidad Nacional Pedro H. Urena</td>
<td>1986</td>
</tr>
<tr>
<td>MS</td>
<td>Computer Science</td>
<td>University of Puerto Rico, Mayaguez Campus</td>
<td>1992</td>
</tr>
<tr>
<td>Ph.D.</td>
<td>Computer Science</td>
<td>Michigan State University</td>
<td>2000</td>
</tr>
</tbody>
</table>

Faculty service at UPRM:

Date of original appointment: January 2007

Dates of advancement in rank:

- Assistant Professor: 2007
- Total years of service: 1/2

Areas of professional expertise:

- Electrical Engineer (Power Electronics, Automation, Embedded systems)

Other related experience—academic or industrial:

- 3 Years experience as Electrical Wire Manufacturing Industry Engineer
- 11 Years experience as Assistant Professor in Private University System

Consulting, patents:

- Industrial automation consultant
- Professional engineer licensed 21076

State(s) in which registered:

- West area PR
- Engineer Licensed for Puerto Rico State

Principal publications of last four years: (FY 2002-2003-2006-2007)

- Intelligent Test Generator (1st Electro technology International Symposium 2002)
- Integer Pair Representation of Binary Terms and Equations (IEEE MWCCS 98)
- Multilevel Three Phase PWM for Induction Motors (ICEM 98)
- New Wide Overmodulation Method (IEEE APEC-2000)
- Design a Flyback Converter in a Power Factor Correction Scheme. Junior Technical Meeting (1992)
- Solar Car History (Diálogo October, 1990)
- Digital Power Factor Meter (UNPHU 1986)

Grants or externally funded project active during the last four years: (FY 2002-2003-2006-2007)

- Intelligent Exam Generator software development (2002 Education Innovative Project)
- PLC virtual Lab development (2004 Education Innovative project)

Scientific and professional societies of which a member:

- IEEE, Power Electronics Society, CIAPR

Honors and awards:

- Department Distinguish Professor (UIPR Aguadilla)
Research Distinguish Professor (UIPR Aguadilla)

Institutional and professional service in the last four years: (FY 2002-2003-2006-2007)
- Web Page Development seminar for faculty
- Exam Generator seminar for faculty
- PE review for HP Engineer
- PLC, robotic and automation seminars for Industrial Technicians
- Ice Maker Manufacturing Industry Automation work using PLC

Professional development activities in the last four years: (FY 2002-2003-2006-2007)
- WebCT Vista Certification.
- Data Mining IEEE-CIAPR seminar.

Offered Courses in the past two years (2005-2006)
- INEL 4085 Machine Electric Introduction

Community service activities: (FY 2002-2003-2006-2007)
- Youth Basketball Team Coach
Name: Ducoudray, Gladys O.

Academic Rank: Assistant Professor

Degrees with fields, institution, and date:

- BS  Physics  University of Puerto Rico, Río Piedras  1994
- MS  Electrical Engineering  Oregon Graduate Inst. of Science & Tech.  1997
- Ph. D.  Electrical Engineering  New Mexico State University  2003

Areas of Professional Expertise:

Electronics, Analog VLSI Low Power System Design, Automated Testing Circuit Design

Other related experience—academic or industrial.

Instructor, Introductory Physics, STEP program at Turabo University, 1 year. Teaching prospective students introductory physics. 1995


State(s) in which registered

New Mexico

Principal publications of last five years: (FY 2000-01 -- 2004-05)


**Grants or externally funded project active during the last five years:**


UPRM TI Analog Program, Texas Instruments, Dallas TX, $100,000/year Aug-2006-Aug 2007.

**Scientific and professional societies of which a member:**

IEEE, Member

**Honors and awards:**

Outstanding graduating Graduate Student, New Mexico State University, Dec 2003. Recognition award given to a Ph. D. student for outstanding work on his or her field in terms of grants publications and other awards

NASA Spacegrant Fellowship, NASA Spacegrant Consortium Fall 2003. Fellowship of $4,000. for research on the aerospace and related fields in electronics.

NMAGEP Fellow, NMAGEP at New Mexico State University, from Jan2002-Dec 2003. Fellowship of $4,000 yearly. For research on analog and Mixed-signal VLSI in electronics.

**Institutional and professional service in the last five years:: (FY 1996-97 -- 2001-02)**

Electronics Committee Coordinator, May 2005-Present, Responsible for reviewing courses textbooks and contents, Projection on electronics area for department, Coordination of laboratory experiences with course work, coordinate meetings between faculty members.
IAP Committee member, 1 year, Reviewing proposals submitted to the committee. Advisor to Carlos Vega Ms Student graduated Summer 2005. Advisor to Laura Sanchez Ms. Students graduated Summer 2007

**Professional development activities in the last five years:**


**Community Service Activities:**

Treasurer of Parent Association for Gymnasts at HGU (non-profit organization), Organize Fundraisers, Allocate money for events and purchase gymnastic equipment. In charge of the finances of the Association.
André L. M. dos Santos  
Electrical & Computer Engineering  
University of Puerto Rico  
Mayagüez, PR

EDUCATION
University of California at Santa Barbara, Santa Barbara, CA  

University of Washington, Seattle, WA  
M. S. degree in Atmospheric Science, February 1994.

Instituto Tecnológico de Aeronáutica, São Jose dos Campos, Brazil  
B. S. degree in Electronics Engineering, December 1988.

EMPLOYMENT HISTORY
August 2005  ….  
   Associate Professor  
   Electrical & Computer Engineering, University of Puerto Rico at Mayagüez

   Assistant Professor  
   College of Computing, Georgia Inst. of Technology

   Research Assistant  
   Dep. of Computer Science, University of California

   Research Assistant  
   Dep. of Atmospheric Science, University of Washington

SELECTED PUBLICATIONS

Five Relevant Publications


**Five Other Publications**


**SYNERGISTIC ACTIVITIES**

- I have been working on projects using tamper resistant devices since 1993. The first project I worked was for a system used by Fujitec Corporation.
- I have designed the security framework for the system based on smart cards used for mass transportation by Fujitec Corporation, currently deployed in US, Europe and South America.
- I have been collaborating with Infineon Technologies, performing research using secure processors manufactured by them since 1996.
- I have developed the prototype of a system for securely accessing data for digital libraries that was tested at the University of California Digital Library.
- I have a patent with Zhang, Pande and Bruecklmayr on tools for a secure processor OS (joint patent held by Infineon and Georgia tech).

**ADVISOR AND COLLABORATORS**

I did my doctoral work with Prof. Richard A. Kemmerer at the University of California, Santa Barbara. I had Prof. Alan G. Konheim and Prof. Terence Smith as members of my doctoral committee, both from University of California, Santa Barbara. I also did work with Prof. Giovanni Vigna from University of California, Santa Barbara. I was an Assistant Professor at the College of Computing at Georgia Tech for 5 years. At Georgia Tech I have worked closely with Wenke Lee, Mustaque Ahamad and Calton Pu.
Shawn D. Hunt

Department of Electrical and Computer Engineering
412 Stefani Bld.      Tel: (787) 832-4040 ext. 3654
Recinto Universitario de Mayagüez      Fax: (787) 831-7564
University of Puerto Rico      email: shawn@ece.uprm.edu
Mayagüez, Puerto Rico 00681-5000      http://ece.uprm.edu/~hunt

Academic Rank:       Professor (Full-Time)
MSEE, Electrical Engineering, Michigan State University, 1989.
BSEE, Electrical Engineering, Tulane University, 1986.

1992-1995       Assistant Professor
1995-2000       Associate Professor
2000-present    Professor

10 Selected Publications:


Selected Funded Proposals:
Researcher in "An Engineering Research Center for Subsurface Sensing and Imaging Systems," 5 years starting August 2005, $12M.


PI in “Proposal for a Communication and Signal Processing Laboratory,” sponsored by the DOD, 18 months starting August 2000, $235,266.37.


CO-PI in "Unsupervised Classification System for Hyperspectral Data Analysis," sponsored by DEPSCOR, Grant no. DAAG55-98-1-0016, 3 years starting August 1997, $328,180.

CO-PI in "Tropical Center for Earth and Space Studies", sponsored by NASA, 5 years starting July 1995, $5.5M

CO-PI in "Development of a Computer Engineering Research Environment at UPR-Mayagüez", sponsored by the National Science Foundation, 5 years starting July 1994, $1.5M.

Selected Funded and Supervised Research Topics: (2000-2007)


“Data collection of the Enrique reef for hyperspectral algorithm validation,” Adrienne Mundorf (U of Rhode Island) and Suhailly Cardona, Summer 2007, CenSSIS grant, US Department of Transportation fellowship.

“De-noising of Raman Spectroscopy Signals,” Luis Quintero. Funded by Censsis Grant. 2006


“Resolution enhancement of AVHRR images,” Alfredo Garcia, Fall 2000, NASA grant.


BIOGRAPHICAL SKETCH
Henrick Mario Ierkic
Electrical and Computer Engineering (ECE) Department
University of Puerto Rico at Mayagüez (UPRM)
PH: 787 8324040 ext. 2081, E-mail: ierkic@ece.uprm.edu

RESEARCH INTERESTS
Radar remote sensing of the atmosphere. Wave propagation. Wireless Communications.

PROFESSIONAL PREPARATION
BS, Ingeniería Eléctrica, Universidad Nacional de Ingeniería, Perú, 1972.
Ph. D., Electrical Engineering, Cornell University, 1980.
Postdoc, Max-Planck Institute for Aeronomy, Germany. 1980-1981

APPOINTMENTS
1997--present, Professor, University of Puerto Rico at Mayaguez (UPRM)
1990—1996, Associate Professor, UPRM

RELEVANT PUBLICATIONS (5)
Zhou, Q. H., H, Monroy, D. C. Fritts, H. M. Ierkic, B. Isham, J. R. Isler, and S. E. Palo,
Radar Observation of Longitudinal Variability of Tidal/Planetary Waves and Mean
Interferometry of Vertical Irregularity Structures in the Auroral E Region,” Radio Sci.,
Roettger J., and H. M. Ierkic, “Postset beam steering and interferometer applications of
VHF radars to study winds, waves and turbulence in the lower and middle atmosphere”,

ADDITIONAL PUBLICATIONS
enhanced plasma line and the reflected HF wave at Arecibo”, J. Atmos. Terr. Phys., 51,
Sulzer M.P., H. M. Ierkic, and J.A. Fejer, “Observational limitations on the role of
Langmuir cavitons in ionospheric modification experiments at Arecibo”, J. Geophys.

SYNERGISTIC ACTIVITIES


ACADEMIC ACTIVITIES

Courses in the area of Applied Electromagnetics (e.g. Radar Theory and Practice, Electromagnetics, Wireless Communications, Smart Antennas), Communications (Telecommunication Theory I and II) and DSP (DSP I). Undergraduate research advisor of many students. MS thesis advisor of 4 students (Radar for atmospheric research) two of which have completed PhDs.

Reviewer for Journal of Atmospheric and Oceanic Technology (2004, 2005). Member of the Americal Meteorological Society (AMS), American Geophysical Union (AGU), and Institute of Electronic and Electrical Engineers (IEEE).
EDUCATION

Ph.D., Electrical Engineering, December 1996 Iowa State University, Ames, Iowa
Dissertation: "Risk-based operating limits for dynamic security constrained electric power systems."

Master of Science Electrical Engineering May 1990 University of Michigan, Ann Arbor, Michigan

Bachelor of Science Electrical Engineering, Magna cum Laude, June 1988 University of Puerto Rico, Mayagüez, PR

ACADEMIC WORK EXPERIENCE

Professor (7/05 – present), Associate Professor (6/00 – 6/05) and Assistant Professor (1/97 – 6/00) of Electrical Engineering, Electrical and Computer Engineering Department, University of Puerto Rico, Mayagüez (UPRM)

General Chair of the 10th International Conference on Probabilistic Methods Applied to Power Systems (PMAPS 2008) Rincón, Puerto Rico, May 25-29, 2008. The PMAPS Conferences fill a needed role in the power engineering community by providing a regular forum for engineers and scientists worldwide to interact around the common theme of power engineering decision problems under uncertainty. (06/06 – 05/08)

President, Electrical and Computer Engineering Department Personnel Committee (8/06 – 06/07)

Elected Academic Senator for the College of Engineering – University of Puerto Rico, Mayagüez. (8/05 – 8/06)

Assistant Dean of Academic Affairs UPRM 2/00 – 8/00 - Duties included: supervisor of the Registrar Office and the Admissions Office of the University of Puerto Rico at Mayagüez, coordinator of the registration process for the whole Campus.

Associate Director for Academic Affairs, Electrical and Computer Engineering Department UPRM 10/00 – 01/02 and 8/99 – 2/00 Duties included: Graduate Programs Director, updating the faculty recruitment plan, coordinator of the curriculum revision and accreditation processes, evaluate the creation of new academic programs, coordinator and supervisor of the Department registration process.

ACADEMIC INTERESTS AT GRADUATE LEVEL: Renewable energy systems and their influence on the electric power network, electric power system dynamics and operation

EXAMPLES OF FUNDED RESEARCH PROJECTS


Colegio San Ignacio - Ejemplo de Sostenibilidad (2007) A $73,332 project to match the energy needs of Colegio San Ignacio with its available renewable energy sources. Demonstration projects with a strong educational component will be proposed to the School to be designed, installed and operated on the Scholl Campus with the participation of the School Faculty and students. The philosophy behind the program will be one of sustainable development.

Programa Panamericano de Capacitación en Ingeniería de Potencia Eléctrica (2006) A $97,370 educational project to deliver a Web-broadcast master program in electric power engineering to engineers in the Dominican Republic. Courses in this program will respond to the reality and necessities of the Dominican Republic electric power industry. The philosophy of the program will be one of sustainable development.
Caguas Sustainable Energy Showcase, Phase I (2006) A $90,055 project sponsored by the Municipality of Caguas, Puerto Rico to assess the current electric energy consumption profile, by sector; residential, commercial, industrial and governmental, of Caguas and to propose achievable goals (percentages of demand), by sector, to be satisfied using renewable energy sources.

Failure Probabilities for Risk-Based Maintenance and Parameter Estimation of Synchronous Machines (2003) A $99,444 project sponsored by the National Science Foundation (NSF) to estimate parameters and failure probabilities for synchronous generators. The proposed method improves estimates of synchronous machine parameters from on-line terminal voltage and current measurements to monitor field and stator winding deterioration over time. The main outcomes of this work are the application of useful alternate robust estimation techniques and the identification of failure modes for risk-based maintenance of generators.

Intelligent Power Routers for Distributed Coordination in Electric Energy Processing Networks (2002) A $499,849 project sponsored by the National Science Foundation (NSF) and the Office for Naval Research (ONR) to develop a model for the next generation power network using a distributed concept based on scalable coordination by an Intelligent Power Router (IPR). Our goal is to show that by distributing network intelligence and control functions using the IPR, we will be capable of achieving improved survivability, security, reliability, and re-configurability. Our approach builds on our knowledge from power engineering, systems, control, distributed computing, and computer networks.

PUBLICATIONS RELATED TO PROPOSED PROJECT


OTHER PROFESSIONAL EXPERIENCE

- (05/07 – present) Consultant – Engineering evaluation of power system transmission and distribution limitations for C Lewis Accountants. Provided technical advice associated to a claim of increased operational costs due to restrictions on a power system operation.
- (10/06 – 12/06) Consultant – Wind Energy Consulting Services for UPC Wind. Provided technical advice in siting and interconnection issues for potential wind energy projects.
- (06/04 – 06/05) Consultant and Partner of ecoEnergy a private corporation that had the objective of building the first commercial electric power plant of Puerto Rico using eolic energy.
- (4/01 – 07/02) Consultant – Wind Energy Consulting Services for the Puerto Rico Energy Affairs Administration. Provider of technical consulting and advisory services in the area of wind energy and electric power systems technology.
- (1998 – present) Expert witness - Civil court cases involving electric hazard, shock and/or electrocution.
Dr. Luis O. Jiménez-Rodríguez.
Professor
Electrical and Computer Engineering Department
University of Puerto Rico at Mayagüez
Ph. 787-832-2825, FAX 787-832-2485
E-mail: jimenez@ece.uprm.edu

Professional Preparation:
Ph.D. Purdue University, 1996
MSEE University of Maryland at College Park, 1991
BSEE University of Puerto Rico Mayagüez Campus, 1989

Appointments:
Professor, 1996-present, Department of Electrical and Computer Engineering, University of Puerto Rico Mayagüez Campus, Mayagüez, P.R.
Visiting Professor, June -December 2004. Department of Telecommunication Systems, and Department of Philosophy and Theology, Pontificia Universidad Católica Madre y Maestra. Teaching courses in social ethics and in pattern recognition.

10 Recent Publications
V. Manian and L.O. Jimenez, “Land cover and benthic habitat classification using texture features from hyperspectral and multispectral images.” In Journal of Electronic Imaging, Volume 16, Issue 2 April-June 2007.,

Papers in Engineering Ethics and Education:


Awards:
Distinguished Professor, UPRM ECE Department, 2000-2001 Academic Year.
UPR Distinguished Researcher in Science and Technology, UPR Office of the President, December 2000.

Synergistic Activities
Dr. Luis O. Jimenez in collaboration with Dr. Miguel Vélez-Reyes (UPRM) and Mr. Samuel Rosario have developed the MATLAB Toolbox for Hyperspectral Image Analysis. http://www.censsis.neu.edu

Dr. Luis O. Jimenez in collaboration with Dr. Miguel Vélez-Reyes developed a software system for the ARMY Topographic Engineering Center in Ft. Belvoir, VA based on the algorithms developed as part of their work in hyperspectral image processing. This is currently used by TEC researchers in the analysis of hyperspectral data.

Dr. Luis Jiménez has served as panelist in NASA PEER review panel to evaluate proposals in The Carbon Cycle Science Program Area, March 2001, Washington.

Dr. Jiménez was Assistant of the Dean to develop an Ethics Across the Curriculum Program to accomplish ABET requirements and UPRM institutional values.

List of Collaborators and Co-Editors
Dr. Efrain O’Neill, UPRM
Dr. Michael Silevitch, Northeastern University
Dr. Charles DiMarzio, Northeastern University
Dr. Shawn Hunt, UPRM
Dr. Eddie Marrero, UPRM
Dr. Miguel Vélez-Reyes, UPRM
Dr. Rosa Buxeda, UPRM
Ms. Lueny Morell, Hewllett Packard
Dr. David Castaño, Boston University
Dr. David Kaeli, Northeastern University

Thesis Advisor and Post Graduate Scholar Sponsor
Phd Advisor: Prof. David Landgrebe, Purdue University
MANUEL A. JIMÉNEZ-CEDEÑO

Academic Preparation:

<table>
<thead>
<tr>
<th>Degree</th>
<th>Field</th>
<th>Institution</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph. D.</td>
<td>Electrical Engineering</td>
<td>Michigan State University</td>
<td>1999</td>
</tr>
<tr>
<td>MS</td>
<td>Electrical Engineering</td>
<td>University of Puerto Rico at Mayagüez</td>
<td>1991</td>
</tr>
<tr>
<td>BS</td>
<td>Electrical Engineering</td>
<td>Universidad Autónoma de Santo Domingo</td>
<td>1986</td>
</tr>
</tbody>
</table>

Faculty service at UPRM:

Date of original appointment: August 1991

Dates of advancement in rank:

- Professor: July 2007 to present
- Associate Professor: July 2002 to June 2007
- Assistant Professor: July 1999 to June 2002
- Instructor: Aug 1991 to June 1994*

Total years of service: 16

*On study leave from July 1994 to June 1999

Areas of professional expertise:

- CAD Techniques for Digital VLSI Layout, Digital Systems Design, Microprocessors/Embedded Systems

Other related experience—academic or industrial.

- APEC University: Invited Professor, Summer 2003. Engineering and Technology School, Santo Domingo, Dominican Republic. Taught graduate-level course in Digital Microelectronics and IC Design.
- Texas Instruments Inc. Wireless CAPCOM Division, Dallas, Texas, Visiting Professor, Summer 2000, Collaborator in the design team of a variable output band-gap voltage reference bank IC.
- Texas Instruments Inc. Power Management Products Division, Dallas, Texas, Visiting Professor, Summer 1999

State(s) in which registered

Professional License, Dominican Republic

Engineer in Training, Michigan

Selected publications of last three years: (FY 2005-2006-2007)


Grants or externally funded project active during the last three years: (FY 2005-2006-2007)

1. Title: “Establishment of a Computational Infrastructure for Researching Hardware and Electronics Design Challenges at the UPRM”
   Researchers: Manuel Jiménez (PI), Nayda Santiago, Domingo Rodriguez, Nelson Sepulveda, Rogelio Palomera, Gladys Ducoudray
   Sponsor: IBM Shared University Research (SUR) Program
   Funding: $85,000

2. Title: “L-DMOS Model Validation Circuits”
   Researchers: Manuel Jiménez (PI) and Rogelio Palomera
   Sponsor: Texas Instruments
   Funding: $50,000

3. Title: “2007 Continuation of the TI Analog, Digital and Mixed-signal Electronics Program at UPRM”
   Researchers: Rogelio Palomera, Manuel Jiménez (Co-PI), and Gladys O. Ducoudray
   Sponsor: Texas Instruments
   Funding: $129,119
   Period: January-December 2007

4. Title: “Study of System-level Design Methodologies for Implementing SAR Support Algorithms”
   Researchers: Manuel Jiménez (PI), Domingo Rodriguez, Nayda Santiago, and Ana Nieves
   Sponsor: Lockheed Martin Corporation
   Funding: $260,000
   Period: January-December 2007
5. Title: “ATE/TPS 44 Voltage Regulator THT to SMT Redesign and Prototyping”  
   Researchers: Pedro Resto, Manuel Jiménez (Co-PI)  
   Sponsor: Intuitive Research and Technology Corporation  
   Funding: $36,000  
   Period: January-October 2006

6. Title: “Integrated Methodology for IPEM Gate Driver Layout Improvement – 2007 Continuation”  
   Researchers: Manuel Jiménez (PI)  
   Sponsor: Center for Power Electronic Systems (CPES)  
   Funding: $30,000  
   Period: August 2006 – July 2007

7. Title: “2006 Continuation of the TI Analog, Digital and Mixed-signal Electronics Program at UPRM”  
   Researchers: Rogelio Palomera, Manuel Jiménez (Co-PI), Gladys O. Ducoudray, and Manuel Toledo  
   Sponsor: Texas Instruments  
   Funding: $116,000  
   Period: January-December 2006

8. Title: “Integrated Methodology for IPEM Gate Driver Layout Improvement – 2006 Continuation”  
   Researchers: Manuel Jiménez (PI)  
   Sponsor: Center for Power Electronic Systems (CPES)  
   Funding: $40,000  

9. Title: “Study of Controller Architectures and GLP Regulations for the Smart Drug Delivery Platform”  
   Researchers: Manuel Jiménez (PI), and Gladys Omayra Ducoudray  
   Sponsor: Hewlett-Packard Corporation  
   Funding: $5,600.00  
   Period: Summer 2005

10. Title: “2005 Continuation of the TI Analog, Digital and Mixed-signal Electronics Program at UPRM”  
    Researchers: Rogelio Palomera, Manuel Jiménez (Co-PI), and Manuel Toledo  
    Sponsor: Texas Instruments  
    Funding: $120,000  
    Period: January-December 2005

11. Title: “Hardware and Software Tools to Support Embedded/DSP Systems Education at UPRM”  
    Researchers: Rogelio Palomera, Manuel Jiménez (Co-PI), Domingo Rodriguez, M. Toledo  
    Sponsor: Texas Instruments  
    Funding: $10,000.00  
    Period: January-August 2005

12. Title: “Integrated Methodology for IPEM Gate Driver Layout Improvement”  
    Researchers: Manuel Jiménez (PI), and Miguel Vélez-Reyes  
    Sponsor: Center for Power Electronic Systems (CPES)  
    Funding: $45,000.00  
    Period: August 2004 – July 2005

Scientific and professional societies of which a member:  
   Institute of Electrical and Electronics Engineers IEEE  
   American Society of Engineering Education ASEE

Honors and awards:
   • General Co-Chair 49th IEEE Int. Midwest Symposium on Circuits and Systems, Aug. 6-9, San Juan PR  
   • Member Steering Committee for the "Midwest Symposium on Circuits and Systems" (Spring 2001 – to present)  
   • Panelist for the National Science Foundation 2003-present  
   • Recipient of a National Science Foundation Fellowship for Minorities and Women (1994-1998)  
   • Recipient of a GTE Corporation Fellowship Award (Spring 1996)
Institutional and professional service in the last three years: (FY 2005-2006-2007)

- ECE-CSE Transition Committee – ECE Department (2006 – to present)
- Research Committee – Engineering College (2004 – to present)
- Electronics Committee Member – ECE Department (2004 – to present)
- ICOM Steering Committee Member – ECE Department (2003 – to present)
- Planning Committee – ECE Department (1999 – to present)
- Graduate Committee Member -- ECE Department (1999 - 2005)

Professional development activities in the last three years: (FY 2005-2006-2007)

1. Title: "High Performance Embedded Computing Workshop (HPEC 2006)"
   Sponsor: MIT Lincoln Laboratory
   Date: September 19-21, 2006 (24 hours)
2. Title: "Organizational Savvy"
   Sponsor: Texas Instruments & Center for Professional Enhancement UPRM
   Date: October 12, 2006 (7 hours)
3. Title: "The Four Disciplines of Execution"
   Sponsor: Texas Instruments & Center for Professional Enhancement UPRM
   Date: August 31, 2006 (7 hours)
4. Title: "Group Decision Making and Problem Solving"
   Sponsor: Texas Instruments & Center for Professional Enhancement UPRM
   Date: May 9, 2006 (7 hours)
5. Title: "Emotional Intelligence"
   Sponsor: Texas Instruments & Center for Professional Enhancement UPRM
   Date: April 6, 2006 (7 hours)
6. Title: "Understanding Ethics in the Context of Engineering as a Global Profession"
   Sponsor: System for the Evaluation of Education Office and the College of Engineering, UPRM
   Date: April 5, 2005 (2 hours)
7. Title: "Crucial Conversations"
   Sponsor: Texas Instruments & Center for Professional Enhancement UPRM
   Date: November 18, 2005 (7 hours)
8. Title: "Win-Win Negotiations"
   Sponsor: Texas Instruments & Center for Professional Enhancement UPRM
   Date: September 23, 2005 (7 hours)
9. Title: "Orientación para Profesores de Nueva Contratación en el Recinto"
   Sponsor: Center for Professional Enhancement UPRM
   Date: August 3 to 5, 2005 (21 hours)
10. Title: "Design of On-line Courses Using WebCT"
    Sponsor: Instituto para el Desarrollo de la Enseñanza y el Aprendizaje en Linea (IDEAL)
    Date: May 5, 2005 (6 hours)
11. Title: "Excercising Influence"
    Sponsor: Texas Instruments & Center for Professional Enhancement UPRM
    Date: April 1, 2005 (6 hours)

Courses taught in the past three years (2005-2007)

<table>
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<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>CIIC 9995</td>
<td>Doctoral Dissertation</td>
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<td>CIIC 8997</td>
<td>Special Topics in CISE</td>
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<td>INEL 4207</td>
<td>Digital Electronics</td>
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<tr>
<td>ICOM 5217/INEL 4217</td>
<td>Microprocessor Interfacing</td>
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<tr>
<td>INEL 4998</td>
<td>Undergraduate Research</td>
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<td>ICOM 4998</td>
<td>Undergraduate Research</td>
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<td>ICOM 5995</td>
<td>Special Problems</td>
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<td>INEL 6079</td>
<td>Advanced IC Design Techniques</td>
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<td>INEL 6045</td>
<td>Engineering Project</td>
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<td>INEL 6046</td>
<td>Master Thesis</td>
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<td>INEL 6080</td>
<td>VLSI Systems Design</td>
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<td>INEL 4206</td>
<td>Microprocessors</td>
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<tr>
<td>INEL 4102</td>
<td>Electrical Systems Analysis II</td>
</tr>
<tr>
<td>INEL-4076</td>
<td>Fundamentals of Electronics</td>
</tr>
</tbody>
</table>
Community service activities: (FY 2005-2006-2007)

- Organization of Workshop “Organizational Savvy” Sponsored by Texas Instruments (October 12, 2006)
- Organization of Workshop “The Four Disciplines of Execution” Sponsored by Texas Instruments (August 31, 2006)
- Organization of Workshop “Group Decision Making and Problem Solving” Sponsored by Texas Instruments (May 9, 2006)
- Organization of Workshop “Problem Solving” Sponsored by Texas Instruments (May 9, 2006)
- Organization of Workshop “Emotional Intelligence” Sponsored by Texas Instruments (April 6, 2006)
- Organization of Workshop “Tools and Toys for an Introductory DSP Experience” offered to High School Students in Pre-engineering Camp, Sponsored by Texas Instruments (Summer 2005)
- Organization of Workshop “A hands-on Experience in DSP” offered to non-EE majors, Sponsored by Texas Instruments (Spring 2005)
- Organization of Workshop “Crucial Conversations” Sponsored by Texas Instruments (November 18, 2005)
- Organization of Workshop “Win-Win Negotiations” Sponsored by Texas Instruments (September 23, 2005)
- Organization of Workshop “Zodiak: The Game of Business Finance and Strategy” Sponsored by Texas Instruments (May 1, 2005)
- Organization of Workshop “Exercising Influence” Sponsored by Texas Instruments (April 1, 2005)
Eduardo J. Juan, PhD, PE  
Associate Professor  
Department of Electrical and Computer Engineering  
University of Puerto Rico at Mayagüez  
Mayagüez, PR 00681  
Phone: (787) 832-4040 x3205  
Fax: (787) 831-7564  
ejuan@ece.uprm.edu

Education:
- Ph.D. Electrical Engineering, Purdue University, May 2001  
- B.S. Electrical Engineering, University of Puerto Rico at Mayagüez, May 1997

Professional Experience:
7/04-present  
Associate Professor, Department of Electrical and Computer Engineering, University of Puerto Rico at Mayagüez, Mayagüez, PR

2/05-present  
Co-Founder and Scientific Advisor, SonarMed, Inc., IN, USA

7/01-6/04  
Assistant Professor, Department of Electrical and Computer Engineering, University of Puerto Rico at Mayagüez, Mayagüez, PR

1/98-5/01  
Research Assistant, Biomedical Acoustics Laboratory, School of Electrical and Computer Engineering, Purdue University, West Lafayette, IN

Spring 2000  
Teaching Assistant, biomedical instrumentation course, School of Electrical and Computer Engineering, Purdue University, West Lafayette, IN

Research Interests:
Biomedical acoustics, medical instrumentation, biosensors.

Funded Research Projects:
- Acoustical Guidance of Liquid-Filled Catheters. Funded by NIH-MBRS Program; $111,361. 5/01/03-4/30/07
- Non-Invasive Stress Level Assessment Using a Hydrogel-Based Biosensor. Funded by Tropical Center for Earth and Space Studies (TCESS-NASA); $60,000, 10/02-10/03.
- Biomedical Research and Education Experiences (BReEd) at UPRM. Funded by NSF; $99,653, 9/03-8/04.
- Development of Technologies for the Manufacture of Cardiac Pacing and Defibrillation Leads: Phase I. Funded by Medtronic, Inc. $45,863, 8/03-12/03.
- Development of Technologies for the Manufacture of Cardiac Pacing and Defibrillation Leads: Phase II. Funded by Medtronic, Inc. $65,363, 1/04-9/04.

Journal Articles:
Conference Articles:


Conference Presentations:


Magazine Articles:


Patents:


Selected Technical Presentations:


*Electrical Shock and Trauma: Cause, Mechanisms of Injury and Case Studies*, Colegio de Ingenieros y Agrimensores de Puerto Rico, Mayagüez Chapter, Mayagüez, PR, November 2005.


*Biomedical Engineering at UPRM*, CIAPR - Industry University Symposium on Electrical Engineering, San Juan, PR, November 2003.
Biomedical Engineering: An Overview, presentation to engineering students of the University of Puerto Rico- Mayagüez, Mayagüez, PR, October 17, 2002.


Honors and Awards:
Geddes-Laufman-Greatbach Outstanding Graduate Student Award, Department of Biomedical Engineering, Purdue University, 1999
SLOAN Fellowship, 1997-1998
GEM Fellowship, 1997-1998

Professional Memberships:
Institute of Electrical and Electronics Engineers (IEEE) – Senior Member
IEEE-Engineering in Medicine and Biology Society – Senior Member

Professional Service:
Reviewer, IEEE Transactions on Biomedical Engineering
Academic Program Reviewer, Puerto Rico’s Council on Higher Education

Institutional Service:

Courses Taught:
INEL 4505 Introduction to Control Systems
INEL 5205 Instrumentation
INEL 5506 Process Control and Instrumentation Engineering
INEL 4102 Circuits Analysis II

Courses Developed:
INEL 5208 Principles of Biomedical Instrumentation

Students:
Supervised research projects of 15 undergraduate students.
Supervised research projects of 5 graduate students.

Electrical and Computer Engineering Service:
Coordinator, Control Systems Area Committee 2002-2007
Member, Departmental Planning Committee 2002-2007
Member, Graduate Committee 2001-present
Dr. KEJIE LU
Assistant Professor

Department of Electrical and Computer Engineering
University of Puerto Rico at Mayagüez
P.O.Box 9042
Mayagüez, Puerto Rico 00681-9042

Office: S-215 Stefani Building
Phone: (787) 832-4040 ext. 3510
Fax: (787) 831-7564
Email: lukejie@uprm.edu

Teaching

- ICOM 4015-050, Advance Programming, Spring 2007
- ICOM 4015-076, Advance Programming, Spring 2007
- ICOM 4015-100, Advance Programming, Fall 2006
- INEL 4207, Digital Electronics, Spring 2006
- INEL 4207-021, Digital Electronics, Fall 2005
- ICOM 5026-080, Computer Networks, Fall 2005

Services

- Member of the Graduate Committee, 2006-2008
- Member of ICOMSW Committee, 2005-current
- Member of COMMSIG Committee, 2005-current

Education

- Ph.D. Electrical Engineering (major in Telecommunications), The University of Texas at Dallas, Dallas, Texas, USA, 2003
- M.S. Communications and Electronic Systems, Beijing University of Posts and Telecommunications, Beijing, China, 1997
- B.S. Telecommunications Engineering, Beijing University of Posts and Telecommunications, Beijing, China, 1994

Experience

- Assistant Professor, Department of Electrical and Computer Engineering, University of Puerto Rico at Mayagüez, Jul. 2005 ~
- Postdoctoral Research Associate, University of Florida, 2004-2005
- Research Assistant, The University of Texas at Dallas, 2001-2003
- Senior Software Engineer, Beijing Research Institute, Huawei Technologies, Beijing, China, 1998-2000
- Software Engineer, GAOHONG Telecommunications, Beijing, China, 1997-1998
- Research Assistant, China Academy of Telecommunications Technology (CATT), Beijing, China, 1995-1997
Research Interests

- Computer and communications networks: architecture and protocol design, performance evaluation, network security, network coding
- Wireless communications: space-time coding, channel capacity, cooperative communication

Funded Research Project


Publications

Selected Journal Publications


Selected Conference Publications

7. Kejie Lu and Yi Qian, "On The Performance Of A Distributed Key Management Scheme In Heterogeneous Wireless Sensor Networks", in Proc. of IEEE MILCOM, Oct. 2006, Washington DC, USA.
Algorithms Supporting Optical Burst Switched Grid Networks," in Proc. of International Conference on Networking and Services (ICNS'06), July 16-18, 2006, Silicon Valley, USA.


26. Tao Zhang, Kejie Lu, and Jason P. Jue, "Differentiated Contention Resolution for QoS in


Professional Activities And Honors

- Senior Member of the IEEE
  - Member of IEEE Communications Society (ComSoc)
    - Technical Committee on Computer Communications (TCCC)
    - Optical Networking Technical Committee (ONTC)
    - Technical Committee on Communications Switching and Routing
    - Technical Committee on Personal Communications (TCPC)
    - Communicatons and Informations Security Technical Committee (CIS TC)
    - Radio Communications Committee (RCC)
- NSF Panelist
- Reviewer of Journals:
  - IEEE Transaction on Communication
  - IEEE Journal on Selected Areas in Communications (JSAC)
  - IEEE Transaction on Vehicular Technology
  - IEEE Transaction on Wireless Communications
  - IEEE Communications Magazine
  - IEEE Communication Letter
  - IEEE Signal Processing Letter
  - SPIE / Kluwer Optical Networks Magazine
  - Elsevier Computer Networks
  - Elsevier Theoretical Computer Science A
  - Elsevier Optics Communications
  - Wiley Wireless Communications and Mobile Computing (WCMC)
  - The International Journal of Management Science (OMEGA)
- Reviewer of Conferences:
  - IEEE INFOCOM
  - IEEE ICC
  - IEEE Globecom
  - IEEE WCNC
  - SPIE Opticomm
  - IEEE ICCCN
  - IEEE LANMAM
  - IEEE VTC
  - IEEE BroadNets
• TPC chairing
  o TPC co-chair of ISWPC 2007
• TPC member
  o TPC member of BroadWISE 2004
  o TPC member of IEEE Globecom 2006
  o TPC member of IEEE ICC 2007
  o TPC member of Chinacom 2007
  o TPC member of AccessNets 2007
  o TPC member of IEEE Globecom 2007
• Special Session chairing
  o IASTED PDCS 2007
• Publicity chairing
  o Publicity chair of BroadWISE 2004
  o Publicity chair of GridNets 2004
  o Publicity vice chair of SPECTS 2005
  o Publicity co-chair of Valuetools 2006
• Honors
  o NSF Student Travel Grant for SPIE Opticomm 2003
  o Doctoral Scholarship, The University of Texas at Dallas (2001-2003)
  o Texas Public Education Grant Scholarship, The University of Texas at Dallas (2001-2003)
Professional Preparation:

- Ph.D. University of Puerto Rico, Mayaguez, June 2004
- MS E.E. University of Puerto Rico, Mayaguez, June 1995
- B.S.E.E. A. C. College of Eng. Tech., Karaikudi, India, June 1990

Appointments:

- Department of Electrical and Computer Engineering, University of Puerto Rico Mayaguez Campus, Mayaguez, P.R.
  - Assistant Professor Jan 2006 - present
  - Post doctoral Associate, CenSSIS Jan 2005-Dec 2005
- Lane Department of Computer Science and Electrical Engineering, West Virginia University, Morgantown, WV.
  - Visiting Scholar Jan 2004-Dec 2004

Journal Publications


Conference Publications


**Presentations**


**Research Support**

*DoD grant W911NF-06-1-0008*  Velez-Reyes(PI)  09/2005-09/2008

Improving algorithms for target detection in hyperspectral infrared imagery.

Role: Co-Investigator

*NGA grant HM1582-06-1-2042*  Velez-Reyes (PI)  09/2006-09/2008

A geometric approach for the analysis of hyperspectral imagery

Role: Co-Investigator

**Reviewer**

*Intl. Journal of Remote Sensing*

*IEEE Trans. GRSS*

*IEEE Trans SMC.*

**Courses**

Pattern Recognition, Electric Circuits.
Efrain O'Neill-Carrillo, PhD, PE
P.O. Box 5937
Mayagüez, PR 00681-5937
(787) 642-3705
oneill@ieee.org

Professional Preparation:
Ph.D. Arizona State University, Tempe, Arizona, 1999
M.S.E.E. Purdue University, West Lafayette, Indiana, 1995
B.S.E.E. University of Puerto Rico, Mayagüez Campus, 1994

Professional Experience:
Electrical and Computer Engineering Department, University of Puerto Rico Mayagüez Campus
Professor July 2004-Present
Associate Professor July 2002-June 2004
Assistant Professor July 1999-June 2002
Electrical Engineering Intern. CPI del Caribe, Dorado, PR, 1/93-7/93.

Books and Book Chapters:
A.A. Irizarry-Rivera, M. Rodríguez-Martínez, B. Vélez, M. Vélez-Reyes, A.R. Ramirez-Orquin, E.

Recent Publications


A. A. Irizarry-Rivera, M. Rodriguez-Martínez, B. Vélez, M. Vélez-Reyes, A. Ramirez-Orquin, E.


Awards:
2005 Senior Member of the Institute of Electrical and Electronics Engineers (IEEE)
2005 IEEE Walter Fee Outstanding Young Engineer Award, IEEE/PES
2004-2005 Outstanding Professor of Electrical and Computer Engineering, UPRM
2004, Early Promotion to Full Professor for Exceptional Merit, UPRM
2003 Electrical Engineer of the Year, PR Society of Professional Engineers and Land Surveyors
2001-2002 Outstanding Professor of Electrical and Computer Engineering, UPRM
2001 NSF Early Career Award for Scientists and Engineers
1998-1999, Regents Graduate Academic Scholarship, Arizona State University

Current Professional Memberships and Affiliations:
Professional Engineer License #14878, Puerto Rico Board of Engineering
Colegio de Ingeniers y Agrimensores de Puerto Rico (CIAPR), PR Society of Professional Engineers and Land Surveyors
IEEE (Institute of Electrical & Electronics Engineers)
IEEE Power Engineering Society
IEEE Power Electronics Society
IEEE Industrial Electronics Society
IEEE Education Society
IEEE Society of Social Implications of Technology
American Society for Engineering Education (ASEE)
Tau Beta Pi, National Engineering Honor Society
Professional Service Activities:
EAC Program Evaluator for Electrical Engineering, Accreditation Board for Engineering and Technology (ABET), elected by IEEE, 2006-current.
Member of the CIAPR Committee to Evaluate Renewable Energy in Puerto Rico and implementation strategies. Since June 2007.
Editor-in-Chief/President of the Board, *Dimension*, Professional Magazine of the CIAPR (PR Society of Professional Engineers and Land Surveyors), since 2006.
Coordinator for Social, Ethical and Global Issues in Engineering, UPRM, since 2006.
Chair of the IEEE Western PR Joint Chapter of the Education Society/SSIT, 2006-Present.
Organizer of the IEEE Western PR Joint Chapter of the Education Society/Society for Social Implications of Technology (SSIT), 2006.
Adjunct Professor, Center for Professional Ethics, UPRM, since 2005.
Member of the Committee to Evaluate the Technical Administration of the Puerto Rico Electric System by the Puerto Rico Electric Power Authority during the Tropical Storm (TS) Jeanne. The official inquiry by the CIAPR about what caused a general electric blackout in the Island of Puerto Rico during the TS of September 15, 2004. Responsibilities included: analysis of technical evidence, as submitted by PREPA, of the power system state and behavior as TS Jeanne crossed over Puerto Rico, the formulation of an hypothesis to explain such behavior, and to judge the decisions made on the administration of the power system during the storm. September 2004 – April 2005.
Chair of the IEEE Western PR Power Engineering Society Chapter, 2004-Present.
President of the Industry-Academe Committee of the PR Institute of Electrical Engineers, 2004-Present.
Creator and President of the Executive Committee of the *First Industry-University Symposium on Electrical Engineering* (IUSEE 2003), November 2003.
Adjunct Professor, Institute for Communities’ Development, UPRM, since 2002.
Secretary-Treasurer, *IEEE/PELS 7th Workshop on Computers in Power Electronics* (COMPEL), Mayagüez, PR, June 2002.
Organizer, leader and presenter of continuing education conferences, short course and seminars for the IEEE, PES and the Colegio de Ingenieros y Agrimensores de Puerto Rico (CIAPR - PR Society of Professional Engineers and Land Surveyors), reaching over 800 practicing engineers in Puerto Rico since 2002.
Author and Contributor for *Tecnomundo*, official publication of the CIAPR, since 2002.
Reviewer for
  * ASEE Frontiers in Education Conference
  * IEEE Transactions on Education
  * IEEE Transactions on Power Systems
Served in several National Science Foundation Proposal Review Panels

Number of graduate students supervised in the past 5 years: 10
Lionel R. Orama-Exclusa
Department of Electrical and Computer Engineering University of Puerto Rico, Mayagüez Mayagüez, Puerto Rico 00681-9044 (787) 832-4040, x2138 lorama@ece.uprm.edu

EDUCATION


LICENSE
Licensed Professional Engineer (P.E.) in the Commonwealth of Puerto Rico. License number 13841, expiration date June 2008.

RESEARCH INTERESTS
Electrical discharges in vacuum and gases, vacuum switching technology, fields stress analysis in electric power devices, power systems transients, alternative energy sources, distributed generation, power systems protection.

RESEARCH PROJECTS

Student Developed DCAS Radar Network for NASA Satellites Validation. Supported by a $90,000 grant from the National Aeronautics and Space Administration (NASA)-IDEAS-ER Program, May 2005-April 2006.

Strengthening Diversity Collaboration Through a Student Led System Test Bed on the Island of Puerto Rico ERC for CASA. With Dr. Sandra Cruz Pol, Dr. Jose Colóm, Dr. Rafael Rodriguez Solis and Dr. Walter Diaz, supported by a $100,000 grant from the National Science Foundation (NSF)-Supplement 2005.

Collaborative Adaptive Sensing of the Atmosphere (CASA). With Dr. Sandra Cruz Pol, Dr. Jose Colóm, Dr. Rafael Rodriguez Solis and Dr. Walter Diaz, supported by a $4M grant from the National Science Foundation (NSF)-Engineering Research Centers (ERC) Program, Fall 2003-Spring 2008.

Acquisition of Instrumentation for the Electric Energy Processing Systems Laboratory at UPRM. With Dr. Efrain O’neill and Dr. Miguel Vélez, supported by a $150,000.00 grant from the National Science Foundation (NSF)Major Research Instrumentation (MRI) Program, Spring 2002-Fall 2004.

Grease Bio-diesel: Clean Energy for Puerto Rico. Supported by a $28,856 grant from the Department of Energy (DOE) through the Southern States Energy Board (SSEB), Fall 2001-Summer 2002.

Integrating Laboratory Practices and Undergraduate Research to the Power Engineering Curriculum at UPRM. With Dr. Efrain O’neill and Dr. Miguel Vélez, supported by a $160,000.00 grant from the National Science Foundation (NSF)-Course Curriculum Laboratory Improvement (CCLI) Program, Fall 2001-Spring 2003.

Grease Bio-diesel for Puerto Rico. With Dr. José Colucci and Dr. Arturo Portnoy, supported by a $224,000.00 grant from the Department of Energy (DOE), Fall 2000-Spring 2002.

Used Cooking Oil. With Dr. José Colucci and Dr. Arturo Portnoy, supported by Panzardi-ERM, Inc. with a
$190,000.00 grant from the Puerto Rico Industrial Development Company (PRIDCO), Fall 2000-Spring 2002.

RESEARCH MENTORING


Probabilities of Lightning Strikes as a Function of Structure Elevation. Undergraduate research project, Fall 2002-Spring 2003.


Self supported motor/generator. Undergraduate research project, Fall 2000.

Medium voltage transmission line modeling for short line fault analysis. Undergraduate research project, Fall 1999.

Protective system failure of residential circuits. Undergraduate research project, Spring 1999.

PUBLICATIONS


TEACHING EXPERIENCE

Programming. Classes taught in traditional and multimedia classrooms, and networked computer environment. Research is conducted in the areas electrical transients, atmospheric electricity, alternative energy sources and gaseous conductors.


**ACADEMIC ADMINISTRATION EXPERIENCE**

*Special Assistant to the Chancellor for Research Affairs*, University of Puerto Rico, Mayagüez, October 2001 to October 2003.

*Director*, Title V Proyect, $2,118,696 Grant from the U.S. Department of Education, University of Puerto Rico, Mayagüez, October 2001 to October 2003.

**OTHER ACADEMIC EXPERIENCE**

*Consulting Board Member for Licensing of the Electrical Engineering Program at the Interamerican University of Puerto Rico*, February 2004 to present.


**INDUSTRIAL EXPERIENCE**


**DESIGN EXPERIENCE**

*Méndez & Co. Facilities*, Ponce, Puerto Rico. Under Development. Design includes all interior and exterior distribution system with 300KVA substation with Back-up power generation. Lighting design was also developed.

*Medical Offices*, San German, Puerto Rico. Design includes all interior and exterior distribution system with 150KVA substation. Lighting design was also developed.

*Plaza Celebración de Eugenio Maria de Hostos*, Mayagüez, Puerto Rico. Design includes all interior and exterior distribution system with 75KVA substation. Lighting design was also developed.

*Plaza de Joyuda*, Cabo Rojo, Puerto Rico. Design includes exterior distribution system with primary distribution line relocation. Lighting design was also developed.


*Ponce de León 245*, San Juan, Puerto Rico. Design includes all interior and exterior distribution system with 150KVA substation, for new structure. Lighting design is also under development.

*Boquerón Townhouses*, Cabo Rojo, Puerto Rico. Under development. Design includes all aerial and underground primary distribution system, for new housing complex.

*Buffalo’s Café*, Caguas, Puerto Rico. January 2001. Design includes all interior distribution system with restaurant grade kitchen. The distribution consists of a 480v, 200A supply, a main distribution for HVAC system and a step-down Dry Type Transformer for lighting and kitchen load.

**CONSULTING EXPERIENCE**


*Consultant, expert witness*, Mayagüez, Puerto Rico. January 2005 to present. Work with Surrillo Pumarada Law Offices, on a lawsuit regarding electrocution a teenager in contact with aerial distribution lines.
Consultant, San José, California, March 2004 to July 2004, on Vacuum Interrupters technology, application and research, Jennings Technology Co.


OTHER PROFESSIONAL EXPERIENCE


PROFESSIONAL DEVELOPMENT


Financiamiento de Proyectos de Eficiencia Energética, Oficina de Asuntos de Energía, marzo de 2004.

Ethics Across the Curriculum Workshop, SEED, Oficina del Decano de Ingeniería, diciembre de 2003.

Diseño de Sistemas de Puesta a Tierra, Colegio de Ingenieros y Agrimensores de Puerto Rico, mayo de 2003.


HONORS

Golden Key National Honor Society, Honorary Member, 2006.


Sigma Xi, The Scientific Research Society, University of Puerto Rico, Mayagüez Campus, April 2002.


PROFESSIONAL ORGANIZATIONS

Institute of Electrical and Electronic Engineers (IEEE)

Power Engineering Society (IEEE-PES)

Colegio de Ingenieros y Agrimensores de Puerto Rico (CIAPR)

Instituto de Ingenieros Electricistas (IIE)
Eduardo I. Ortiz Rivera

(i) Professional Preparations:
Ph.D, Electrical Engineering, Michigan State University, East Lansing, MI 05/2006
MS, Electrical Engineering, Michigan State University, East Lansing, MI, 05/2002
BS, Electrical Engineering, University of Puerto Rico, Mayagüez, PR, 05/2000

(ii) Appointments:

<table>
<thead>
<tr>
<th>Date</th>
<th>Position</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>08/2006 to present</td>
<td>Assistant Professor, University of Puerto Rico-Mayagüez, PR</td>
<td>University of Puerto Rico</td>
</tr>
<tr>
<td>05/2007 - 07/2007</td>
<td>Research Assistant, Argonne National Laboratory, Argonne, IL</td>
<td>Argonne National Laboratory</td>
</tr>
<tr>
<td>08/2002 – 07/2006</td>
<td>Research Assistant, Michigan State University, East Lansing, MI</td>
<td>Michigan State University</td>
</tr>
<tr>
<td>05/2002 - 07/2002</td>
<td>Research Assistant, Fermi National Accelerator Laboratory, Batavia, IL</td>
<td>Fermi National Accelerator Laboratory</td>
</tr>
<tr>
<td>08/2001 - 04/2002</td>
<td>Teaching Assistant, Electrical and Computer Eng., MSU, East Lansing</td>
<td>Michigan State University</td>
</tr>
<tr>
<td>05/2001 - 7/2001</td>
<td>Research Assistant, Fermi National Accelerator Laboratory, Batavia, IL</td>
<td>Fermi National Accelerator Laboratory</td>
</tr>
<tr>
<td>08/2000 - 04/2001</td>
<td>Teaching Assistant, Electrical and Computer Eng., MSU, East Lansing</td>
<td>Michigan State University</td>
</tr>
<tr>
<td>08/1999 – 04/2000</td>
<td>Research Assistant, Tren Urbano, ATI, San Juan, PR</td>
<td>Tren Urbano, ATI</td>
</tr>
</tbody>
</table>

(iii) Most Relevant Publications:

1. Ortiz-Rivera, Eduardo I. “Analytical Model for a Photovoltaic Module using the Electrical Characteristics provided by the Manufacturer Data Sheet” IEEE Trans. on Power Electronics. (Acc.)
2. Ortiz-Rivera, Eduardo I. “A Novel Method to Estimate the Maximum Power for a Photovoltaic Inverter System,” IEEE Transactions on Power Electronics. (Accepted)

(iv) Synergistic Activities
- Member of the Center for Power Electronic Systems sponsored by NSF.
- Advisor for the University of Puerto Rico- Polytechnic University of Puerto Rico-Alternativa de Transporte Integrado Professional Development Program
- Paper Reviewer for the IEEE Transactions in Power Electronics.
- Paper Reviewer for the IASTED Transactions in Power Quality.
- Advised 10 undergraduate students on 6 different undergraduate research projects at UPRM.
- Photovoltaic, Wind Energy, Fuel Cells, Power Electronics, and Control researches.

(v) Collaborators
Dr. Ning, Xi, Dr. Piercy Pierre, Dr. Fang Z. Peng Michigan State University
Dr. Efrian O’Neill, Dr. Miguel Velez, Dr. Miguel Figueroa and Dr. Erick Aponte, UPRM
Dr. Claudio Rivetta, Stanford Linear Accelerator Laboratory
Mr. Guenter Conzelmann, Argonne National Laboratory

(vi) Advisors
Dr. F. Z. Peng, Ph.D. Advisor, Michigan State University, East Lansing, MI
Dr. Piercy Pierre, MS Academic Advisor, Michigan State University, East Lansing, MI

(vii) Graduate Students Supervised (Since 2006)
Omar Gil and Juan Arias at the University of Puerto Rico-Mayagüez.
Irvin Balaguer at Michigan State University.

(viii) Honors, Awards and Patents:
- Graduate Assistance In Areas Of National Need Fellow (GAANN) Fellow, 2004
- Mathematical modeling of the Z-Source converter (2004), Chinese Academy of Science Institute of Automation, sponsored by the National Science Foundation, Beijing, China (EAPSI Program).
- National Consortium for Graduate Degrees for Minorities in Engineering and Science (GEM) Fellow, 2002
- Alfred P. Sloan Ph.D. Fellow, 2001
PALOMERA GARCÍA, ROGELIO

Academic rank: Professor

Degrees with fields, institution, and date:

<table>
<thead>
<tr>
<th>Degree</th>
<th>Field</th>
<th>Institution</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS</td>
<td>Electronics and Communications Engineering</td>
<td>University of Guadalajara, México</td>
<td>1971</td>
</tr>
<tr>
<td>MS</td>
<td>Electrical Engineering</td>
<td>University of Electrocommunications, Japan</td>
<td>1975</td>
</tr>
<tr>
<td>Ph.D.</td>
<td>Docteur es Sciences Techniques</td>
<td>Swiss Federal Institute of Technology</td>
<td>1979</td>
</tr>
</tbody>
</table>

Faculty service at UPRM:

Date of original appointment: 1985

Dates of advancement in rank:

- Instructor:
- Assistant Professor: 1985 to 1986
- Associate Professor: 1986 to 1992
- Professor: 1992 to present

Total years of service: 22

Areas of professional expertise:

Integrated Circuits, Circuit Theory, Fuzzy Logic, Neural Networks, Linear algebra, Graph Theory

Other related experience—academic or industrial:

- June 1975 -June 1979, Research assistant, Department of Electricity, Swiss Federal Institute of Technology, Lausanne, Switzerland.
- November 1979 -August 1985, Titled Full time Scientist Researcher, Centro de Investigación Científica y de Estudios Superiores de Ensenada, Ensenada, Baja California, Mexico
- Invited Professor, San Diego State University, Department of Electrical Engineering, Fall 1984
- Invited Summer Faculty Internships, OakRidge National Laboratory, Oak Ridge, TN, Summer: 1990, 1991
- 1992-1993, Researcher, Department of Electricity, Swiss Federal Institute of Technology, Lausanne, Switzerland

Consulting, patents:

Consulting:

- Novatek, Puerto Rico, 1994
- AMI Microsensor, 2002

State(s) or Countries in which registered:

- Mexico
**Principal publications of last five years: (FY 1996-97 -- 2001-02)**

None

**Grants or externally funded project active during the last five years: (FY2002 - 2007)**

- (Co-PI) Establishment of an Analog Oriented Program at UPRM, Texas Instruments (~$500K, Aug 1999-June 2002)
- (PI) Continuation of Mixed Signal Program at UPRM, Texas Instruments ($120K, Jan 2003-Dec 2003)
- (PI) Continuation of Mixed Signal Program at UPRM, Texas Instruments ($120K, Jan 2004-Dec 2004)
- (PI) Continuation of Mixed Signal Program at UPRM, Texas Instruments ($130K, Jan 2005-Dec 2005)
- (PI) Continuation of Mixed Signal Program at UPRM, Texas Instruments ($130K, Jan 2006-Dec 2006)
- (PI) Continuation of Mixed Signal Program at UPRM, Texas Instruments ($130K, Jan 2007-Dec 2007)

Active at Industrial Affiliate Program, with funded projects. (25 projects since 1995)

**Scientific and professional societies of which a member:**

- Senior Member of the IEEE: (Circuits and Systems, Education, Fuzzy Systems, Social Implications of Technology, Professional Communication societies)
- Chairman of the IEEE Circuits and Systems - Signal Processing Chapter of Western Puerto Rico Section
- Member of the Institute of Electronics, Information and Communication Engineers, Japan.

**Honors and awards:**

- Scholarship from the Japan Ministry of Education 1972-1975

**Institutional and professional service in the last five years: (FY 2002 - 2007)**

- Assistant to the Dean on International Relations

**Professional development activities in the last five years: (FY 2002 - 2007)**

- General Co- Chair of the 49th IEEE International Midwest Symposium on Circuits and Systems 2006
- Special Sessions Co-Chair of the 50th IEEE Midwest Symposium on Circuits and Systems 2007

**Community service activities: (FY 2002 - 2007)**

PARSIANI, HAMED
parsiani@ece.uprm.edu

Academic rank: Professor

Degrees with fields, institution, and date:

<table>
<thead>
<tr>
<th>Degree</th>
<th>Field</th>
<th>Institution</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS</td>
<td>Mathematics</td>
<td>Oregon State University</td>
<td>1970</td>
</tr>
<tr>
<td>BS</td>
<td>Electrical Engineering</td>
<td>Oregon State University</td>
<td>1971</td>
</tr>
<tr>
<td>MEE</td>
<td>Electrical Engineering</td>
<td>Texas A&amp;M University</td>
<td>1973</td>
</tr>
<tr>
<td>Ph. D.</td>
<td>Electrical Engineering</td>
<td>Texas A&amp;M University</td>
<td>1979</td>
</tr>
</tbody>
</table>

Faculty service at UPRM:

Total years of service:  21

Areas of professional expertise:

Remote Sensing, Image Processing, LIDAR, Communications, Microprocessors

Most Recent Active Research Interests:

- Development of Lidar system for advanced atmospheric research
- Aerosol Characterization using sunphotometer and Lidar over western region of PR
- Soil Type and Moisture Determination using Radar
- Vegetation Health Index determination using Radar
- Image Processing and classification of Radar images

Grants or externally funded project active during the last seven years:

UPRM-Deputy-PI of “Center of Remote Sensing & Technology”, NOAA-CREST research grant for $2,500,000 per year for 2006-2011.

PI of “soil moisture algorithm development using Radar”, GSSI Inc. grant 2006-2007, $36,000.00

UPRM-Deputy-PI of “Center of Remote Sensing & Technology”, CREST-NOAA research grant for $2,500,000 per year for 2001-2006.

Co-PI of “Tropical Center for Earth and Space Studies”, NASA-URC II, Goddard Flight Center, NASA grant for $4,999,513.00, with UPR matching fund for $2,450,000.00, 2000-2005.

Research collaborator, PaSCOR-NASA grant, for $3,163,167.00, with UPR matching fund for $299,918.00, 1999-2004.

Journals & Proceedings Publications (2002 to present)


2. Hamed Parsiani, Enrico Mattei, “Soil Moisture Determination Based on Radar Response and


Scientific and professional societies of which a member:

Institute of Electrical and Electronics Engineers, (Member)

Honors and awards:

Permanent member of the Eta Kappa Nu Honor Society, granted by Texas A&M University.

Professional development activities in the last five years:

Attended a course on “Hyperspectral Imaging and Data Analysis,” Center for the Study of Earth from Space, University of Colorado Boulder, June, 2003.

Attended a course on “Ground Penetrating Radar”, at GSSI, Salem New Hampshire, Dec. 4,5, 2001,

Attended a course on “Multispectral Image Processing”, Robert A. Schowengerdt, Aerosense 1999,
Name (Last, First): Rodríguez, Domingo

Professional Preparation

- **BSEE at the City University of New York, New York – June 1979**
- **MS at Union College, Schenectady, New York, June 1981**
- **Ph.D. at the City University of New York, New York, January 1988**

Appointments

Jan 1988 – July 1988  **Post Doctoral Associate Center Large Scale Computation - CUNY**
July 1988 – present  **Professor at the University of Puerto Rico, Mayaguez Campus**

Publications

Recent Publications


Other Publications


**Synergistic Activities**

1. Director of the UPRM-ECE Institute for Computing and Informatics Studies, at the R&D Center.

2. Collaborated in the development and the establishment of the PhD in Computing and Information Sciences and Engineering at ECE-UPRM.


4. Short Courses Taught

   a. Advanced Signal Processing Algorithms and Hardware/Software Co-design
   b. Multidimensional Signal Processing and HPC Implementations
   c. Distributed Signal Processing and Active Sensor Array Imaging Techniques
   d. Time-frequency Analysis and Holomorphic Information Processing
   e. Kronecker Products Algebra Methods for Discrete Unitary Transforms

**Collaborators & Other Affiliations**

- Mandayam, Narayan – Rutgers University
- Paredes, Marlio – Turabo University
- Becerra-Fernandez, Irma – University of Puerto Rico
- Madey, Greg – Univ. of Notre Dame, IA.
- Prietula, Michael – Emory University

**Graduate Advisors: Richard Tolimieri and Louis Auslander**
Academic rank:  Associate Professor

Degrees with fields, institution, and date:

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<tr>
<th>Degree</th>
<th>Field</th>
<th>Institution</th>
<th>Date</th>
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<tbody>
<tr>
<td>BS</td>
<td>Mathematics</td>
<td>University of Puerto Rico, Rio Piedras</td>
<td>1994</td>
</tr>
<tr>
<td>MS</td>
<td>Computer Science</td>
<td>University of Maryland, College Park</td>
<td>1996</td>
</tr>
<tr>
<td>Ph. D.</td>
<td>Computer Science</td>
<td>University of Maryland, College Park</td>
<td>2001</td>
</tr>
</tbody>
</table>

Faculty service at UPRM:

Date of original appointment: July 2001 (Month, Year)

Dates of advancement in rank:

- Assistant Professor: 2001 to 2005
- Associate Professor: 2005 to Present
- Total years of service: 6

Areas of professional expertise:

Database Management Systems, Computer Networks

Industrial Experience:

Chief Technology Officer, Phidelix Technologies Corp, 2006-present

Consulting, patents:


Principal publications of last five years: (FY2002-2003-2006-2007)


Grants or externally funded project active during the last five years: (FY2002-2003-2006-2007)


7. PI for IBM SUR Grant, IBM, $100K, 2005-2006


Scientific and professional societies of which a member:

1. Association for Computer Machinery (ACM)

2. Special Interest Group on the Management of Data (SIGMOD)

Honors and awards:

1. 2006 Distinguished Professor, Department of Electrical and Computer Engineering, University of Puerto Rico, Mayaguez.

2. 2005 NSF CAREER AWARD for project “CAREER: NetTraveler – A Database Middleware System for Ubiquitous Data Access on Wide-Area Networks”.
Institutional and professional service in the last five years:  (FY2002-2003- 2006-2007)

1. Member of the ICOM Computing Systems Committee
2. Member of the INEL/ICOM Graduate Committee
3. Member of the CISE Ph.D. Graduate Committee
4. Member of the Campus Senate Computing Ad Hoc Committee
5. Coordinator for the CISE Ph.D. Program
6. Member of NSF Panel on Cyber Infrastructure
7. Member of NSF Panel on IT SBIR Proposals
8. Member of NSF Panel on Minority Infrastructure and Instrumentation Proposals
9. Member of the Ad Hoc Committee for the Puerto Rico Higher Education Board regarding the IT B.S. degree of the National College of Business and Technology.

Professional development activities in the last five years:  (FY2002-2003- 2006-2007)


Offered courses in the past two years (2005-2007)


Community service activities:  (FY2002-2003, 2006-2007)

Palo Seco Sports Club, Board of Directors for the Caboqueron Condominium
Néstor J. Rodríguez

PROFESSIONAL PREPARATION:

BSEE, University of Puerto Rico, 1978
MSEE, Ohio State University, 1981
Ph.D., University of Wisconsin-Madison, 1988

APPOINTMENTS:

1996 – present  Professor, University of Puerto Rico
1991 – 1996  Associate Professor, University of Puerto Rico
1988 – 1991  Assistant Professor, University of Puerto Rico

PUBLICATIONS:


SYNERGISTIC ACTIVITIES:

1. Co- founder of the Computing Alliance for Hispanic-Serving Institutions (CAHSI)
2. Co-PI of four NSF-MII grants for increasing the participation of Hispanic in computing. Worked as project manager in two of these projects.
3. Collaborated with other three colleagues in the development and the establishment of the Ph.D. in Computing and Information Sciences and Engineering at UPRM.

4. Co-Chair of the last four Computing Research Conference at UPRM. This conference provides a forum for graduate and undergraduate students to present research work in different areas computing.

5. Collaborated in the development of the proposal for the establishment of the Computing Sciences and Engineering and the Software Engineering BS programs at UPRM.

6. Collaborated in the development of the proposal for the establishment of the Department of Computing and Information Sciences and Engineering in the Engineering School at UPRM.

COLLABORATORS AND OTHER AFFILIATIONS:

Collaborators:

José A. Borges - ECE Department, University of Puerto Rico at Mayaguez
Celia R. Colón - Nursing Department, University of Puerto Rico at Mayaguez
Domingo Rodriguez - ECE Department, University of Puerto Rico at Mayaguez
Ann Gates – University of Texas at El Paso
John Fernandez – Texas A&M at Corpus Christy
Richard Aló –University of Houston Downtown
Moshen Beheshti – California State University at Dominguez Hill
Malek Adjouadi – Florida International University
Desh Ranjan – New Mexico State University
Alex Ramirez - HACU

Thesis Advisor:

Isable Najera, UPRM
Arianna Lopez, UPRM
Maria Diaz, UPRM
Gilberto Crespo, UPRM
Carlos Pérez, UPRM
Yajaira Soler, UPRM
Viviam Murillo, UPRM
Emily Angarita, UPRM
Marjorie Zambrana, UPRM
Leo Velez, UPRM
Amarilis Cuasresma, UPRM
Jaime Ramos, UPRM
**Rafael A. Rodríguez Solís**  
Department of Electrical and Computer Engineering  
University of Puerto Rico  
Mayagüez, PR 00681-9042  
Office: (787) 832-4040, ext. 2106  
Fax: (787) 831-7564  
e-mail: rarsolis@ieee.org

### Summary
Dr. Rafael A. Rodriguez Solís received a BSEE and a BSCpE from the University of Puerto Rico at Mayagüez in 1990. He also received a M.S. degree from University of Florida in 1993 and a Ph.D. from the Pennsylvania State University in 1997, both in Electrical Engineering. He is currently a Professor of Electrical and Computer Engineering at the University of Puerto Rico, the Director of the UPRM Radiation Laboratory and the UPRM Education Thrust Leader of the Center for Subsurface Sensing and Imaging Systems (CenSSIS). He received a NSF CAREER award in 2001 to work in the development of wideband slot-like antennas and worked in the development of tunable antennas with electroceramic materials with the NASA Tropical Center for Earth and Space Studies (TCESS) at UPRM. In addition, he is working in the development of low cost electronically scanned antenna alternatives for the Center for Adaptive Sensing of the Atmosphere (CASA). Dr. Rodriguez Solís was named Outstanding Professor in Electrical Engineering by the UPRM Engineering Faculty in 2001. Dr. Rodriguez Solís is a member of the IEEE Antennas and Propagation Society and the Microwave Theory and Techniques Society. His research interests include wideband microwave and millimeter-wave antennas, tunable and multiband antennas, wideband and tunable microwave circuits, and numerical methods in electromagnetics, with emphasis in the Finite Difference Time Domain Method for Electromagnetics.

### Education

**Ph.D., Electrical Engineering**  
*The Pennsylvania State University, University Park.*  
12/97  
Dissertation: “Analysis and Design of a Microwave 3-D Frequency Independent Phased Array Using Folded Slots.” Designed, analyzed, built and tested antenna array prototypes from 2 to 12 GHz.

**M.S., Electrical Engineering**  
*University of Florida, Gainesville.*  
12/93  

**B.S., Electrical Engineering**  
*University of Puerto Rico, Mayagüez.*  
06/90  
Magna Cum Laude. Specialization in Communications and Electronics.

**B.S., Computer Engineering**  
*University of Puerto Rico, Mayagüez.*  
06/90  
Magna Cum Laude. Specialization in Hardware Systems.

### Experience

**Professor**  
*University of Puerto Rico, Mayagüez.*  
01/98 to present  
Research interests: Broadband microwave antennas and circuits, microwave/millimeter-wave antennas, numerical methods in electromagnetics.
- UPRM CenSSIS Education Thrust Leader
- Researcher in TCESS
- Researcher in CASA ERC
- Researcher in PASSER program
- Director of UPRM Radiation Laboratory
Rafael A. Rodríguez Solís

- Coordinator for the ECE Applied Electromagnetics Area, 2000-present
- ECE Graduate Committee, 2001-present
- School of Engineering Graduate Committee, 2001-2006
- UPRM Graduate Council, 2006-present
- Faculty advisor to student branch of UPRM IEEE Communications Society
- Graduated 9 M.S. students, advising 4 graduate students, member of graduate committee of 17 M.S. students, and advised 46 undergraduate students on 23 different research projects.
- Reviewer for IEEE Transactions on Antennas and Propagation Special Issue on Multifunction Antennas and Antenna Systems, Feb. 2006
- Panelist for the NSF-SBIR Program in 2003 and 2005
- Panelist for the NSF Graduate Research Fellowship Program in 2005

Visiting Scientist BBN Technologies, Cambridge, MA.
06/99 to 08/99 Consulted on antennas and R.F systems for wireless networks.

Independent Consultant REMCOM, Inc., University Park, PA.
08/97 to 12/97 Modeled, designed and fabricated microwave circuit and antennas. Validated and tested electromagnetic simulators.

Instructor The Pennsylvania State University, University Park.
06/97 to 08/97 Taught Engineering Electromagnetics course to Electrical Engineering juniors.

Engr. Technical Associate BBN Systems and Technologies, Cambridge, MA.
08/96 to 08/97 Evaluated and recommended wireless LAN adapters and developed Linux device drivers.

Summer Intern BBN Corporation, Cambridge, MA.
05/96 to 08/96 Integrated wireless IP-secure LAN using custom off the shelf components. Demonstrated integrated system to customers and upper management. Developed service offerings using the integrated system.

Summer Staff MIT Lincoln Laboratory, Lexington, MA.
06/95 to 08/95 Developed computer model of complex phased array antenna system to investigate effects in the radiation pattern of random failures and excitation errors.

Graduate Assistant University of Florida, Gainesville.
08/91 to 08/93 Conducted laboratory sessions of a Computer Architecture course and a Microprocessors course and worked on the improvement of a physics-based model for microwave BJTs.

Engineer I Telefónica Larga Distancia, San Juan, Puerto Rico.
05/90 to 08/91 Specified required test equipment for sites, developed synchronization plan for network and prepared bid specifications to purchase test equipment and network synchronization system.

Publications


### Presentations
- J.G. Colom Ustáriz, **R.A. Rodríguez Solís**, “Design and Simulation of a Tunable Ferroelectric Lange Coupler,” Ferroelectrics Workshop 2001, San Juan P.R.

### Grants
- **Wideband Slot-like Antennas and Enhancement of Applied Electromagnetics Education at UPRM.**
  - NSF ECS-0093650, $584,346
- **Wideband RF Front-end for Cross-well Radar Tomography Applications**
  - NSF Center for Subsurface Sensing and Imaging Systems, $60,224
- **Electroceramic Antennas and Devices**
  - NASA Tropical Center for Earth and Space Studies, $174,975
- **Acquisition of Microwave Instrumentation for the UPRM Radiation Laboratory.**
  - NSF ECS-9977178, $677,104
- **Partnership for Space Science Education and Research.**
  - NASA, $794,993

### Professional Courses
- **Introduction to Networking and Wireless Networks**
  - CASA ERC, Mayagüez, PR, Jan. 2006
- **Practical Design of Microstrip Arrays and Reflectarrays**
  - 2003 IEEE Antennas and Propagation International Symposium, Columbus, OH.
- **Adaptive Antennas: The Future of Mobile Communications**
- **Smart Antennas for Wireless Systems**
  - 2000 IEEE Antennas and Propagation International Symposium, Salt Lake City, UT.
- **Microwave Antenna Measurements.**
  - California State University, Northridge, 1994.
- **Digital Transmission Systems.**

### Honors

### Professional Organizations
- Member of the Microwave Theory and Techniques Society and the Antennas and Propagation Society of the Institute of Electrical and Electronic Engineers.

### Languages
- Fluent in Spanish and English

### Other Interests
- TaeKwonDo, cycling, and playing saxophone.
Biographical Sketch for José M. Rosado-Román

Professional Preparation

Appointments
University of Puerto Rico, Mayagüez, Puerto Rico: Associate Professor of Electrical Engineering, 2005–present.
University of Puerto Rico, Mayagüez, Puerto Rico: Assistant Professor of Physics, 1999–2000.

Professional Societies
American Geophysical Union
Institute of Electrical and Electronics Engineers
American Society of Engineering Educators
Phi Kappa Phi
Tau Beta Pi

Awards and Honors
2005 Granted tenure at University of Puerto Rico - Mayagüez
2005 PI - NASA MUCERPI - PaSSER Project (Original PI: Rafael Fernández Sein)
2004 Promotion to Associate Professor at University of Puerto Rico, Mayagüez
2000 PI - Cornell Studies of the Ionosphere (Original PI: Mario Ierkic)
1989 NASA Graduate Student Research Award: Underrepresented Minority Focus
1989 BSEE Graduation: Magna Cum Laude
1988 NSF Academic Achievement Award

Three Most Closely-Related Publications

One Other Publication
Five Synergistic Activities

Developing undergraduate Certificate in Space Science and Technology at University of Puerto Rico.
Participating in local Industrial Affiliates Program to stimulate interest in atmospheric research at University of Puerto Rico.
Undergraduate research with the World Wide Lightning Locator Network.
Promote science, math and engineering technology to cadets in the Civil Air Patrol as a squadron Aerospace Education Officer.
Developing database structures for easy access of extremely large databases.

Collaborators and Co-Editors

Dr. Daniel Altschuler (Arecibo Observatory, Arecibo, Puerto Rico, USA)
Dr. Javier Arroyo (University of Puerto Rico, Mayagüez, Puerto Rico, USA)
Dr. Mark Chang (University of Puerto Rico, Mayagüez, Puerto Rico, USA)
Dr. Donald Farley (Cornell University, Ithaca, New York, USA)
Dr. Félix Fernández (University of Puerto Rico, Mayagüez, Puerto Rico, USA)
Prof. Rafael Fernandez-Sein (University of Puerto Rico, Mayagüez, Puerto Rico, USA)
Dr. Sixto Gonzalez (Arecibo Observatory, Arecibo, Puerto Rico, USA)
Dr. Warren Moos (Johns Hopkins University, Baltimore, Maryland, USA)
Dr. Efraín O’Neill-Carrillo (University of Puerto Rico, Mayagüez, Puerto Rico, USA)
Dr. Luis Quiñones (University of Puerto Rico, Mayagüez, Puerto Rico, USA)
Dr. Rafael Rodríguez-Solís (University of Puerto Rico, Mayagüez, Puerto Rico, USA)
Prof. Julio Santiago (University of Puerto Rico, Mayagüez, Puerto Rico, USA)
Dr. Charles Seyler (Cornell University, Ithaca, New York, USA)
Dr. Wesley Swartz (Cornell University, Ithaca, New York, USA)
Dr. Julio Urbina (Penn State University, University Park, Pennsylvania, USA)

Graduate and Postdoctoral Advisors

Dr. Michael Kelley (Cornell University, Ithaca, New York, USA)
Dr. Donald Farley (Cornell University, Ithaca, New York, USA)

Current and Former Graduate and Postdoctoral Advisees

Michael Rodríguez (ME Comp. Eng., University of Puerto Rico, Mayagüez, Puerto Rico, USA)
BIOGRAPHICAL SKETCH

Nayda G. Santiago

PROFESSIONAL PREPARATION

Ph.D.  Electrical Engineering  Michigan State University  2003
M.Eng.  Electrical Engineering  Cornell University  1990
B.S.  Electrical Engineering  University of Puerto Rico, Mayaguez Campus  1989

APPOINTMENTS

2003-Present:  Assistant Professor, Electrical and Computer Engineering Department, University of Puerto Rico, Mayaguez Campus.
2000-2003:  Instructor, Electrical and Computer Engineering Department, University of Puerto Rico, Mayaguez Campus.
1997-2000:  Research Assistant, Department of Electrical and Computer Engineering, Michigan State University.
Summer 1996:  Summer Intern, Cornell Theory Center, Cornell University
1995-1996:  Teaching Assistant, Department of Electrical and Computer Engineering, Michigan State University.
1990-1994:  Instructor, Electrical and Computer Engineering Department, University of Puerto Rico, Mayaguez Campus.
1989 - 1990:  Research Assistant, School of Electrical and Computer Engineering, Cornell University
1988-1989:  Lab Instructor, Electrical and Computer Engineering Department, University of Puerto Rico, Mayaguez Campus.
Summer 1988:  Summer Intern, Department of Electrical Engineering, Texas A & M.

PUBLICATIONS

Five publications most closely related to the proposal project

Five other significant publications


SYNERGISTIC ACTIVITIES
1. Computing Alliance of Hispanic Serving Institutions, CAHSI, Intervention: Promoting undergraduate research and the affinity research group model among HSIs

COLLABORATORS AND OTHER AFFILIATIONS
1. Graduate advisors
   - Dr. Diane Rover, PhD Dissertation
   - Dr. Michael Kelly, MEng Project

2. List of Current Collaborators
   - Domingo Rodriguez, Professor, Director WALSAIP Project, UPRM
   - Fernando Vega, Assistant Professor, ECE Department, UPRM
   - Miguel Velez, Professor, ECE Department, UPRM
   - Nestor Rodriguez, Professor, ECE Department, UPRM
   - Manuel Jimenez, Associate Professor, ECE Department, UPRM
   - Omayra Ducoudray, Assistant Professor, ECE Department, UPRM
   - Ana Nieves, Associate Professor, Psychology Department, UPRM
   - Eddie Marrero, Associate Professor, Psychology Department, UPRM
   - Kensall D. Wise, Professor of EE and CS, Univ of Michigan, Ann Arbor, Director, Center for Wireless Integrated MicroSystems an NSF Engineering Research Center
   - Anne Gates, Program Head, CS Department, University of Texas, El Paso, Director of Computing Alliance of Hispanic Serving Institutions
   - Malek Adjouadi, Associate Professor, Department of ECE, and Director, Center for Advanced Technology and Education (CATE), Florida International University
   - Moshen Beheshti, Chair, Computer Sciences Department, California State University Dominguez Hills
   - Richard Alo, Professor, Director of Center for Computational Science and Advanced Distributed Simulation, Department of Computer and Mathematical Sciences, University of Houston-Downtown

3. Graduate students currently under supervision
   - David Ortiz, MSEE
   - Ricardo Veguilla, MSCpE

4. Past Graduate Students
   - Gustavo Chaparro, MSCpE, July 2006
   - Javier Morales, MSEE, February 2007
Biographical Sketch for JAIME SEGUEL

Professional Preparation

- B.S. in Electronic Engineering, Catholic University of Valparaiso, Chile, 1972
- M.S. in Applied Mathematics, University of Santiago, Chile, 1982.
- Ph.D. in Mathematics (Theoretical Computer Science), City University of New York, 1987.

Professional Appointments

- 1988 - present: Professor of Computer Science, University of Puerto Rico at Mayagüez.
- 1987 - 1988: Assistant Professor of Computer Science, Notre Dame College of Saint John's University of New York.
- 1981 – 1983: Assistant Professor, Northern University, Arica, Chile

Publications (Selected)


Synergistic Activities

1. Co-founder of the IBM sponsored LA Grid project, a multi-institution infrastructure for grid technology development and applications
2. Member of the Computer Science and Engineering Advisory Council, a consulting organization appointed by the UPRM Chancellor and formed by members of industry and academia
3. Member of the Computing and Information Technology cluster, an organization established by the government of Puerto Rico to advance the development of knowledge based economy on the Island.
4. Member of Committee for the creation of a Department of Computer Science and Engineering at the UPR-Mayaguez.

Collaborators and Other Affiliations

Collaborators

1. Dr Liana Fong, Dr. Jean-Pierre Prost, IBM Research
2. Hugh Nicholas, Pittsburgh Supercomputing Center

Advisor: Dr. Louis Auslander (deceased)

Thesis Advisor (from 2001 – present)

3. Iván David, MS in Computer Engineering, Thesis title “Parallel Composite Edge-length Crystallographic FFT”, Graduated in May 2004
4. Daniel Burbano, MS in Computer Engineering, Thesis title “Parallel Prime Edge-length Crystallographic FFTs”, Graduated in May 2003
Nelson Sepulveda

(a) Professional Preparation

University of Puerto Rico, Mayagüez Electrical Engineering B.Sc., 2001
Michigan State University Electrical Engineering M.S., 2002
Michigan State University Electrical Engineering Ph.D., 2005

(b) Appointments

01/2006 to present - Assistant Professor, Department of Electrical and Computer Engineering, University of Puerto Rico, Mayaguez Campus
05/2006 – 08/2006 - Visiting Faculty Researcher, Air Force Research Laboratories (SND-Division), Wright Patterson Air Force Base, Dayton OH
05/2005 – 12/2005 - Sandia National Laboratories MESA Fellow, Sandia National Laboratories, Albuquerque, NM
01/2001 - 05/2005 - Teaching Assistant, Department of Electrical and Computer Engineering, University of Puerto Rico, Mayaguez Campus
08/2000 - 12/2000 - Lab Instructor, Department of Electrical and Computer Engineering, University of Puerto Rico at Mayaguez
05/2000 - 08/2000 - Summer Intern, College of Computing, Georgia Institute of Technology, Atlanta, GA

(c) 5 Most Relevant Publications


(d) Synergistic Activities

• NSF Panelist of CAREER proposals, Division of Electrical, Communications and Cyber Systems, 2006
• “Polycrystalline Diamond Mechanical Resonators with submicrometer and nanometer dimensions” Presentation at Material Research Society Meeting Spring 2006, San Francisco, CA
• “Polycrystalline Diamond (Poly-C) MEMS Resonators” Seminar at University of Michigan, invited by the NSF-WIMS ERC on January 28th, 2005
• “Electrostatic and Piezoelectric Testing Methods for RF MEMS Resonators” Oral presentation at IEEE MWSCAS 2006 conference, San Juan, PR.

(e) Collaborators & Other Affiliations

• Collaborators:

  Air Force Research Laboratories, Dr. Rebecca Cortes
  Air Force Research Laboratories, Dr. John L. Ebel
  UPRM Professor, Physics Department, Dr. Felix Fernandez
  UPRM Professor, ECE Department, Dr. Rafael Rodriguez-Solis
  UPRM Assist. Professor, ME Department, Dr. Ruben E. Diaz
  UPRM Assist. Professor, MSE Department, Dr. Agnes Padovani
  Michigan State University, Professor Dr. Leo Kempel
  University of Michigan Professor, EECS Department, Dr. Michel Maharbiz
  Sandia National Laboratories, Dr. John P. Sullivan

• Graduate and Postdoctoral Advisors.

  Dr. Dean Aslam, Michigan State University
  Dr. Leo Kempel, Michigan State University
  Dr. John P. Sullivan, Sandia National Laboratories

• Thesis Advisor and Postgraduate-Scholar Sponsor.
  - Mr. Diego Aponte-Roa, Electrical and Computer Engineering Department UPR-Mayaguez (exp. grad. 2008).
  - Mrs. Maria F. Cordoba-Erazo, Electrical and Computer Engineering Department UPR-Mayaguez (exp. grad. 2008).
Academic Rank: Assistant Professor

Institution: University of Puerto Rico, Mayagüez Campus
Department: Electrical and Computer Engineering
Date of original appointment: August 2007

Degrees Obtained:
B.S. Electrical Engineering University of Puerto Rico, Mayagüez, PR 2001
M.S. Electrical Engineering Georgia Institute of Technology, Atlanta, GA 2003
Ph.D. Electrical Engineering Georgia Institute of Technology, Atlanta, GA 2007

Areas of Professional Expertise:
- Analog and mixed-signal circuit design
- Sub-threshold circuit design
- Floating-gate transistors

Work Experience:
Graduate Research Assistant - 08/2001 - 06/2007
ECE Department at Georgia Institute of Technology, Atlanta, GA

Co-Op Student - 08/2005 - 12/2005
Power Management Products, Texas Instruments, Manchester, NH

Publications


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**Grants or Externally Funded Projects**

None

**Honors and awards:**

Best Student Paper Award at the 2005 IEEE Custom Integrated Circuits Conference

Presidential Fellowship at Georgia Institute of Technology
A. Professional Preparation

Ph.D. Cp.E. Virginia Polytechnic Institute and State University, December 2007
M.S. Statistics University of Chicago, December 1999
M.S.Cp.E. Northwestern University, September 1998
B.S.E.E. University of Puerto Rico Mayagüez Campus, June 1996

B. Appointments

a. Academic
Department of Electrical and Computer Engineering,
University of Puerto Rico Mayagüez Campus,
Mayagüez, P.R.
Assistant Professor, Jan 2008-Present

b. Professional

C. Publications Associated with Proposed Work:


D. Synergistic Activities
Dr. Suris’ research interests span the boundaries between communications and networking systems. He is currently involved in the design and implementation of a cognitive engine to
enable cognitive radio and cognitive networks. Dr. Suris is involved in the curricular revision of the undergraduate program at UPRM with aims of adding a networking area to the Computer Engineering program.

E. List of Collaborators

Recent Collaborators: Kejie Liu, Ryan W. Thomas, Allen B. MacKenzie, Zhu Han, Ramakant Komali, Kejie Liu, James Neel, Lizdabel Morales

Graduate Advisor: Luiz DaSilva

F. Awards

2004 Bradley Fellowship (Virginia Tech)
1997 NSF Minority Graduate Research Fellowship
1996 Walter P. Murphy Fellowship (Northwestern University)
OBJECTIVE
Present my qualifications as an Electrical Engineering professor and professional.

EDUCATION

Master of Science in Electrical Engineering: University of Virginia, Charlottesville, VA Master Thesis Title: Mobile Robot Navigation with Vision-Based Neural Networks Major: Neural Networks applied to Robotics, Minors: Manufacturing Systems, and Image Processing, May 1994

Bachelor of Science in Electrical Engineering: University of Puerto Rico, Mayagüez, PR Major: Automatic Controls, Minor: Economics, December 1991

EXPERIENCE
University of Puerto Rico, Mayagüez Campus, P.O. Box 9042, Mayagüez, Puerto Rico 00681-9042: Associate Director for Accreditation and Graduate Studies of the Department of Electrical and Computer Engineering: August 2005 to June 2007

University of Puerto Rico, Mayagüez Campus, P.O. Box 9042, Mayagüez, Puerto Rico 00681-9042. Department of Electrical and Computer Engineering: Associate Professor. July 1998 to Present

<table>
<thead>
<tr>
<th>Main Courses</th>
<th>Other Activities</th>
</tr>
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<tbody>
<tr>
<td>• Robotics and Automation</td>
<td>• Electronic Laboratories Coordinator</td>
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<tr>
<td>• Intelligent Systems and Control</td>
<td>• Committee for ABET Accreditation</td>
</tr>
<tr>
<td>• Machine Vision</td>
<td>• Committee of Planning and Development</td>
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<tr>
<td>• Introduction to Control Systems</td>
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</tbody>
</table>

The 49th IEEE Midwest Symposium on Circuits and Systems (MWSCAS 2006)
Volunteer as Track Chairperson and Review Committee Member for the Control Systems, Mechatronics & Robotics Track. Volunteer as Session Chairperson for Neural Networks & Fuzzy Systems and Image Processing II Sessions. August 2006.

University of Virginia, Charlottesville, VA
Department of Physics: Production of electronic control boards to be used in nuclear reactor experiments. Supervisor: Bill Stephens, Summer 1996

Home and Building Control Division: New Product Development--design aid for damper actuators: Designing tests for new prototypes to ensure they meet their specifications. Supervisor: Larry Rodgers, Summers of 1993 and 1992

Puerto Rico Electric Power Authority (PREPA), P.O. Box 790, Mayagüez, Puerto Rico 00681. Mayagüez Regional Office: Software development and computerize records. Introducing computer technology to personnel. Supervisor: Gaspar Rodriguez, Summer 1991

University of Puerto Rico, Mayagüez Campus, P.O. Box 9042, Mayagüez, Puerto Rico 00681-9042. Department of Electrical Engineering: Setting up experiments and searching for equipment for a new Control Laboratory. Supervisor: Gerson Beauchamp, October 1990 - May 1991

Puerto Rico Electrical Power Authority, G.P.O. Box 4267 San Juan, PR 00936-4267 Electric System Training Center: Microprocessor application design for training courses. Supervisor: Carlos Taulet, Summer 1990

PUBLICATIONS


RESEARCH

• “Medical Devices Research Group (MDRG).” A group of professors from the College of Engineering at UPRM, each having an area of expertise related to the medical devices and biomedical engineering field. The mission of MDRG is to assist medical device companies located in Puerto Rico solve research and development problems related to manufacturing processes or to the development of new products and technologies.

| Project Title                                                                 | Sponsor                  |
| "Development of Technologies for the Manufacture of Cardiac Pacing and Defibrillation Leads”, August 2003-December 2003 | Medtronic - Villalba    |
| "Development of Technologies for the Manufacture of Cardiac Pacing and Defibrillation Leads: Phase II", January 2004 - August 2004 | Medtronic - Villalba    |

• “Center for Subsurface Sensing and Imaging Systems (CenSSIS).” Participant in the developing of a robust algorithm for objects segmentation and classification. The development focus in the identification of coral reefs. This research is sponsored by a NSF grant.

• “Robotic Soccer.” Multidisciplinary research to design a team of five robots that play autonomously controlled by a main computer. A vision system is used to identify the field, ball, foe robots and our own robots using color segmentation. Position and velocities calculated from the vision system are passed to an AI strategy module that plans the game moves. Finally the our own designed robots read a wireless signal and execute the commands. F-180 rules of the RoboCup organization are followed.

• Industrial Affiliates Program 2006: “Plantain Processing Automation.” A project of peeling plantain automatically for a agriculture production site in Puerto Rico.

• Industrial Affiliates Program 2003 - 2004: “Assistance Technology for Handicap and Impaired People.” The Program of Technological Assistance of Puerto Rico asked for the design of several devices to aid impaired and handicap people. Among these devices are a low cost robotic arm (below $400) to be attached to wheelchair and mobile vehicles to guide blind people.

• Industrial Affiliates Program 2000 - 2001: “Tele-operating the Khepera Mobile Robot through an eye-tracking device.” A helmet with an infrared vision system and a head tracker (based in both magnetic sensors and external vision system) were used to determine the site where the operator was looking inside an remote image sent by the robot. The robot, then was commanded to go the site of interest.

• Industrial Affiliates Program 2000 - 2001: “Design of a control system of a multi-legged mobile robot.” A de-centralized controller was designed to handle low-level tasks such as walking, and high-level tasks like retrieving occluded objects.

• Industrial Affiliates Program 1999 - 2000: “Assembly competition of mobile robots.” Organizer of event and advisor of teams for a beacon-finding competition. Students built and compete for being the first in finding a hidden beam by the use of autonomous robots. This research was sponsored by Motorola.

• “Assembly and Testing of the Talrik II Mobile Robot.” Undergraduate research to expose students to the different parts of a mobile robot.
• “Image Acquisition Device for the Human Eye.” Undergraduate research that proposes alternatives for applications involving eye-related sciences.


WORKSHOPS
• ABET Accreditation Workshop, Sponsor: System for the Evaluation of Education Office at UPRM, April 2006
• Orientation on Institutionalizing Assessment in the Administrative/Service Units, Sponsor: UPRM, April 2006
• Organizational Savvy and Ethical Lobbying, Sponsor: Texas Instrument, October 2006
• Intellectual Property at the University of Puerto Rico and the Law of Ethics, Sponsor: Center for Professional Enhancement at UPRM, May 2006
• Assessment 101, Sponsor: Center for Professional Enhancement at UPRM, March 2006
• Building Surveys, Sponsor: Center for Professional Enhancement at UPRM, September 2005
• Design of WEB based courses using WEBCT, Sponsor: “Instituto para el Desarrollo de la Enseñanza y el Aprendizaje en Línea (IDEAL)” at UPRM, May 2004
• PowerPC and M-Core Seminar: Sponsor: Motorola DNA Academy, August 2001
• Learning Styles: Felder Model, Sponsor: Center for Professional Enhancement, February 2001
• ABET EC 2000 Workshop, Sponsor: Engineering Dean Office at UPRM, September 2001
• Ethics Across the Curriculum, Sponsor: Engineering Dean Office at UPRM, April 2001
• Engineering Ethics, Sponsor: Department of Humanities at UPRM, October 2000
• Microcontroller 68HC12 Family, Sponsor: Motorola DNA Academy, Lecturer: Norbel Navarro, March 1999
• Preparing Syllabus, Sponsor: Center for Professional Enhancement at UPRM, February 2001

HONORS
• IEEE Senior Member
• NSF Ph.D. Fellow (1994-1997)
• GEM Fellow of the National Consortium for Graduate Degrees for Minorities in Engineering and Science (1992-1993).
• Dean's List (1989-1991)
• First Prize in the Calculus Bowl, celebrated in Cayey Campus, University of Puerto Rico (1988).
• Third Prize in the Second Iberoamerican Mathematics Bowl celebrated in Uruguay (1987).
• Honorable Mention in National Hispanic Scholar Awards Program Competition, College Board (1987).
• First Prize in the Science Fair of the District of San Juan, Department of Education, Commonwealth of Puerto Rico (1986).
• National Honor Society, Hortus Chapter (1986).

PROJECTS AT GRADUATE SCHOOL
• Geometrical object recognition using neural networks for variable perspective, orientation, and translation.
• Extracting features from images for mobile robot navigation.
• Neural network training for answering mathematical aptitude tests.
• Cutting paper with laser technology.
• Manufacturing process simulations of industries.
• Robotic camera calibration for grasping geometrical objects.
EDUCATION:

Ph.D.: Louisiana State University, 1984
MSEE: University of Puerto Rico at Mayagüez, 1979
BSEE: University of Puerto Rico at Mayagüez, 1974, (Magna Cum Laude)

AREAS OF PROFESSIONAL EXPERTISE

Remote Sensing, Computer Vision, Geographic Information Systems, Image Processing, Artificial Intelligence

APPOINTMENTS

Department of Electrical Engineering and Computers
University of Puerto Rico at Mayagüez
Professor: July 1992
Associate Professor: July 1987
Assistant Professor: July 1984
Instructor: July 1975
Teaching Assistant: August 1974
TOTAL UPRM SERVICE: 33 years, (College of Engineering)

OTHER INSTITUTIONAL EXPERIENCE:

Dean- College of Engineering, University of Puerto Rico at Mayagüez, February 2000 to present
Director- Center for Research and Development at the University of Puerto Rico at Mayagüez, June 1999 to February 2000
Associate Director- Electrical and Computer Engineering, University of Puerto Rico at Mayagüez, March 1990 to June 1998
Director- Center for Computing Research and Development (CECORD), Electrical and Computer Engineering, University of Puerto Rico at Mayagüez, 1994 to June 1999
Director- Laboratory of Remote Sensing and Image Processing (LARSIP), Electrical and Computer Engineering, University of Puerto Rico at Mayagüez, 1989 to 1998
Associate Dean of Academic Affairs- College of Engineering, University of Puerto Rico at Mayagüez, June 1998 to June 1999
Research Assistant- Remote Sensing and Image Processing Center, Electrical and Computer Engineering, Louisiana State University, July 1980 to June 1984

BOOK CHAPTERS


SOME JOURNAL PUBLICATIONS


SOME RECENT CONFERENCE PROCEEDINGS


SOME RECENT PRESENTATIONS


“Continuous Improvement Educational Initiative: A Campus-Wide Assessment Effort”, by A.D. Sharma and R. Vásquez, World Congress on Engineering & Technology Education - WCETE 2004 in Santos, Brazil, March 14-17, 2004; and also at the ASEE Annual Meeting in Salt Lake City, Utah, June 22-24, 2004.


SOME RECENT GRANTS:

“Center of Remote Sensing & Technology”, CREST-NOAA, $2,500,000/5 year, 2006-2011-Deputy-PI

“Statistical Techniques to Improve the Hydro-Estimator Rainfall Algorithm During Heavy Storms over Puerto Rico” Funded by NOAA/NWS, $100,000, September 2006 to July 2008-Collaborator for Remote Sensing

“Soil Moisture Estimation and Validation a Hydro-Estimator” Funded by NOAA-CREST, $270,000, August 2003 to July 2006, PI

“National Aeronautical Space Administration: Experiments Program to Stimulate Competitive Research” NASA-EPSCOR, 1,125,000/ 5 year, 2002-2007-Co-PI

“Center of Remote Sensing & Technology”, CREST-NOAA, $2,500,000/5 year, 2001-2006-Deputy PI

“Tropical Center for Earth and Space Studies”, NASA-URC II, Goddard Flight Center, NASA, $4,999,513.00, UPR matching fund for $2,450,000, 2000-2005-Co-PI

“PaSCOR-NASA” grant, $3,163,167.00, UPR matching fund for $299,918, 1999-2004-Research collaborator

“Partnership for Spatial Computational Research” (PaSCoR), NASA (PAIR), $2,301,289, June 1998 to May 2003 – PI
OTHER SERVICE DUTIES

- Chair, Co-Chair and/or committee member of numerous conferences such as ISWPC 2007, ICEE 2006, LACCEI 2006, MWSCAS 2006, ITHET 2005, ADMI 2005, FIE 1997 & 1999, and other
- President for Information, Association of Department of Computer Science and Engineer for Minority Institutions (ADMI), Washington, D.C., 1998-2001
- Vice-President IEEE Western Section, 1998-2001
- Vice-President of IEEE-CS Chapter, 1998-2001
- Peer Reviewer for various programs at NSF 1990-present
- President of IEEE Western Section, 1997-98
- Vice-president for Information, Association of Department of Computer Science and Engineer for Minority Institutions (ADMI), Washington, D.C., 1992-1998

CONSULTING

- President, Consulting Board for the Accreditation of EDP College, Council of Higher Education, 1995-2002
- President, Consulting Board for the Accreditation of Interamerican University, Guayama Campus, Council of Higher Education, 1993-1995
- President, Consulting Board for the Accreditation of Polytechnic University, Council of Higher Education, 1992-1994
- President of the Review Committee for the MU-SPIN Program at Goddart Space Center NASA, 1992

PROFESSIONAL SOCIETIES

- IEEE - Institute of Electrical and Electronics Engineers
- ASEE - American Society for Engineering Education
- SPIE - International Society for Optical Engineering
- ASPRS - American Society for Photogrammetry and Remote Sensing
- PRS - Pattern Recognition Society
- ACM - Association for Computing Machinery

HONORS AND DISTINCTIONS

- Tau Beta Pi
- Eta Kappa Nu
- Who is Who Among Students in American Universities?
- Sigma Xi

MASTER STUDENTS SUPERVISED: 30 (1 student in progress)
PhD STUDENTS SUPERVISED: 4 (3 students in progress)
VEGA-RIVEROS, J. FERNANDO

Academic rank: Professor

Degrees with fields, institution, and date:

- BS Electrical Engineering University Javeriana 1979
- MS Electrical Engineering Syracuse University 1983
- Ph. D. Electrical Engineering Syracuse University 1989

Faculty service at UPRM:

Date of original appointment: July 2001

Dates of advancement in rank:

- Associate Professor: 2001 to 2006
- Professor: 2006 to Present
- Total years of service: 5.5

Areas of professional expertise:

- Artificial Intelligence, knowledge-based systems

Other related experience—academic or industrial:

- Communications Engineer; Communications Division; Avianca Airlines; Planning; design and support of communication systems. July 1979, December 1980. Colombia.
- Communications Projects Coordinator; Communications Division; Avianca Airlines; coordination and management of communication projects. January 1981, July 1982. Colombia.
- Postdoctoral Research Associate; Institute for Energy Research at Syracuse University; research on Artificial Intelligence Applications for Energy Management Systems. June 1989, June 1990. USA.
- Professor; Department of Electronics Engineering; Javeriana University; October 1990, June 2001. Colombia.
- Chairman Electronics Engineering Department; Javeriana University; May 1999, June 2001. Colombia.

Consulting, patents:

None

State(s) in which registered:

None

Principal publications of last four years: (FY 2002-2003 – 2006-2007)


Grants or externally funded project active during the last four years: (FY 2002-2003 - 2006-2007)


Scientific and professional societies of which a member:

Institute of Electrical and Electronics Engineers, (Member)

Honors and awards:

“Mención de Honor” from Vicerrectoria Académica (Mention of Honor, Academic Vicerrector), Pontificia Universidad Javeriana (Javeriana University). Awarded for the research project “Tecnologías de Información y Educación” (Education and Information Technologies), Oct 8 1999.

Diamond Award; 2nd Asia-Pacific Forum on Engineering and Technology Education. To the best Forum Paper. Sydney, Australia, July 4-7 1999.

Fellow: Parallel Architectures Center at Syracuse University, June-Aug 1987.

Institutional and professional service in the last four years: (FY 2002-2003 - 2006-2007)


Professional development activities in the last four years: (FY 2002-2003 - 2006-2007)

- Founding member and UPRM representative in Digital Publishing University Research Community (Chameleon Federation), led by HP Labs.

Offered courses in the past two years (2005-2007)

- ICOM 4998 Undergraduate Research
- ICOM 5015 Artificial Intelligence
- ICOM 5047 Computer Engineering Design
- ICOM 6215 Expert Systems
- ICOM 6995 Independent Studies in Computer Engineering
- ICOM 6999 Master Thesis
- INEL 6995 Special Topics in Electrical Engineering
- CIIC 8997 Independent Study
- CIIC 9995 Doctoral Dissertation

Community service activities: (FY 2002-2003 - 2006-2007)

- President of Parents and Teachers Association, Immaculate Conception Academy – Elementary School level, Mayagüez, FY 2004-05
- Vicepresident of Parents and Teachers Association, Immaculate Conception Academy – High School level, Mayagüez, FY 2005-06
Dr. Miguel Vélez-Reyes, Professor  
Electrical and Computer Engineering Department  
University of Puerto Rico at Mayagüez  
Ph. 787-832-2825, FAX 787-832-2485  
E-mail: mvelez@ece.uprm.edu

Professional Preparation:

- **Ph.D.**  
  Massachusetts Institute of Technology, September 1992
- **Electrical Engineer**  
  Massachusetts Institute of Technology, June 1988
- **S.M.E.E.**  
  Massachusetts Institute of Technology, June 1988
- **B.S.E.E.**  
  University of Puerto Rico Mayagüez Campus, June 1985

Appointments:

- Department of Electrical and Computer Engineering, University of Puerto Rico Mayagüez Campus, Mayagüez, P.R.  
  - **Professor**  
    July 2000-Present
  - **Associate Professor**  
    July 1995-June 2000
  - **Assistant Professor**  
    July 1992-June 1995


Books and Book Chapters:


5 Recent Journal Publications:


5 Recent Conference Proceedings


Current Grants:


Co-PI in *Center for Subsurface Sensing and Imaging Systems*. A consortium between Northeastern University (lead institution), Boston University, Rensselaer Polytechnic Institute, and the University of Puerto Rico Mayagüez Campus. NSF Engineering Research Centers Program. August 2000 to July 2005. UPRM Component $3.75M

UPRM Project Director in *Center for Power Electronic Systems*. A consortium between Virginia Institute of Technology and State University (Lead Institution), University of Wisconsin, Rensselaer Polytechnic Institute, North Carolina A&T, and the University of Puerto Rico Mayagüez Campus. NSF Engineering Research Centers Program. August 1998 to July 2003. UPRM Component $1.0M

Awards:
2006 Inducted in the Puerto Rico Academy of Arts and Sciences
1997 NSF Presidential Early Career Award for Scientists and Engineers.
2000 Senior Member of the Institute of Electrical and Electronics Engineers (IEEE)
1999 IEEE Walter Fee Outstanding Young Engineer Award, IEEE.
1997-98 Distinguished Professor, UPRM ECE Department.
1998 Distinguished Professor, of the Puerto Rico Professional Engineers and Land Surveyors Association Mayagüez Chapter.

Current Professional Memberships and Affiliations:
Licensed Engineer in Puerto Rico since 1996
Colegio de Ingenieros y Agrimensores de Puerto Rico
Institute for Electrical and Electronics Engineers (IEEE)

President IEEE Puerto Rico Western Chapter April 1998-2000
Vice-President IEEE Puerto Rico Western Chapter from January 1995 to April 1998
American Society for Engineering Education
SPIE – The International Society for Optical Engineering

Academic Service Activities:
Program Evaluator for Electrical Engineering, Accreditation Board for Engineering and Technology (ABET), elected by IEEE, 2003-current.
Program Committee Member, SPIE Conference on Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imager, 2004-present.
Chairman, 2002 IEEE Workshop on Computers in Power Electronics
Associate Editor, IEEE Transactions on Power Electronics Special Issue on Digital Control, 2002
Region 9 Representative, IEEE Power Electronics Society Administrative Committee. 2000-2003
Member, IEEE Power Electronics Society Committee on Modeling and Simulation.
Reviewer for
   Annual Meeting of the IEEE Industry Applications Society
   ASEE Frontiers in Education Conference, San Juan, PR
   IEEE Applied Power Electronics Conference
   IEEE Power Electronic Specialists Conference
   IEEE International Electric Machines and Motor Drives Conference
   IEEE Transactions on Industry Applications
   IEEE Transactions on Power Electronics
   IEEE Transactions on Education
   IEEE Transactions on Power Systems
   IEEE Transactions on Geoscience and Remote Sensing
   IEEE Transactions on Control Technology
Served in several National Science Foundation Proposal Review Panels

Number of graduate students supervised in the past 5 years: 20
VENKATESAN, KRISHNASWAMI

Academic rank: Professor

Degrees with fields, institution, and date:

<table>
<thead>
<tr>
<th>Degree</th>
<th>Field</th>
<th>Institution</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS</td>
<td>Electrical Engineering</td>
<td>University of Jabalpur, India</td>
<td>1962</td>
</tr>
<tr>
<td>MS</td>
<td>Electrical Engineering</td>
<td>University of Roorkee, now Indian Institute of Technology (IIT-Roorkee)</td>
<td>1966</td>
</tr>
<tr>
<td>Ph. D.</td>
<td>Electrical Engineering</td>
<td>University of Roorkee, (IIT-Roorkee), India</td>
<td>1974</td>
</tr>
</tbody>
</table>

Faculty service at UPRM:

Date of original appointment: January 1983

Dates of advancement in rank:

- Associate Professor: 1983 to 1987
- Professor: 1987 onwards
- Total years of service: 24 years

Areas of professional expertise:

- Electrical Machines, Power Electronics, and Electrical Drives

Other related experience—academic or industrial.

- 1962 – 1963 Bhilai Steel Project, Bhilai, India, Engineer,
- 1963 – 1966 Govt of India, Senior Fellowship under Tech Teacher Training Program
- 1966 – 1973 University of Roorkee, Roorkee, India -- Lecturer in Electrical Engineering
- 1973 – 1980 University of Roorkee, Roorkee, India -- Reader in Electrical Engineering,
- 1980 – 1983 Concordia University, Montreal, Canada -- Post Doctoral Research Associate,

Consulting, patents


State(s) in which registered

- Puerto Rico

Principal publications of last four years: (FY 2002-2003 - 2006-2007)

1. L. Arnedo and K. Venkatesan, 'P-Spice modeling of an induction motor drive system for high frequency studies', (Conference record) IEEE conference on computer applications in Power Electronics, June 2002


Grants or externally funded project active during the last four years: (FY 2002-2003 - 2006-2007)

CPES funding for graduate and Undergraduate research

Scientific and professional societies of which a member:

- Institute of Electrical and Electronics Engineers, Senior Member
- Colegio de Ingenieros y Agrimensores, Member

Honors and awards:

- May 1988, Distinguished Professor Award, Faculty of Engg, UPR, Mayaguez
Aug 1994, Who is Who among America's Teachers
Dec 1978. Khosla Research Award, Univ of Roorkee, India
Nov 1978. Paper prize award, Institution of Engineers (India) for a paper published in Journal of Instn of Engrs (India), Elect Div.
Jan 1980 Paper prize award from Institution of Engineers (India) for a paper published in Journal of Instn of Engrs (India), Elect Div.

Institutional and professional service in the last four years: (FY 2002-2003 - 2006-2007)

Supervision and development of Power Electronics Laboratory at this institution

Professional development activities in the last four years: (FY 2002-2003 - 2006-2007)

Offered Courses in the past two years (2005-2007)

Community service activities: (FY 2002-2003 - 2006-2007)
None
List of Publications 1999-2005 in alphabetical order by first author last name:


117. Ortiz, J.L., R.Pineiro,” EVOLUTIONARY LEARNING ALGORITHM FOR MORPHOLOGICAL PERCEPTRONS.” The Third IASTED International Conference on Artificial Intelligence and Applications (AIA 2003), September 8-10, 2003, Benalmádena, Spain.


119. Ortiz, J.L. C. Ocasio, “Analog Hardware Model for Morphological Neural Networks.”IASTED International Conference in Neural Networks and Computational Intelligence (NCI 2003). Cancun,


158. Rodriguez, M., Wide Area Query Execution in “Mocha”, 2002 IASTED IKS International Conference St. Thomas, Virgin Islands


Appendix E:
Description of Facilities
1 Facilities Description:

1.1 UPRM Atmospheric and Space Sciences Laboratory

The goal of the UPRM Atmospheric and Space Sciences Laboratory (UASSL) is to facilitate research in space and atmospheric sciences at UPRM. UASSL facilities include a dedicated and fully furnished structure in 10 acres of land in Aguadilla. The premise has hosted a 1.92MHz interferometer system to observe mesospheric tides. The land is administered by the Isabela Experimental Station of UPRM. Furthermore, the Isabela site has hosted the Cornell University Portable Radar Interferometer (CUPRI) to study mid-latitude sporadic-E layers at 50 MHz.

UASSL strives to maintain ever growing scientific and academic ties with the National Astronomy and Ionosphere Center (NAIC), the organization that operates the Arecibo Observatory (AO). UPRM faculty has used the AO facilities to carry out studies of: tilting of the F-region of the ionosphere, HF induced plasma interactions, coherent scattering from sporadic-E layers, waves and turbulence in the troposphere and stratosphere, and others.

1.2 Biomedical Instrumentation Research Laboratory (BIRLab)

The Biomedical Instrumentation Research Laboratory investigates novel technologies that can be applied towards the development of diagnostic and therapeutic medical devices. Current projects include the development of an acoustical system to monitor and guide intravascular catheters and the study of the electrical properties of molecularly imprinted polymeric matrices used to detect biological markers.

1.3 Cloud Microwave Measurements of Atmospheric Events (CLiMMATE)

1.3.1 Research

Understanding the role of clouds in the Earth’s heat budget and the radiation transfer processes is vital for global climate models and meteorological studies. The research in this lab comprises the areas of remote sensing of the atmosphere, including rain and clouds, using microwave sensors such as radars and radiometers at various frequencies.

Microwave remote sensing has the advantage over optical remote sensing in that the information do not depend on the illumination by the Sun, therefore radars can "see" during the night as well as during the day. Radars can also penetrate clouds and provide information about the microphysical properties of clouds and rain. Several physical parameters important to weather prediction and climate modeling such as mean drop size diameter, and rain rate distribution can be retrieve from the information provided by these sensors.

1.3.2 About CLiMMATE

Some of our work includes the development of algorithms and the calibration of the atmospheric models to better retrieve the physical and radiative characteristics of the atmosphere, including water vapor content, liquid water, and raindrop distribution. In addition, we study the atmospheric attenuation suffered by the radar signal as it travels through the clear atmosphere due to water vapor and oxygen gases. This attenuation varies, among other factors, with frequency, radar scanning angle air temperature and pressure.
Data collected with the UMass Cloud Profiling Radar System (CPRS) operating at 33GHz and 95GHz is analyzed and presented here as well as preliminary data from the NOAA wind profiler, operating at 2.8GHz. This work is sponsored by NASA and NSF.

1.4 Communication and Signal Processing Laboratory
The Communication and Signal Processing Laboratory is the center for DSP hardware implementation in the department. Its main use is as the center of the undergraduate capstone course in the communication and signal processing area. In addition, the laboratory is used by graduate and undergraduate students performing research implementing various signal processing algorithms on DSPs and work in digital audio. In addition to the 15 PCs, the laboratory has various DSP platforms from TI and Analog Devices, 500MHz oscilloscopes, function generators, meters, and 2.4 GHz spectrum analysers.

1.5 Electric Energy Processing Systems Laboratory (E²PSyL)
E²PSyL is a leading facility in the Caribbean in electric energy research and in the education of researchers and professionals in the field. (E²PSyL) has experimental and computational facilities for research in power electronics and power systems at UPRM. E²PSyL also supports multi-disciplinary projects with Industrial and Mechanical Engineering. The laboratory was established under NSF grant ECS 9702860 (PECASE Award), it is part of the Center for Power Electronics Systems (CPES) under grant ECS 9731677, is being expanded by MRI grant ECS 0116314 and will also be supported by ECS 0134021 (CAREER Award) and ECS 0224743 (NSF/ONR EPNES Grant). There are three areas that comprise E²PSyL: energy systems component testing and prototyping; energy systems component modeling and simulation; power quality and energy conservation.

1.6 Integrated Circuits Design Laboratory (ICDL)
The Integrated Circuits Design Laboratory (ICDL) mission is to study, develop, and disseminate knowledge on novel techniques for the design, modeling, and testing of analog, mixed-signal, and digital integrated circuits and systems. As part of its mission, the laboratory also provides the infrastructure to develop electronic circuits and systems strategies that target new application areas. ICDL’s vision is to become the best university-level electronics design center in Puerto Rico, training students in innovative techniques and design methodologies as well as contributing to the advancement of the electronics area in general. The laboratory is equipped with state-of-the-art, industry-grade tools for the design, modeling, simulation, and validation of electronic circuits and systems, design and testing workstations, and specialized testing equipment. Current projects being carried in the lab include the development of CAD methodologies for automated circuit design, system-level characterization of circuit components for performance maximization, mixed-mode behavioral modeling of oversampled data converters, and novel telemetric strategies to monitor the condition of mechanical components in real time, among others.

1.7 Laboratory for Applied Remote Sensing and Image Processing
The UPRM Laboratory for Applied Remote Sensing and Image Processing (LARSIP) has extensive computing and image processing equipment and is continually involved in efforts to upgrade and extend the capabilities of the facility. Its 1506 sq. ft. location is divided in four rooms; two dedicated for student’s research equipped with 20 PCs (w/ 19” monitors), and 7 SUN workstations (w/ 19” and 21” monitors). A total of six printers and one HP Scanjet 5370C scanner are installed in the laboratory facility for use by the student and technical staff, models are; HP Laserjet 4000DTN, HP Designjet 1055CM, HP Officejet 1070, HP Officejet G85, Tektronix Phaser 740, Kodak 8650. The PCs feature 2.7 GHz CPU, 1 GB of
RAM, 40 GB of hard disk running Windows XP Professional operating system. The UNIX workstations are sun ultra 2, 5, 10 and Sunblade 2000. A 42” Panasonic plasma display, Polycom conference phone and laptop are used by students to participate in video and teleconferences with education and research partners. The third room is dedicated to servers, cameras, instruments, and technical staff. The laboratory runs with 3 servers; 2 for UNIX clients (Sun Ultra Enterprise 3000 and Enterprise 450) and 1 for PC clients (Dell PowerEdge 4200). Servers have a memory range of 1GB to 4GB and storage capacity on the range of 40GB to 100GB. Network communications are mostly carried out by four main switches; HP Procurve 8000M, 2 HP Procurve 2626 and a GigaEthernet Fiber Foundry switch, this last maintains the connection between LARSIP and the Electrical and Computer Engineering Department network. The fourth room has two offices for visiting faculty and post-docs, and lounge area for the use of students and administrative staff. The laboratory is powered backup with a 36KVA UPS.

For validation experiments, we have 2 VIS hyperspectral cameras (SOC-700 Hyperspectral Imager from Surface Optics Inc and a CCD camera with a VariSpec™ tunable imaging filter), a MikroScan 7515 LWIR (broadband thermal camera in the 8.0 to 14.0 μm spectral range) camera, and a GER 1500 VIS spectrometer. The SOC-700 Hyperspectral Imager is comprised of a high-speed, low-noise visible camera, high quality visible spectrometer and an integrated scanning system and software. The VariSpec™ tunable imaging filters are high-quality interference filters, but the color of the light transmitted is electronically controllable, providing rapid, vibration less, and noiseless selection of any wavelength in the visible and near-IR ranges. We also have a modified GER-1500 spectrometer enclosed within a custom underwater housing. The GER 1500 is a relatively small field-portable instrument, measuring just 15x8x26 cm, that has the advantageous capability of functioning in a stand alone operation. It uses a silicone diode array to measure 512 spectral bands in the range from 350 to 1050 nm, with a nominal bandwidth of 1.5 nm and automated dark current corrections. Available light collecting optics include a full-angle 8° and 4° lenses and measurement acquisition is aided by an onboard sighting laser.

1.8 **Power Electronics Laboratory**

Power Electronics Lab is used for graduate research in the fields of Switching Power Supplies, Low temperature electronics, maximum power tracking from solar panels, motor control, and EMI investigations in Power Electronics and Drive Systems. Undergraduate research projects in power electronics are also being carried out. The laboratory is also used to teach a course in Power Electronic Design for undergraduate students.

1.9 **Process Instrumentation and Control Laboratory**

The Process Instrumentation and Control Laboratory includes 21 PC workstations of varying ages, ranging from 486 to Pentium III with data acquisition equipment and software. It includes demonstrative control equipment such as inverted pendulum, fluid level control, magnetic levitation, vibration control, and others for simple projects to supplement three courses in the automatic control area.

1.10 **Radiation Laboratory**

The UPRM Radiation Laboratory was established through the NSF Major Research Instrumentation Grant ECS-9977178 in 2000. The laboratory research focuses on the development of microwave and millimeter-wave circuits and antennas and atmospheric radar systems. The Radiation Laboratory houses microwave instrumentation operating up to 50 GHz including a 8530A/8510C network analyzer and a spherical near-field antenna measurement system, several computer workstations with Agilent’s ADS, Ansoft’s Designer and HFSS and Remcom’s XFDTD, and a LPKF milling machine for prototyping. The laboratory is a
partner in the Center for Collaborative and Adaptive Sensing of the Atmosphere, a NSF Engineering Research Center led by the University of Massachusetts. In addition, the laboratory faculty has ongoing research collaborations with LARSIP, the UPRM Physics Department, the University of Colorado at Boulder and the Georgia Institute of Technology.

1.11 Rapid Systems Prototyping Laboratory (RASP)

The main mission of the Rapid Systems Prototyping Laboratory is to conduct academic- and industrial-level research to develop methodologies, tools, and structures to enable the rapid prototyping of hardware systems in general, with especial emphasis in digital hardware, embedded systems, and digital signal processing applications in particular. The Rapid Systems Prototyping Laboratory has as its vision to develop the most advanced environment for rapid systems prototyping at the university-level in Puerto Rico. The laboratory infrastructure provides programming tools for hardware description languages and general programming. It also provides modeling and simulation tools, reconfigurable hardware platforms, testing equipment, and system development tools. Current projects in the lab include research in 3-D scalable arithmetic hardware methods, software methods for power efficiency in embedded systems, DSP systems for sensor array structures, and hardware methods for Fuzzy systems, among others.

1.12 Robotics Laboratory

The Robotics and automatization laboratory is used for education, the INEL 5516 Robotics and Automatization course, and graduate and undergraduate research. The Lab has two modern CRS mechanical arms, and one vintage IBM arm. It also has varied computational resources, 6 computers in all, where four are dedicated to the Robotics course. The computers have process control and manufacturing simulators, Visual C++ and Labview among others. In addition, two of the computers have hardware and software to permit computer vision, one with both color and b/w cameras. There two computers are generally used in research projects. The Laboratory also has modular AROMAT PLCs, both large and small and of high capacity. The modules include input and output expansions and both manual and computer based programmers. The laboratory also has a pneumatic learning station.

1.13 Space Information Laboratory

The Space Information Laboratory (SIL) is charged with receiving data from satellites and making it available to the user components within the NASA project Tropical Center for Earth and Space Studies (TCESS) and to the academic research community at large. The laboratory has an L-band HRPT receiving station for the reception of NOAA satellites. The station has also been receiving and processing SeaWiFs satellite telemetry thanks to the cooperation of Dr. Fernando Gilbes (Geology Department), and his students.

An X-band ground station capable of receiving RADARSAT 1, LANDSAT 7, and the MODIS sensor aboard the TERRA is also operated by SIL. Our station is certified to receive and process up to Level 0 commercial images for RADARSAT 1. The LANDSAT 7 reception system is able to process telemetry up to Level 1G and 1R. This is a reconfigurable processor based on field-programmable gate arrays (FPGAs) developed by Vexcel Corporation. The MODIS processing system, also developed from Vexcel, has been performing flawlessly.

The Space Information Laboratory (SIL) represents a significant research and educational tool at the service of the university faculty and students. The SIL has supported a Ph.D. student (Marine Sciences) and several master’s students. Numerous undergraduates have learned to operate a satellite ground station

E-6
and to process the resulting telemetry into imagery for diverse uses. The SIL welcomes students with skills in communications, networking, image processing, and programming.

1.14 Atmospheric Phenomena Laboratory (APL)
The Atmospheric Phenomena Laboratory is involved in the detection of lightning discharges and related physics. Current projects include the maintenance of the existing system (upgrading from W95 to WXP, fixing antenna design defects), study of the impact of climate on urban development.
<table>
<thead>
<tr>
<th>Laboratory</th>
<th>Equipment and Computing Resources</th>
<th>Location</th>
<th>Size (sq. ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmospheric Phenomena Laboratory (APL)</td>
<td><strong>Workstations</strong>: 5 PCs with LabView&lt;br&gt;<strong>Testing</strong>: 6 Funcion Generators&lt;br&gt;4 A/D Data Acquisition Cards (National Labs)&lt;br&gt;3 Atmospheric parameter modules (PTV)&lt;br&gt;4 dual-loop lightning detector antennas&lt;br&gt;1 high voltage arc discharge unit (Tesla Coil)</td>
<td>S-120A (Also UPR Cayey &amp; Arecibo)</td>
<td>200</td>
</tr>
<tr>
<td>Aguadilla Radar Facility</td>
<td><strong>Workstations</strong>: 1PC&lt;br&gt;<strong>Testing</strong>: 1 100 MHz Spectrum Analyzer/Modem Unit (Genesis Software Pty Ltd)&lt;br&gt;<strong>Measurements</strong>: 3 dual inverted V receivers 1.92 MHz&lt;br&gt;1 10kW 1.92 MHz 4 dipole transmitter</td>
<td>Finca Montaña (Rt 459)</td>
<td>100</td>
</tr>
<tr>
<td>Biomedical Instrumentation  Research Laboratory (BIRLab)</td>
<td><strong>Workstations</strong>: 4 PCs, Pentium 3 or higher.&lt;br&gt;Laser and Inkjet Printers, Hydrophones (Reson), Miniature Speakers and Microphones, 60 MHz Oscilloscope (Agilent), 15 MHz Waveform Generator (Agilent), Voltmeter (Agilent), Triple Output Power Supply (Agilent), Electronic components&lt;br&gt;Data acquisition board (National Instruments)&lt;br&gt;LabVIEW Software Matlab</td>
<td>S-215</td>
<td>331</td>
</tr>
<tr>
<td>Cloud Microwave Measurements of Atmospheric Events (CLiMMATE)</td>
<td><strong>Workstations</strong>: 1 Linux workstation 800Mhz, 512MB RAM with IDL license; 1 PC, 2GHz, 256MB RAM, 40GB HD, Win XP with Fortran, IDL, Adobe PhotoShop, Macromedia Illustrator, Java2; 1PC 866MHz, 384MB RAM, 70GB HD, Win XP IDL license; 1PC 866mhZ, 128MB RAM, 60GB HD, WIN 98 &amp; IDL; 1PC 866MHZ, 384MB RAM, 8.5GB HD, WIN XP, IDL.</td>
<td>S-201</td>
<td>462</td>
</tr>
<tr>
<td>Communication and Signal Processing Laboratory</td>
<td><strong>Workstations</strong>: 14 PIII-550, 256 MB RAM, 10 GB HD, 19” Display&lt;br&gt;<strong>Testing</strong>: 15 500MHz Oscilloscopes&lt;br&gt;15 Function Generators&lt;br&gt;15 Multimeters</td>
<td>S-222E</td>
<td>758</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>4.2.3 GHz Spectrum Analysers</td>
<td>CID</td>
<td>204, 206, 347</td>
<td></td>
</tr>
<tr>
<td><strong>Testing:</strong></td>
<td><strong>1 GHz Oscilloscope</strong> (Tektronics). Digital scope - HP 54602B, 150 MHz. One portable three-phase scope meters (Tektronics THS720P), three portable single-phase scopemeters (Fluke 43). High voltage and high current probes. HP table multimeters. QUADTech 2200 Transformer Test System.</td>
<td><strong>Power Quality &amp; Energy Conversion</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Motor drives testing equipment</strong></td>
<td><strong>Mikkon Thermal Imaging Camera</strong></td>
<td>Three phase power quality monitoring system</td>
<td></td>
</tr>
<tr>
<td><strong>Magtrol HD-705-6 Dynamometer</strong> (max. torque 50 lb-in., 1.4 kW max - 5 min)</td>
<td><strong>Several fractional horsepower</strong> three-phase induction motors</td>
<td>Schaffner surge generator (Schaffner NSG 2050, PNW 2050-2225, CDN 133/153) for generation of transient disturbances.</td>
<td></td>
</tr>
<tr>
<td><strong>1 Magtrol HD-815-6N Dynamometers; DSP-6000, 5410</strong> (max. torque 250 lb-in., 7.025 kW max - 5 min)</td>
<td><strong>Circuit boards for controller implementation:</strong> Analog Devices ADSP 2102, ADMC200-EVAL; DSPACE DS1102 DSP Controller Board (TI’s C31).</td>
<td>Two photovoltaic systems with a combined energy output of 1 kW. Systems include BP Solar panels, AC Delco Lead-Acid Sealed Deep Cycle Batteries of 105 Ah @ 12 volts (4 pieces), Trace SW 2512 True-Sine Wave Inverter, 2500 W, 12 volts DC, 120 VAC 60Hz, GC-1000 Intertie True-Sine Wave Inverter, 1000W, 48 volts DC, 120 VAC 60Hz, Trace Charge Controller Regulator Model C40 for 12, 24, and 48</td>
<td></td>
</tr>
<tr>
<td><strong>Brushless DC 1 hp motor</strong> (APIGettys)</td>
<td><strong>HP function generators</strong></td>
<td><strong>Power supplies from fraction volts to 500 Vdc</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Several fractional horsepower</strong> three-phase induction motors</td>
<td><strong>Motor Control Card</strong> (dSpace ACE1103, CP1103)</td>
<td><strong>Motor Control Card</strong> (dSpace ACE1103, CP1103)</td>
<td></td>
</tr>
<tr>
<td><strong>5 hp motors</strong></td>
<td><strong>5 hp motors</strong></td>
<td><strong>5 hp motors</strong></td>
<td></td>
</tr>
<tr>
<td>Laboratory</td>
<td>Workstations</td>
<td>S-222H</td>
<td>241</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>--------</td>
<td>-----</td>
</tr>
<tr>
<td>High Tech Tools and Toys Laboratory</td>
<td><strong>Workstations:</strong> 12 P-4 1.4 Ghz, 256 MB RAM, 40 GB HD, 19&quot; Display</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Integrated Circuits Design Laboratory (ICDL) | **Server:** Sun Sparc Ultra Enterprise 450, 4 x 400 Mhz, 1.6GB RAM, 54 GB HD, Solaris  
**Workstations:** Sun Blade, 512MB, 30GB  
**Testing:** 4 PCs P4, LabView, Sun Sparc 2-based TI VLCT | S-210  | 600 |
| Laboratory for Applied Remote Sensing and Image Processing (LARSIP) | **Servers:** (1) Sun Sparc Ultra Enterprise 450, 4x480 Mhz, 4GB RAM, 100GB HD, Solaris  
(2) Sun Sparc Ultra Enterprise 3000, 2x250 Mhz, 1GB RAM, 40GB HD, Solaris, (3) DELL PowerEdge 4200, 2x300 Mhz, 256 MB RAM, Windows NT-4  
**Workstations:** 6 Sun Wks (Ultra 1, 2, 5, 10, SunBlade 2000), 4 DELL Dimension 8100, 1.7Ghz, 1GB RAM, 36GB HD, Windows 2K, 8 DELL Optiplex 240, 2.2 Ghz, 1GB RAM, 20GB HD, Windows XP, 3 Gateway Professionals, 1.5Ghz, 1GB RAM, 36GB HD  
**Imaging:** Surface Optics hyperspectral imager, CCD camera with LCD tunable filter for hyperspectral imaging. | CID    |     |
| Power Electronics Laboratory | **Workstations:** 3 Gateway2000 PCs, 1 Sun Workstation.  
**Testing:** Tektronix TDS 754A,2430A,2245A Oscilloscopes, Storage Oscilloscopes, LISN, Sun environmental chamber, Harmonic analyser, Electronic loads, Power Supplies, function generators, Solar panels, HP measuring instruments, Leader oscilloscope and multimeters, etc. | S-101  | 367 |
| Process Instrumentation and Control Laboratory | **Workstations:** 9 Gateways 4DX2-66, 16 MB RAM, 340 MB HD, 15" Display, Windows NT  
1 Gateway P4D-66, 16 MB RAM, 340 MB HD, 15" Display, Windows 95  
1 Gateway P5-100, 32 MB RAM, 2 GB HD, 15" Display, Windows 95  
1 Dell Dimension PIII-933, 128 MB RAM, 8 GB HD, 17" Display  
8 Gateway E4200 PII-400, 128 MB RAM, 8 GB HD, 17" Display  
1 Gateway Pentium 133, 32 MB RAM, 17" Display  
Several experimental setups for experiments | S-213  | 671 |
<table>
<thead>
<tr>
<th>Laboratory</th>
<th>Control Systems</th>
<th>Server</th>
<th>CID</th>
<th>Total</th>
</tr>
</thead>
</table>
| Radiation Laboratory               | **Workstations:** HP Visualize 2 PA-RISC x 500 MHz, 4GB RAM, 3 x 18 GB HD IBM RS/6000 2 PowerPC, 1GB, 2 x 18 GB HD, 2x Dell Precision 530 Dual Xeon @ 2.3GHz, 1GB RAM, 40 GB HD
**Testing:** 8530A/8510C Microwave Receiver/Network Analyzer (50 GHz), 8719ES Network Analyzer (13.2 GHz), E4433B Signal Generator (4 GHz), 83650B Synthesized Sweeper (50 GHz), E4419 Dual Power Meter, 8565EC Spectrum Analyzer (50 GHz), NSI Spherical Near-Field Antenna Measurement System (40 GHz), **Prototyping:** LPKF Protomat C60 Milling Machine | S-120 447                                                                                     |      |       |
| Rapid Systems Prototyping (RASP)   | **Workstations:** 8 P-III PCs-900, 128 MB RAM, 20 GB HD
**Testing:** Scope, Logic Analyzer, Xilinx Virtex II boards, Spartan                                                                                     |                                                                                               | S-114B 220                                                                                  |      |       |
| Robotics Laboratory                | **Workstations:** 6 PCs, two modern CRS mechanical arms, and one vintage IBM arm, AROMAT PLCs.                                                                                                               |                                                                                               | S-102 562                                                                                   |      |       |
| Space Information Laboratory       | **Server:**
2. P4-1.4 Ghz, 1GB RAM, 100GB HD, 19” Monitor, Win2k Server
**Workstations:**
1. DELL Precision 220, Dual P3-733 Mhz, 256MB RAM, 120 GB HD, 19” Monitor, Win2k Pro
2. Gateway Select, Athlon 800 Mhz, 768MB RAM, 40GB HD, 19” Moin, Win2k Pro
3. Duron 1Ghz, 128 MB RAM, 8GB HD, 17” Monitor, Win2k Pro
4. Sun Ultra 5 Sparc, 128 MB RAM, SunOS 5.7
5. HP Vectra, PII-400 Mhz, 384MB RAM, 10GB HD, 15” Monitor, WinNT 4
6. Origin 200, 4xMIPS R10000, 1.5GB RAM, 9GB HD, 200GB Fiber channel HD, IRIX 6.5
7. DELL, P2-450 Mhz, 384MB RAM, 80GB HD, 15” Monitor, Win2k Pro |                                                                                               | CID 900                                                                                      |      |       |
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<td>9.</td>
<td>2xDell Dimension 8200, P4-2 Ghz, 1GB RAM, 120GB HD, 21” Monitor, Win2k Pro</td>
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<td>P4-1.5 Ghz, 512 MB RAM, 40GB HD, Linux</td>
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<td>Sun SparcStation 20, 384MB RAM, SunOS 5.7</td>
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Appendix F: Sample Program of Studies for the Different Tracks
Sample study plan for a student entering with a BS to the Control Systems Track

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<td>INEL 6078</td>
<td>Estimation, Detection, and Stochastic Processes</td>
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Sample study plan for a student entering with a BS to the Electronics Track

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### Sample study plan for a student entering with a BS to the Applied Electromagnetics Track

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<td>Microwave Active Circuits</td>
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# Sample study plan for a student entering with a BS to the Power Electronics Tracks

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Sample study plan for a student entering with a BS to the Power Systems Track

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<td>INEL 5505</td>
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**Qualifying Exam**

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## Sample study plan for a student entering with a BS to the Signal Processing Track

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<td>Introduction to Remote Sensing</td>
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### Qualifying Exam

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Appendix G: Syllabuses of Existing Courses
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

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<tr>
<td>Two-port networks</td>
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<td>Oscillator circuits</td>
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<td>Phase Lock loops</td>
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Mixer Circuits 7
Frequency Synthesizers 5
Modulators and Demodulators 3
Exams 3
Total hours: (equivalent to contact period) 60

8. Grading System
☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

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10. Bibliography:
3. Microwave Circuit Design Using Linear and Nonlinear Techniques, Vendelin, Pavio and Rohde, John Wiley and Sons, 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:
Rafael Rodriguez, August 2007
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

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<td>6. Linear Discriminant Functions</td>
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<td>7. Artificial Neural Networks</td>
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10. Advanced Topics

11. Exams

Total hours: (equivalent to contact period)

8. Grading System

☐ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

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10. Bibliography:

4. W. Gibson, Pattern Recognition, Berkley, 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:

Vidy 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 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:

7. Course time frame and thematic outline

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<td>Signal Conditioning Circuits</td>
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8. Grading System
☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

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10. Bibliography:

11. According to Law 51
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Person who prepared this description and date of preparation:
Eduardo Juan, August 2007
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 combinational 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**

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
</tr>
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<tbody>
<tr>
<td>Introduction to system controllers, design procedures</td>
<td>2</td>
</tr>
<tr>
<td>Use of MDS diagrams for system specification</td>
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<tr>
<td>System controller design</td>
<td>8</td>
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<tr>
<td>Use of decoders and multiplexers in system controller design</td>
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<tr>
<td>Combinational design with ROMs</td>
<td>2</td>
</tr>
<tr>
<td>Combinational design with programmable logic devices (PLD).</td>
<td>2</td>
</tr>
<tr>
<td>Use of ROMs in controller design</td>
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</tr>
<tr>
<td>Use of PLDs in controller design</td>
<td>4</td>
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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

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TOTAL: 100%

10. Bibliography:

11. According to Law 51
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Person who prepared this description and date of preparation:
Gladys Ducoudray, August 2007
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 lineales y no lineales, tales como generadores de onda, reguladores de voltaje, voltajes 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:**
   - Seminar on Cadence Tools for simulation modeling and layout.
   - Account on ICDL server for simulation purposes.

7. **Course time frame and thematic outline**

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
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<tr>
<td>1. Course Introduction</td>
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<tr>
<td>2. Operational Amplifier (OA) Fundamentals</td>
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<tr>
<td>3. Examples of Linear OA Circuits</td>
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<tr>
<td>4. Examples of Non-linear OA Circuits</td>
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</table>
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 22
   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

Total hours: (equivalent to contact period) 45

8. Grading System
   ☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

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<td>☐ Other, specify:</td>
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TOTAL: 100%

10. Bibliography:
5. Marc Thompson, Intuitive Analog Circuit Design, Newnes 2006

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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 issues 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 analíticas y herramientas avanzadas de
   diseño asistido por computadoras. Discusión de tópicos referentes al diseño físico y
   desarrollo de pruebas funcionales de circuitos integrados analógicos.

3. Pre/Co-requisites and other requirements:
   INEL 4205 and INEL 4201.

4. Course Objectives:
   To develop in the students the fundamental skills in the design and analysis of analog and mixed
   signal integrated circuits using advanced CAD tools, and to provide an understanding of the
   central issues involved in the layout and test of such 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

<table>
<thead>
<tr>
<th>Outline</th>
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<tr>
<td>Models for IC devices</td>
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<tr>
<td>small signal.</td>
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<td>Model considerations in evolving technological trends.</td>
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<td>Introduction to CAD tools for analog design: Set up, schematic</td>
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<tr>
<td>Concept / Topic</td>
<td>Hours</td>
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<tr>
<td>-------------------------------------------------------------------------------</td>
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<tr>
<td>Drawing, symbol and subcircuit creation, simulation, layout, extraction, Prep for fabrication and DFT</td>
<td>2</td>
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<tr>
<td>Concepts of analog layout, Bipolar, MOS, and BiCMOS technologies.</td>
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<tr>
<td>Basic integrated circuit amplifiers: Darlington, differential pairs, and cascode configurations</td>
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<td>Dynamic range considerations in integrated amplifier circuits.</td>
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<tr>
<td>Current sources, active loads, and reference circuits.</td>
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<tr>
<td>Operational amplifier architectures: analysis and design considerations</td>
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<td>Frequency response of ICs, feedback analysis, and stability.</td>
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<td>Issues in the design of mixed signal ICs.</td>
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<tr>
<td>Test and measurement techniques of analog and mixed signal ICs.</td>
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<td>Seminars on Mixed Signal Test Design Tests</td>
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8. Grading System

[ ] Quantifiable (letters) [ ] Not Quantifiable

9. Evaluation Strategies

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10. Bibliography:


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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:
   - 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
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<tr>
<td>Introduction, radiation mechanisms</td>
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<td>Fundamental parameters</td>
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<td>Radiation integrals and vector potentials</td>
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<td>Linear dipoles</td>
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<td>Loop antennas</td>
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<tr>
<td>Antenna arrays and mutual impedance</td>
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<tr>
<td>Impedance matching</td>
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<td>Broadband antennas, frequency independent antennas</td>
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<td>Aperture, Horn and Reflector antennas</td>
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<td>Microstrip patches</td>
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8. **Grading System**

☒ Quantifiable (letters) ☐ Not Quantifiable

9. **Evaluation Strategies**

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10. **Bibliography:**


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**Person who prepared this description and date of preparation:**

José Colom, August 2007
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

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13 Course time frame and thematic outline:

<table>
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<td>Review: Smith Chart, load matching</td>
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<td>Noise in microwave circuits</td>
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<td>Basic amplifier design</td>
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Person who prepared this description and date of preparation:
Jose G. Colom, November 2006.
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**

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
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<td>Fiber optic communication systems</td>
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<tr>
<td>Optics review</td>
<td>5</td>
</tr>
<tr>
<td>Light wave fundamentals</td>
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<tr>
<td>Integrated optic waveguides</td>
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<tr>
<td>Optic fiber waveguides</td>
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<td>Light sources</td>
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<td>Light detectors</td>
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<td>Distribution networks</td>
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| 9. Evaluation Strategies |

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</tr>
<tr>
<td>Short Quizzes</td>
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**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

### 11. According to Law 51

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**Person who prepared this description and date of preparation:**
Hamed Parsiani, August 2007
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 discrete 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 [x] 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**

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
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<tbody>
<tr>
<td>Introduction to DSP</td>
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<td>Discrete Systems</td>
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<td>Discrete Time Fourier Transform</td>
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<td>Z Transform</td>
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<td>FIR filter design</td>
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8. **Grading System**

- [x] Quantifiable (letters)
- [ ] Not Quantifiable

9. **Evaluation Strategies**

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<td>Portfolio</td>
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<td>Projects</td>
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<tr>
<td>Journals</td>
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<tr>
<td>Other, specify: homework</td>
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10. **Bibliography:**

   2006.

11. **According to Law 51**

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**Person who prepared this description and date of preparation:**
Shawn D. Hunt, August 2007.
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 [x] discussion [ ] computation [ ] laboratory
   - [ ] seminar with formal presentation [ ] seminar without formal presentation [ ] workshop
   - [ ] art workshop [ ] practice [ ] trip [ ] thesis [ ] special problems [ ] tutoring
   - [ ] research [x] 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**

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
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</thead>
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<tr>
<td>Background and preview</td>
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</tr>
<tr>
<td>Random processes: Stationary processes; Ergodic processes; Power spectral density; Gaussian process</td>
<td>6</td>
</tr>
<tr>
<td>Elements of information theory: Entropy and information. Source-coding theorem. Data compaction.</td>
<td>7</td>
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Error-control coding: Linear block codes. Cyclic codes. Convolutional codes. Trellis-coded modulation

Error-control coding: Introduction to compound codes (Turbo codes)

Baseband and passband digital transmission

Spread-spectrum modulation

Exams

Total hours: (equivalent to contact period)

8. Grading System

☐ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

<table>
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<th>Percent</th>
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<td>☒ Projects</td>
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<td>☐ Journals</td>
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<td>Take-home problems</td>
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TOTAL: 100%

10. Bibliography:


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Person who prepared this description and date of preparation:

Henrick M. Ierkic, August 2007.
# 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

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to wireless communications</td>
<td>1</td>
</tr>
<tr>
<td>Modern wireless communication systems (2G, 3G)</td>
<td>3</td>
</tr>
<tr>
<td>---------------------------------------------</td>
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</tr>
<tr>
<td>Mobile radio propagation for large scales. Reflection. Diffraction. Outdoor and indoor propagation models.</td>
<td>9</td>
</tr>
<tr>
<td>Mobile propagation for small scales. Multipath channel. Parameters. Measurements. Types of fading. Statistical models for fading channels.</td>
<td>10</td>
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<tr>
<td>Modulation techniques for mobile radio</td>
<td>3</td>
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<tr>
<td>Diversity and channel coding</td>
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</tr>
<tr>
<td>Multiple access techniques for wireless communications</td>
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</tr>
<tr>
<td>Wireless networking</td>
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<tr>
<td>Wireless systems and standards</td>
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<td>Exams</td>
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<td><strong>Total hours: (equivalent to contact period)</strong></td>
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### 8. Grading System

- [x] Quantifiable (letters)
- [ ] Not Quantifiable

### 9. Evaluation Strategies

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<tr>
<td>☐ Journals</td>
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### 10. Bibliography:


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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 requieren 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**

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

- [x] Quantifiable (letters)
- [ ] Not Quantifiable

### 9. Evaluation Strategies

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**TOTAL:** 100%

### 10. Bibliography:


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Prepared by Rafael Rodriguez, August 2007
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 procesamiento 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

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
</tr>
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<tbody>
<tr>
<td>Introduction to design</td>
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<tr>
<td>Introduction to proposal preparation</td>
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<td>Ethics Seminar</td>
<td>2</td>
</tr>
<tr>
<td>Guidelines for Literature Review</td>
<td>3</td>
</tr>
<tr>
<td>Revision, discussion and update of proposals</td>
<td>8</td>
</tr>
<tr>
<td>Algorithm Design, Testing and implementation</td>
<td>30</td>
</tr>
<tr>
<td>Design process</td>
<td>4</td>
</tr>
<tr>
<td>Periodic and Final Project Presentations</td>
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[□] Quantifiable (letters) [□] Not Quantifiable

9. Evaluation Strategies

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<td>Short Quizzes</td>
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<td>Portfolio</td>
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<tr>
<td>Projects</td>
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<tr>
<td>Journals</td>
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<tr>
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10. Bibliography:

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/

11. According to Law 51

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Prepared by Shawn Hunt, August 2007
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:**

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**

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
</tr>
</thead>
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<tr>
<td>Introduction</td>
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<tr>
<td>Digital Image fundamentals</td>
<td>5</td>
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<tr>
<td>Image Enhancement in Spatial domain</td>
<td>9</td>
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<tr>
<td>Image Enhancement in Frequency domain</td>
<td>8</td>
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<td>Image Restoration</td>
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<td>----------------------</td>
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<td>Image Compression</td>
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8. **Grading System**

☑ Quantifiable (letters) ☐ Not Quantifiable

9. **Evaluation Strategies**

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<td>☐ Other, specify:</td>
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**TOTAL:** 100%

10. **Bibliography:**

Textbook:

References:
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**

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Prepared by Hamed Parsiani, August 2007
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**

<table>
<thead>
<tr>
<th>Outline</th>
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<tr>
<td>Tariffs &amp; Load Characteristics</td>
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<tr>
<td>Fundamentals of Distribution Systems</td>
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<td>Distribution Transformer Connections &amp; Loading</td>
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<td>Fundamentals of Distribution System Protection</td>
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11. **According to Law 51**

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**Person who prepared this description and date of preparation:**

Dr. José R. Cedeño, August 2007
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:**
   - Spanish: Características y Criterios de Selección de Motores de Corriente Alterna (c.a.) y de Corriente Continua (c.c); Diseño 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 characteristics.

5. **Instructional Strategies:**
   - conference
   - discussion
   - computation
   - laboratory
   - seminar with formal presentation
   - seminar without formal presentation
   - workshop
   - art workshop
   - practice
   - trip
   - thesis
   - special problems
   - tutoring

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**

<table>
<thead>
<tr>
<th>Outline</th>
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<tbody>
<tr>
<td>Introduction to Electric Drive Systems</td>
<td>1</td>
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<tr>
<td>Mechanical system requirements</td>
<td>2</td>
</tr>
<tr>
<td>Review of power converters for drive systems</td>
<td>3</td>
</tr>
<tr>
<td>Modeling of D.C motors</td>
<td>2</td>
</tr>
<tr>
<td>Phase and chopper controlled D.C drives</td>
<td>6</td>
</tr>
<tr>
<td>Feedback controller design</td>
<td>3</td>
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</table>
Polyphase induction motors—Review of steady state analysis 2
Performance calculation of voltage and current source 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

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10. Bibliography:


Bibliography:
1. J. Chiasson, Modeling and High Performance Control of Electric Machines, John Wiley, 2005

11. According to Law 51

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Person who prepared this description and date of preparation:

Miguel Vélez-Reyes, August 2007
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.


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

6. **Minimum or Required Resources Available:**
   Standard lecturing facilities. Scientific calculator.

7. **Course time frame and thematic outline**

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<td>CT Performance</td>
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<td>Operating Principles of Electro-Magnetic Relays</td>
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<td>Electromagnetic Induction Relays</td>
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<td>Directional Relays, Application of Overcurrent Relays, Case Studies</td>
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<td>Distance Relays, Application Case Study</td>
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### Step Distance Protection, Pilot Relaying, Case Study

| Total hours: (equivalent to contact period) | 45 |

### Generator Protection Survey

| 3 |

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</table>

**Person who prepared this description and date of preparation:**
José R. Cedeño, August 2007
# 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; controllability 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 observability 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

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
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<td>System classification and structures</td>
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<tr>
<td>Introduction to linear algebra</td>
<td>3</td>
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<tr>
<td>Mathematical description of systems and examples of physical systems</td>
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<td>Analysis and solution of linear continuous system</td>
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<td>Linearization of dynamical systems</td>
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<td>Discrete time systems, difference equations, and the Z transform and its application</td>
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<tr>
<td>Discretization of continuous time systems</td>
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<td>Stability of continuous and discrete time linear systems</td>
<td>6</td>
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<tr>
<td>Controllability and observability</td>
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<td>State feedback an pole placement</td>
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<tr>
<td>State estimators</td>
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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 instrumentación analógica y digital y en mini o microcomputadoras. Enfasis en normas establecidas y consideraciones prácticas.

3. **Pre/Co-requisites and other requirements:**
   - INEL 4505 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**

<table>
<thead>
<tr>
<th>Outline</th>
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<tbody>
<tr>
<td>Elements in process control standards and practical consideration</td>
<td>9</td>
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<tr>
<td>Transducers</td>
<td>12</td>
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<tr>
<td>Analog and digital signal conditioning</td>
<td>4</td>
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<tr>
<td>PID control: practical considerations for both analog and digital controllers</td>
<td>10</td>
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<td>Discrete-state process control programmable controllers and industrial applications</td>
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9. **Evaluation Strategies**

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**Person who prepared this description and date of preparation:**

Eduardo Juan, August 2007
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 prácticas para la implantación de los sistemas de control digital.

3. **Pre/Co-requisites and other requirements:**
   - INEL 4505

4. **Course Objectives:**
   - Analyze, design, and implement digital control systems for single-input single-output physical systems.
   - 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**

<table>
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<tr>
<th>Outline</th>
<th>Contact Hours</th>
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<tr>
<td>Modeling of digital and discrete systems</td>
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<td>Discrete Time Systems and the Z-transform</td>
<td>6</td>
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<tr>
<td>State space representation of discrete systems. Properties of the models</td>
<td>4</td>
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8. Grading System

☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

<table>
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<td>☒ Final Exam</td>
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<tr>
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<td>☒ Other, specify: Homework Sets</td>
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TOTAL: 100%

10. Bibliography:


11. According to Law 51

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Person who prepared this description and date of preparation:
Gerson Beauchamp, August 2007
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:**
   Spanish: Análisis 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**

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
</tr>
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<tbody>
<tr>
<td>Automation: definitions and manufacturing terminology, equipment used, and justifications</td>
<td>3</td>
</tr>
<tr>
<td>Manufacturing process simulation and design for assembly techniques</td>
<td>3</td>
</tr>
<tr>
<td>Industrial on-off sensors and actuators such as stepper and DC</td>
<td>5</td>
</tr>
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</table>
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

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<td>☑ Short Quizzes</td>
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TOTAL: 100%

10. Bibliography:
- J.A. Rehg, Glenn J. Sartori, Programmable Logic Controllers, Prentice Hall 2006

11. According to Law 51
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Person who prepared this description and date of preparation:
Raúl Torres, August 2007
Course Syllabus

<table>
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<tr>
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<tr>
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<table>
<thead>
<tr>
<th>2. <strong>Course Description:</strong></th>
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<tbody>
<tr>
<td>English: Investigations or special problems in electrical engineering or related fields. Open to outstanding electrical engineering students.</td>
</tr>
<tr>
<td>Spanish: Investigación o problemas especiales de ingeniería eléctrica y ramas afines. abierto a estudiantes sobresalientes de ingeniería eléctrica.</td>
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<table>
<thead>
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<th>3. <strong>Pre/Co-requisites and other requirements:</strong></th>
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<td>seminar with formal presentation</td>
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<thead>
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<th>Other options</th>
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<td>art workshop</td>
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<th>6. <strong>Minimum or Required Resources Available:</strong></th>
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<td>Access to journals and other serial publications in the library. Other resources depend on the problems or topics being studied.</td>
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<table>
<thead>
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<th>7. <strong>Course time frame and thematic outline</strong></th>
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<th>9. <strong>Evaluation Strategies</strong></th>
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<td>Depend on the problems or topics being studied. It could include: proposal, reports, oral presentations, and exams.</td>
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<td>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.</td>
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</table>

**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: Análisis y síntesis 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 análisis 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**

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
</tr>
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<tbody>
<tr>
<td>Introduction to Nonlinear Systems</td>
<td>1</td>
</tr>
<tr>
<td>Second order systems and analysis in the phase plane</td>
<td>6</td>
</tr>
<tr>
<td>Fundamental properties of ordinary differential equations</td>
<td>3</td>
</tr>
<tr>
<td>Lyapunov Stability (first and second method)</td>
<td>12</td>
</tr>
<tr>
<td>Frequency domain analysis of nonlinear systems (describing functions)</td>
<td>3</td>
</tr>
<tr>
<td>Introduction to nonlinear feedback control systems</td>
<td>2</td>
</tr>
<tr>
<td>Design of nonlinear control systems using linearization</td>
<td>6</td>
</tr>
<tr>
<td>Input/State and Input/Output Feedback linearization</td>
<td>6</td>
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</table>
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

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<td>☐ Oral Reports</td>
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</tbody>
</table>

10. Bibliography:

Classical textbooks still among the best in the subject:

11. According to Law 51
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Person who prepared this description and date of preparation:
Miguel Vélez-Reyes, August 2007
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**

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
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<tbody>
<tr>
<td>1. Introduction to state-variable representation of systems</td>
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<tr>
<td>2. Static Optimization</td>
<td>3</td>
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<tr>
<td>3. Optimal Control of Discrete-Time Systems</td>
<td>8</td>
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<tr>
<td>4. Linear Quadratic Regulator for Discrete-Time Systems</td>
<td>8</td>
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<tr>
<td>5. Discretization of Continuous-Time Systems</td>
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<td>6. Steady-State Sub-Optimal Control</td>
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<tr>
<td>7. Calculus of Variations</td>
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<tr>
<td>8. Linear Quadratic Regulator for Continuous-Time Systems</td>
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<tr>
<td>9. The Tracking Problem</td>
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</table>
10. Final-Time-Free and Constrained Input Control

11. Output Feedback and Structured Control

Total hours: (equivalent to contact period)

8. Grading System

☐ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

<table>
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<tr>
<th></th>
<th>Quantity</th>
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<td>☐ Oral Reports</td>
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<td>☐ Monographs</td>
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10. Bibliography:


11. According to Law 51

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Person who prepared this description and date of preparation:
Gerson Beauchamp, August 2007
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**

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. History and principles of remote sensing</td>
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</tr>
<tr>
<td>2. Introduction to Radiative Transfer and the physics of remote sensing</td>
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<tr>
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<tr>
<td>4. Information extraction from remote sensing imagery</td>
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<tr>
<td>5. Hyperspectral remote sensing and information extraction</td>
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</tr>
<tr>
<td>6. Geographic information systems</td>
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<td>7. Future trends and research presentations</td>
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<tr>
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8. **Grading System**
- Quantifiable (letters)
- Not Quantifiable

9. **Evaluation Strategies**

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<td>Oral Reports</td>
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<td>Monographies</td>
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10. **Bibliography:**

11. **According to Law 51**
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**Person who prepared this description and date of preparation:**
Miguel Vélez-Reyes, August 2007
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
   - [x] research  [ ] other, please specify:

6. **Minimum or Required Resources Available:**
   - Journals and other serial publications available in the library in Computer Engineering (IEEE & ACM)

7. **Course time frame and thematic outline**

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>RISC and CISC ARchitectures</td>
<td>8</td>
</tr>
<tr>
<td>Definición de arquitectura</td>
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</tr>
<tr>
<td>Distinción Entre Arquitectura y Organización</td>
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</tr>
<tr>
<td>Conjunto de Instrucciones</td>
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<tr>
<td>Tipos de Data</td>
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<td>Registros</td>
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<tr>
<td>Acceso a Memoria</td>
<td></td>
</tr>
<tr>
<td>Efecto de la Arquitectura en la Implementación</td>
<td></td>
</tr>
<tr>
<td>Ejemplos de Arquitecturas RISC</td>
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</tr>
<tr>
<td>Apoyo Arquitectural a Lenguajes de Alto Nivel</td>
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<tr>
<td>Instrucciones de Brinco</td>
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<td>Programmed I/O</td>
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8. **Grading System**

- [x] Quantifiable (letters)  [ ] Not Quantifiable

9. **Evaluation Strategies**
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<td>Oral Reports</td>
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<td>Monographs</td>
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<td>Portfolio</td>
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</table>

10. Bibliography:

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:
Nestor Rodríguez, August 2007
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: Teoría y diseño de procesos de conversión directa de energía. Conversión termoelectrica, termionica y fotovoltaica. Celdas de combustible. Introducción a termodinámica irreversible y su aplicación para describir operaciones. Ecuaciones magnetohidronámic (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**

<table>
<thead>
<tr>
<th>Outline</th>
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<td>Solar, MHD, Wind, Hydrogen, and other sources,</td>
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<tr>
<td>Storage technologies</td>
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</table>
**Interconnection Issues**
- Power electronics & power quality
- Net metering & DG
- Standards
- Economic analysis

**Social Implications of Energy**
- Energy Policy
- Public perception
- Environment and compliance technologies
- Life cycle analysis

**Exams**

Total hours: (equivalent to contact period)

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### 8. Grading System

- **Quantifiable (letters)**
- **Not Quantifiable**

### 9. Evaluation Strategies

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<td>☐ Monographs</td>
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**TOTAL:** 100%

### 10. Bibliography:


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### 11. According to Law 51

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---

**Person who prepared this description and date of preparation:**

Agustín Irizarry, August 2007
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:**


   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**

<table>
<thead>
<tr>
<th>Outline</th>
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<tr>
<td>Overview of Optimization</td>
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<tr>
<td>Introduction to Evolutionary Computation</td>
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<tr>
<td>Evolutionary Programming</td>
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<td>Evolution Strategies</td>
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8. Grading System

☐ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

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<td>☐ Short Quizzes</td>
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<td>☐ Monographies</td>
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10. Bibliography:


11. According to Law 51

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Person who prepared this description and date of preparation:
José R. Cedeño, August 2007.
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**

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<tr>
<td>System dynamic performance and criteria for system dynamic performance</td>
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<tr>
<td>Types of stability studies</td>
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<tr>
<td>The Classical Model</td>
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<td>The swing equation</td>
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</table>
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 6
Parameters

Synchronous Machine and Network Interaction
Power Transfer
Interface 5

Modeling of Controls and Loads
Loads 8
Excitation Systems
Turbine-Governor

Small Signal Stability
• Linearization of system equations 8
• Eigenvalues analysis, sensitivity techniques
• Modes, participation factors

Current Developments 4

One exam 1

Total hours: (equivalent to contact period)

8. Grading System
☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

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This the most modern available reference.


Another modern reference.

These are the BEST modern references.


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Person who prepared this description and date of preparation:
Agustín Irizarry, August 2007
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:**
   - 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**

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
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<tbody>
<tr>
<td>Overview of Power Systems Operation and Control</td>
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<tr>
<td>Mathematical Background</td>
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<td>Unit Commitment</td>
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<td>Control of Generation</td>
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<td>Interchange of Power and Energy</td>
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<td>Optimal Power Flow</td>
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<td>Emergency Operations</td>
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9. Evaluation Strategies

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<td>☒ Other, specify: homework</td>
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TOTAL: 100%

10. Bibliography:


11. According to Law 51

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Person who prepared this description and date of preparation:
José R. Cedeño, August 2007
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:**


3. **Pre/Co-requisites and other requirements:**

4. **Course Objectives:**

   Introduce students to advanced methodologies in control systems design.

5. **Instructional Strategies:**

   - [x] conference
   - [ ] discussion
   - [x] 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**

<table>
<thead>
<tr>
<th>Outline</th>
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<td>State variable representation of dynamic systems.</td>
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<tr>
<td>Solution of the state equation: time and frequency domain methods. Modes of dynamic systems.</td>
<td>6</td>
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<tr>
<td>Internal and Lyapunov stability. Poles of multivariable systems.</td>
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<tr>
<td>Controllability and Observability.</td>
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<tr>
<td>Realizability and minimal realization.</td>
<td>3</td>
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<td>Multivariable transmission zeros. Multivariable pole-zero</td>
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</table>
cancellations.

Introduction to feedback systems. Full-state and output feedback. Eigenstructure assignment.
Tests

Total hours: (equivalent to contact period)

8. Grading System

☒ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

<table>
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<th>Quantity</th>
<th>Percent</th>
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<td>☐ Oral Reports</td>
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<td>☐ Monographies</td>
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<td>☒ Other, specify: homework</td>
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10. Bibliography:

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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 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**

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
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<tbody>
<tr>
<td>1. Embedded system design process</td>
<td>2</td>
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<tr>
<td>2. Architecture and instruction sets</td>
<td>8</td>
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<td>3. Hardware interfacing and FPGA's</td>
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<td>4. Software interfacing and operating systems</td>
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<td>5. Communication protocols</td>
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<td>6. System design methods</td>
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<td>7. Tests</td>
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   **Total hours: (equivalent to contact period)** 45

8. **Grading System**
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<td>Short Quizzes</td>
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10. Bibliography:

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Person who prepared this description and date of preparation:
Manuel Toledo, August 2007
### 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; Análisis de Fourier de Senales Multidimensionales; Diseño e Implementación de Filtros digitales Bidimensionales; Aplicaciones de Tecnica de Filtros Digitales a la Formación de Haces y Análisis de Imágenes.

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**

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
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<tr>
<td>1. Multidimensional Signals and Systems</td>
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<tr>
<td>a. 2-D Discrete Signals.</td>
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</tr>
<tr>
<td>c. Frequency-domain characterization of signals and systems.</td>
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</tr>
<tr>
<td>d. Sampling continuous 2-D signals.</td>
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<tr>
<td>2. Discrete Fourier Analysis of Multidimensional Signals</td>
<td>6</td>
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</tbody>
</table>
### 3. Design and Implementation of 2-D FIR filters
- a. Implementation.
- b. Design using windows.

### 4. Multidimensional Recursive Systems
- a. Finite order difference equations.

### 5. Design and implementation of 2-D IIR filters
- a. Implementation.
- b. Design in state space and in the frequency domain

### 6. Applications in Image Processing
- a. Short-time Fourier Transform
- b. Beamforming
- c. Adaptive and Nonlinear Techniques
- d. Image Formation from Sensor Data

### 7. Exams  3
**Total hours: (equivalent to contact period)** 45

### 8. Grading System
- [ ] Quantifiable (letters)
- [x] Not Quantifiable

### 9. Evaluation Strategies

<table>
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<td>[x] Projects</td>
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### 10. Bibliography:
3. Dan E. Dudgeon, Russell M. Mersereau, Multidimensional Signal Processing, 1984 (Classical textbook in the subject)
5. Alexandre Smirnov, Processing of Multidimensional Signals, Springer Verlag, 1999

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**Person who prepared this description and date of preparation:**
Domingo Rodriguez, August 2007
## 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 foundations, fast algorithms for the Discrete Fourier Transform. Fast convolution algorithms, multidimensional techniques, fast filtering computations, architecture of filters and transforms, fast algorithms in VLSI. Application studies in transmission error controlling codes, sonar, radar, speech, image processing, and other engineering areas. Study of software implementations on vector and parallel architectures. Algorithms and symbolic computation.

**Spanish:** Fundamentos Teoricos, Algoritmos Rapidos Para la Transformada Discreta Fourier, Algoritmos Para Convoluciones Rapidas, Tecnicas Multidimensionales, Computaciones Rapidas de Filtrado, Arquitecturas de Filtros y Transformadas, Algoritmos Rapidos en Vlsi. Estudio de Aplicaciones en Codigos Para Controlar Errores de Transmision, Procesamiento de 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 assistance 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

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
</tr>
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<tbody>
<tr>
<td>1. Introduction to Digital Signal Processing and Digital</td>
<td>6</td>
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</table>
### Communications
- Digital Signals and Systems
- Fundamental Concepts of Analog and Digital Communications Systems
- Fundamental Concepts of Discrete-time Signal Processing
- Cyclic Convolution Operations and Fast Unitary Transforms

### Fundamental Algebraic Structures
- Sets, Relations, Cartesian Products, Number Functions
- Semi-groups, Groups, Fields, Vector Spaces, Linear Algebras

### Finite Dimensional Linear Operators and Signal Algebras
- Matrix Representations
- Algorithm Implementations

### Finite Impulse Response Filters and the Discrete Fourier Transform
- Linear and Cyclic Arithmetic Complexities
- Algorithm Implementations

### Cyclic Codes
- Linear Codes vs. Convolutional Codes
- Algorithm Implementations

### Fast Algorithms for Multidimensional Applications
- Fourier Transform
- Block Convolutions and Toeplitz Systems

### Software and Hardware Algorithm Design and Development Techniques
- Source and Channel Coding Applications
- Digital Modulation Applications
- Time-frequency Signal Analysis Algorithm Applications
- Space-time Adaptive Processing Algorithm Applications

### Exams
- Total hours: (equivalent to contact period)

### Grading System
- Quantifiable (letters)
- Not Quantifiable

### Evaluation Strategies

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<td>Oral Reports</td>
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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

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
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<tbody>
<tr>
<td>1. Semiconductor physics and conductivity</td>
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<tr>
<td>2. Capacitance of reverse-biased PN junctions and MOS structures</td>
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<td>3. Forwar-biased PN junctions</td>
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<td>4. MOSFETs</td>
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<td>5. Bipolar transistors</td>
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<td>6. IC Devices and technologies</td>
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<td>7. Photonic devices</td>
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8. **Tests**

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9. **Evaluation Strategies**

10. **Bibliography:**

5. R. Muller and T. Kamins, Device Electronics for Integrated Circuits, Wiley, John and Sons, 2002

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**Person who prepared this description and date of preparation:**
Manuel Toledo, August 2007
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 frecuencia.
   Topologías unidireccionales y bidireccionales con conmutación suave para convertidores de cd a
   cd y de cd a monofásico o a trifásico y sus aplicaciones 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

<table>
<thead>
<tr>
<th>Outline</th>
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<tr>
<td>High frequency effects on power converter components, operation</td>
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<tr>
<td>and electromagnetic interference</td>
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<tr>
<td>Soft-switching in power converters</td>
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<td>Quasi-resonant, Resonant and Multi-resonant dc-dc power</td>
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<tr>
<td>converters: Operation, analysis, design and applications</td>
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<td>Simulation, modeling and control of soft-switched dc-dc power converters</td>
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<tr>
<td>Bidirectional soft-switched dc-dc converters: Operation, analysis,</td>
<td>2</td>
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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**

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<tr>
<th></th>
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10. **Bibliography:**

5. Rashid M. H. and Rashid, H. M., SPICE for Power Electronics and Electric Power (Electrical and Computer Engineering): CRC, 2005

11. **According to Law 51**

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**Person who prepared this description and date of preparation:**
Carlos Cuadros, August 2007
# 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**

<table>
<thead>
<tr>
<th>Outline</th>
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<td>Introduction</td>
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<tr>
<td>1. What is intelligence and artificial intelligence?</td>
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<tr>
<td>2. Expert system characteristics.</td>
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<td>3. Learning mechanisms.</td>
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<tr>
<td>4. Mathematical modeling for estimations and approximations.</td>
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<td>1. Biological neural systems</td>
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<tr>
<td>2. Artificial Neural Networks</td>
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<tr>
<td>a. Perceptron</td>
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<tr>
<td>b. Backpropagation</td>
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<tr>
<td>c. Associate Memories</td>
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<td>d. HPP Network</td>
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<td>e. ART and ART II (optional)</td>
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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

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10. Bibliography:
1. A. Ruano, Intelligent Control Systems Using Computational Intelligence Techniques, IEE Press, 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:
Raúl Torres, August 2007
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 velocidad 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**

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<td>1- Review of torque vs speed steady-state characteristics for</td>
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induction and dc motors.

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<td>2-</td>
<td>Review of power converters for electric drives.</td>
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<td>3-</td>
<td>Closed loop control of DC motor drives.</td>
</tr>
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<td>Space vector modeling of AC machines.</td>
</tr>
<tr>
<td>5-</td>
<td>Vector and field oriented control of AC machines.</td>
</tr>
<tr>
<td>6-</td>
<td>Modeling and control of induction motor drives.</td>
</tr>
<tr>
<td>7-</td>
<td>Modeling and control of permanent magnet and brushless dc motors.</td>
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<td>8-</td>
<td>Modeling and control of switched reluctance motors.</td>
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<td>9-</td>
<td>Sensors and transducers used in electric drive systems</td>
</tr>
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<td>10-</td>
<td>Hardware for controller implementation.</td>
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<td>11-</td>
<td>Power quality issues in electric drives.</td>
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<td>12-</td>
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8. Grading System

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9. Evaluation Strategies

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10. Bibliography:

- J. Chiasson, Modeling and High Performance Control of Electric Machines, John Wiley, 2005
- D.W. Novotny and T.A. Lipo, Vector Control and Dynamics of AC Drives, Oxford University Press, 1998. (Classic textbook in AC drives control)

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:

Carlos Cuadros, August 2007
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 millimeter-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
<table>
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<tr>
<th>Outline</th>
<th>Contact Hours</th>
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<td>Printed antenna elements: microstrip patches, slots and dipoles</td>
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<td>Techniques for circular polarization</td>
<td>3</td>
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<tr>
<td>Band broadening and tuning</td>
<td>3</td>
</tr>
<tr>
<td>Design and analysis of microstrip arrays</td>
<td>11</td>
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<tr>
<td>Array pattern synthesis</td>
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<td>Adaptive antennas</td>
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<tr>
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- Not Quantifiable

9. Evaluation Strategies

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Person who prepared this description and date of preparation:
José Colom, August 2007
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
<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
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<tbody>
<tr>
<td>1- Importancia de las microondas para percepción remota.</td>
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<tr>
<td>2- Repaso teoría de antenas</td>
<td>2</td>
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</table>
3- Teoría de radiometría: Radiación termal, Radiación de Cuerpo Oscuro, Ley de Planck
Radiación de cuerpo no oscuro
Teoría de Transferencia de radiación ,Temperatura aparente, Emisión y reflexión
5-Interacción de las microondas con componentes de la atmósfera
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.
7-Sistemas de radiómetros, Temperatura de Ruido, Figura de Ruido
8-Ruido para un sistema en cascada
9-Temperatura de Ruido equivalente para un Receptor Superheterodino
10-Calibración de Radiómetros
12-Exams
Total hours: (equivalent to contact period) 45

8. Grading System
☐ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

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10. Bibliography:
IEEE Transactions on Geoscience and Remote Sensing (available online from UPRM library)
Iain Woodhouse, Introduction to Microwave Remote Sensing, CRC Press, 2004

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

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<td>2. Photolithography</td>
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<td>3. Etching (Dry and wet)</td>
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<td>4. Dopant Diffusion</td>
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<td>5. Metal Evaporation</td>
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<td>6. Device Electrical Testing</td>
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7. System Integration 7
8. Tests 3
Total hours: (equivalent to contact period) 45

8. Grading System
☐ Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

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10. Bibliography:

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Person who prepared this description and date of preparation:
Nelson Sepulveda, August 2007
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 stochastic signals and linear systems.
   - Estimate power spectral densities.
   - 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**

<table>
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<tr>
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<th>Contact Hours</th>
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<tr>
<td>Review of Stochastic Processes</td>
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<td>LMS Algorithm</td>
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8. **Grading System**

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9. **Evaluation Strategies**

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**TOTAL:** 100%

10. **Bibliography:**


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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 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**

<table>
<thead>
<tr>
<th>Outline</th>
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<tbody>
<tr>
<td>1. Review of circuit elements characteristics, basic laws</td>
<td>3.0</td>
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<td>2. Review of Laplace transform and its application to circuit analysis</td>
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<td>3. RC, RL, and LC circuit transients</td>
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<td>4. RLC circuit measurements</td>
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<td>5. Single and multiple switching transients</td>
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<td>6. Three phase and abnormal switching transients</td>
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</tr>
<tr>
<td>7. Travelling waves on transmission lines</td>
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<td>8. Lighting surge phenomena</td>
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<tr>
<td>9. Modeling of power apparatus for transient analysis</td>
<td>3.0</td>
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<tr>
<td>10. Selection of protective devices for transient events</td>
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### Total hours: (equivalent to contact period)

### Grading System
- Quantifiable (letters) [x]  Not Quantifiable

### Evaluation Strategies

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**TOTAL:** 100%

### Bibliography:

### According to Law 51
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**Person who prepared this description and date of preparation:**
Lionel Orama, August 2007
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:
   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 through 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

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
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<tbody>
<tr>
<td>1. Probability Review, Random Vectors</td>
<td>4</td>
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<tr>
<td>2. Random Processes and Sequences</td>
<td>10</td>
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<tr>
<td>3. Random Processes and Linear Systems</td>
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<td>5. Parameter Estimation</td>
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<td>6. Estimation from Waveform Observations</td>
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<td>7. Kalman and Wiener Filtering</td>
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8. Tests

| Total hours: (equivalent to contact period) | 45 |

8. Grading System

- Quantifiable (letters)
- Not Quantifiable

9. Evaluation Strategies

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<td>☒ Other, specify: Homework</td>
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10. Bibliography:


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Person who prepared this description and date of preparation:

Miguel Vélez-Reyes, August 2007
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**

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
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<tbody>
<tr>
<td>MODELING AND ANALYSIS OF NOISE IN ANALOG CIRCUITS</td>
<td>16</td>
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<td>MODELING AND ANALYSIS OF NOISE IN DIGITAL CIRCUITS</td>
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9. Evaluation Strategies

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<td>☐ Other, specify:</td>
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TOTAL: 100%

10. Bibliography:
10- Technical papers from journals and conferences in Circuits and Systems and Computer Aided Design of Electronic Circuits.

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Person who prepared this description and date of preparation:
Manuel Jiménez, August 2007
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). Análisis 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**

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
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<tbody>
<tr>
<td>1. Introduction</td>
<td>1.5</td>
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<tr>
<td>2. Logic Design with MOSFETS</td>
<td>1.5</td>
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<tr>
<td>3. Introduction to HDLs</td>
<td>3</td>
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<tr>
<td>4. Physical Structure of CMOS ICs</td>
<td>1.5</td>
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<tr>
<td>5. Fabrication Process CMOS ICs</td>
<td>1.5</td>
</tr>
<tr>
<td>6. Elements of Physical Design</td>
<td>1.5</td>
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<tr>
<td>7. Review of MOS Transistor Theory</td>
<td>3</td>
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</table>
8. Analysis of CMOS Logic 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

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References


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Person who prepared this description and date of preparation:

Manuel Jiménez, August 2007
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., convertidores 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 analyze 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

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
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<tbody>
<tr>
<td>Common dc-dc PWM converter configurations, analysis, design, basic modeling and control.</td>
<td>8</td>
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<tr>
<td>Transformer isolated dc-dc PWM converter configurations, analysis, design, basic modeling and control, power supply applications.</td>
<td>10</td>
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<tr>
<td>Inverter basic concepts, configurations, modulation techniques, voltage and harmonic control</td>
<td>8</td>
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</table>
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**  
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9. **Evaluation Strategies**  

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10. **Bibliography:**  

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**Person who prepared this description and date of preparation:**  
Carlos Cuadros, August 2007
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 Processing; boundary Detection; Region Growing; Texture and Shape Analysis.

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**

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
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<td>Course Introduction</td>
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<td>Machine vision systems: Illumination, Camera and lenses selection, and positioning devices.</td>
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<td>Introduction to Geometrical Optics</td>
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<td>Binary Image Processing</td>
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<td>Regions</td>
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<td>Edge detection</td>
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<td>Contours and region representation</td>
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<td>Shading</td>
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8. **Grading System**

☑ Quantifiable (letters) ☐ Not Quantifiable

9. **Evaluation Strategies**

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10. **Bibliography:**


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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 distorsión 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**

<table>
<thead>
<tr>
<th>Outline</th>
<th>Contact Hours</th>
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<tbody>
<tr>
<td>Introduction to Electric Power Quality 1</td>
<td>1</td>
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<tr>
<td>Indices of distortion and interference, industry standards</td>
<td>4</td>
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<tr>
<td>Analysis methods: transient and steady state</td>
<td>6</td>
</tr>
<tr>
<td>Measurements: voltage, current, power, energy and power factor. Instrumentation</td>
<td>4</td>
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<td>Modeling under nonsinusoidal conditions</td>
<td>6</td>
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<td>Review of power electronics</td>
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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

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TOTAL: 100%

10. Bibliography:

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:
Efrain O’Neill, August 2007
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 función de ambigüedad, 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 apertura 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

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<td>Radar measurements</td>
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<td>Cross-section of radar targets</td>
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<tr>
<td>Propagation and polarization</td>
<td>4</td>
</tr>
<tr>
<td>The matched filter</td>
<td>2</td>
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</table>
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

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10. Bibliography:

11. According to Law 51
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Person who prepared this description and date of preparation:
Rafael Rodriguez, August 2007
Course Syllabus

1. General Information:
   - Alpha-numeric codification: INEL 6106
   - Course Title: Introduction to Radar Systems
   - 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 aprendera 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
<table>
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<tr>
<td>Introduction to Radar Systems.</td>
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</tr>
<tr>
<td>Radar Equation</td>
<td>6</td>
</tr>
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</table>
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

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<tr>
<td>Oral Reports</td>
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<td>Monographs</td>
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<td>Portfolio</td>
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<td>Projects</td>
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<td>Journals</td>
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<td>TOTAL:</td>
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</table>

10. Bibliography:
2. Richard J. Doviak, Dusan S. Zrnic, Doppler radar and weather observations, 2nd Ed., AP, 1993

11. According to Law 51
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Person who prepared this description and date of preparation:
Rafael Rodriguez, August 2007
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 parámetros-S. Diferentes tipos de amplificadores tales como bajo en ruido, de potencia, y ancho de banda amplio se discuten en detalle. El curso también cubre el diseño de osciladores usando resonadores dieeléctricos. Simulación 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**

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<th>Contact Hours</th>
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<tbody>
<tr>
<td>Two port circuits.</td>
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<tr>
<td>Matching Networks, S Parameters, Microstrip, Smith Chart</td>
<td>4</td>
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<tr>
<td>Max Gain Amplifier design, stability, DC bias, power gain circles,</td>
<td>6</td>
</tr>
<tr>
<td>unilateral case, bilateral case</td>
<td></td>
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</table>
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

<table>
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<td>☐ Short Quizzes</td>
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<tr>
<td>☐ Oral Reports</td>
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<td>☐ Monographies</td>
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<td>☐ Projects</td>
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10. Bibliography:
References:

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:

   - 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**

<table>
<thead>
<tr>
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<th>Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introducción y Discusión del Prontuario: Discusión del prontuario, dinámica de la clase y métodos de evaluación; Motivación del curso</td>
<td>1 hour</td>
</tr>
<tr>
<td>Campos Electromagnéticos (Repaso): Ecuaciones de Maxwell; Parámetros constitutivos; Condiciones de frontera; Potencia y energía; Variación armónica en tiempo.</td>
<td>2 hour</td>
</tr>
<tr>
<td>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*; Rotación de Faraday*; Ferritas*; Teorema de reciprocidad de Lorentz en medios anisotrópicos*.</td>
<td>3 hour</td>
</tr>
<tr>
<td>Ecuación de Onda y sus Soluciones (Repaso):Coordenadas cartesianas; Coordenadas cilíndricas*, Coordenadas esféricas*.</td>
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</tr>
<tr>
<td>Propagación y Polarización (Repaso): Modos TEM; Modos TEM en medios con pérdidas; Polarización.</td>
<td>2 hour</td>
</tr>
<tr>
<td>Reflexión y Transmisión: Incidencia normal; Incidencia oblicua, Medios con pérdidas; Características de polarización en reflexión; Ondas en medios multiperíodos, Ondas de superficie; Ondas en medios no homogéneos; Estructuras periódicas y modos de Floquet.</td>
<td>8 hour</td>
</tr>
<tr>
<td>Potenciales Auxiliares Vectoriales, Construcción de Soluciones y Ecuaciones de Disper 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</td>
<td>3 hours</td>
</tr>
<tr>
<td>Teoremas y Principios Electromagnéticos: Dualidad; Teorema de unicidad; Teoría de imágenes; Teorema de reciprocidad; Teorema de equivalencia de volumen y superficie.</td>
<td>3 hours</td>
</tr>
<tr>
<td>Guías de Onda y Cavidades: Guías de onda rectangulares y cilíndricas; Guías de onda parcialmente rellenas, Cavidades rectangulares, cilíndricas y esféricas; Líneas de transmisión esférica.</td>
<td>8 hours</td>
</tr>
<tr>
<td>Dispersión: Dispersión por superficies planas, cilindros circulares, cuñas conductoras y esferas conductoras</td>
<td>6 hours</td>
</tr>
<tr>
<td>Funciones de Green: Problemas Sturm-Liouville, Identidades</td>
<td>5 clases</td>
</tr>
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<td><strong>Total hours:</strong> (equivalent to contact period)</td>
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8. **Grading System**

- [x] Quantifiable (letters)
- [ ] Not Quantifiable

9. **Evaluation Strategies**

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<td>Monographies</td>
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</table>
10. Bibliography:


References:

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

11. According to Law 51

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

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
Appendix H:
Description of Courses that can be used to satisfy the Mathematics Requirement
Sample Courses to Satisfy the Mathematics Requirement

This is a list of potential courses that can be used to meet the mathematics requirement in the EE Ph.D. program. It includes courses in Mathematical Sciences and related courses with applied mathematics content offered at the college of engineering. The list will be revised by the ECE Graduate Committee yearly and updated according to course offers in mathematical sciences and related fields and interests of the faculty.

Courses from the Mathematical Sciences Department

MATE 5016. GAME THEORY (On demand). Three credit hours. Three hours of lecture per week. Mathematical theory and solution of different classes of games, such as two-person, rectangular or matrix, and multipersonal games.

MATE 5047. INTERMEDIATE DIFFERENTIAL EQUATIONS (I) (Odd numbered years). Three credit hours. Three hours of lecture per week. Prerequisites: MATE 4009 and MATE 4031 or its equivalent. Existence, continuity and differentiability of solutions; stability and Lyapunov’s theorem.

MATE 5049. CALCULUS OF VARIATIONS (On demand). Three credit hours. Three hours of lecture per week. Prerequisite: MATE 4009. Origin and historical development of the calculus of variations; first variation of a functional; canonical forms of Euler's equations; second variation: sufficient conditions for weak and strong extremals; applications to problems in geometry, mechanisms and physics.

MATE 5055. VECTOR ANALYSIS (On demand). Three credit hours. Three hours of lecture per week. Prerequisite: MATE 3063 or MATE 3185. Introduction to vector analysis as a tool for mathematicians. The algebra and calculus of vectors, including gradient, divergence and curl, Stokes’ and Green's theorems, curvilinear coordinates, and simple n-dimensional space. Applications in physics and geometry.

MATE 5056. TENSOR ANALYSIS (On demand). Three credit hours. Three hours of lecture per week. Prerequisite: MATE 3063 or MATE 3185. Cartesian tensors, Cartesian tensor fields, gradient vector, Laplacian, covariant and contravariant tensor fields, the differential line-element and the fundamental tensors, covariant differentiation and the Riemann-Christoffel tensor.

MATE 5150. LINEAR ALGEBRA (I). Three credit hours. Three hours of lecture per week. Prerequisite: MATE 4008. Study of the essentials of linear algebra, including finite dimensional vector spaces, linear equations, matrices, determinants, bilinear forms, inner products, spectral theorem for normal operators, and linear transformations.

MATE 6005. COMBINATORICS (On demand). Three credit hours. Three hours of lecture per week. Enumerative analysis and optimization techniques: permutations and combinations, generating functions, recurrence relations, the principle of inclusion and exclusion, rudiments of graph theory, transport network, and linear programming.
MATE 6025. NUMERICAL LINEAR ALGEBRA. Three credit hours. Three hours of lecture per week. Matrix analysis techniques fundamental to problem solving and the development of optimization methods and numerical solution of differential equations. Topics include: eigenvalue and eigenvector problems, numerical methods, singular value decomposition, special problems, and applications.

MATE 6026. NUMERICAL OPTIMIZATION. Three credit hours. Three hours of lecture per week. Modern optimization methods and their application to various problems in science and engineering. Topics include: optimization on convex sets, minimization methods of nonlinear problems, nonlinear equations, conjugate methods, and special structure problems.

MATE 6045. OPTIMIZATION THEORY (II) (Odd numbered years). Three credit hours. Three hours of lecture per week. Classical optimization techniques: linear, nonlinear, geometric programming, dynamic programming, the path method.

MATE 6201-6202. ABSTRACT ALGEBRA (II)- (I). Three credit hours per semester. Three hours of lecture per week each semester. Prerequisite: authorization of Director of the Department. A survey of abstract algebra. Algebraic systems studied include groups, ring, fields, Galois theory, modules over rings, partially ordered algebraic systems and theory of categories.

MATE 6261. THEORY OF FUNCTIONS OF A REAL VARIABLE I (I). Three credit hours. Three hours of lecture per week. Set theory, the axiom of choice and Zorn's lemma, structure of the real number system, metric and topological spaces, Borel sets and Baire functions, limit theorems, properties of continuous and semicontinuous functions, derivatives and sequences of functions, functions of bounded variation, Riemann-Stieltjes integration.

MATE 6262. THEORY OF FUNCTIONS OF A REAL VARIABLE II (II). Three credit hours. Three hours of lecture per week. An introduction to measure theory and Lebesgue integration, covering the following topics: inner and outer measure, measurable sets, Lebesque measurable sets, Vitali’s covering theorem, measurable functions, convergence in measure, the Lebesque integral for real functions of a real variable, the Radon-Nykodym theorem, multiple integrals, Fubini's theorem, L spaces, convergence in the mean.

MATE 6301. THEORY OF FUNCTIONS OF A COMPLEX VARIABLE (II) (Even numbered years). Three credit hours. Three hours of lecture per week. This course provides a rigorous foundation in the theory of functions of a complex variable. Topics include theory of analytic functions, contour integration and infinite series.

MATE 6530. DIFFERENTIAL GEOMETRY I (II) (Even numbered years). Three credit hours. Three hours of lecture per week. Prerequisite: MATE 6670. Study of Riemannian metrics, affine and Riemannian connections, geodesics, curvatures, Jacobi fields, immersions.

MATE 6531. DIFFERENTIAL GEOMETRY II (On demand). Three credit hours. Three hours of lecture per week. Prerequisite: MATE 6530. Study of complete manifolds, spaces of constant curvature, variations of energy, Rauch comparison theorem, Morse index theorem, fundamental group of manifolds of negative curvature, sphere theorem.

MATE 6551. ALGEBRAIC TOPOLOGY (On demand). Three credit hours. Three hours of lecture per week. Homotopy and homology groups associated with a topological space.

MATE 6622. TOPICS IN THE THEORY OF FUNCTIONS OF A COMPLEX VARIABLE (I) (Even numbered years). Three credit hours. Three hours of lecture per week. Prerequisite: MATE 6301. Conformal mapping. Riemann surfaces, harmonic functions, the Dirichlet problem.

MATE 6651-6652. INTRODUCTION TO HIGHER GEOMETRY (I, Even numbered years)-(On demand). Three credit hours per semester. Three hours of lecture per week each semester. Homogeneous Cartesian coordinates, linear dependence of points and lines, harmonic division, line coordinates, cross-ratio; transformation; metric, affine, and projective geometries; points and line curves, space geometry.

MATE 6670. DIFFERENTIABLE MANIFOLDS (I, Every two years) (On demand). Three credit hours. Three hours of lecture per week. Differentiable manifolds, vector fields, the Frobenius theorem, differential forms and tensor fields, Lie groups, homogeneous spaces, integration on manifolds.

MATE 6672. NUMERICAL MATHEMATICAL ANALYSIS (I). Three credit hours. Three hours of lecture per week. Mathematical methods of computation applicable to automatic digital computers, choice and use of tables, finite differences, roots of equations, numerical differentiation and integration, curve fitting, least squares, harmonic analysis.

MATE 6674. NUMERICAL METHODS FOR DIFFERENTIAL EQUATIONS. Three credit hours. Three hours of lecture per week. Fundamentals of mathematical modeling with partial differential equations and numerical methods for their solution with the computer. Convergence and stability of distinct schemes of finite differences or finite elements for various types of partial differential equations.


MATE 6676. MATHEMATICS OF MODERN SCIENCE II (II). Three credit hours. Three lectures per week. Prerequisite: MATE 6675. A more advanced study of some topics covered in MATE 4071-4072. Sturm-Liouville systems, calculus variations, integral equations, tensors, and finite differences.

MATE 6677. ELEMENTARY PARTIAL DIFFERENTIAL EQUATIONS (I) (Even numbered years). Three credit hours. Three hours of lecture per week. Prerequisite: MATE 4009.
General theory of partial differential equations of the first and second order, linear partial differential equations, study of some of the important types of differential equations of mathematical physics.

COMP 6785. ANALYSIS OF ALGORITHMS (II). Three credit hours. Three hours of lecture per week. Prerequisite: authorization of the Director of the Department. Analysis of algorithms: graph algorithms, algorithms for classical problems in linear algebra. Integer and polynomial arithmetic, complexity, and NP-completeness.

ESMA 5015. STOCHASTIC SIMULATION (I) (Even numbered years). Three credit hours. Three hours of lecture per week. Prerequisite: ESMA 4001 or MATE 4001. Basic methods of simulation, modeling of complex systems, simulation languages, generation of random numbers, model validity, analysis of solutions, variance reduction techniques, and the design of experiments.

ESMA 6205. APPLIED REGRESSION (II). Three credit hours. Three hours of lecture per week. Simple linear regression, multiple linear regression, robust regression methods and analysis of residuals. Problems and remedial measures in the design of regression models. Selection of independent variables. Non-linear regression.

ESMA 6305. STATISTICAL METHODS (I). Three credit hours. Three hours of lecture per week. Populations and samples, probability distributions, sampling distributions, statistical inference, linear and multiple regression and correlation, analysis of variance and covariance. Use of statistical computer package.

ESMA 6600. PROBABILITY THEORY (I). Three credit hours. Three hours of lecture per week. Sample spaces and events, conditional probability and independence, discrete and continuous random variables, moment generating functions, and limit theorems.

ESMA 6607. ADVANCED SAMPLING THEORY (II) (Even numbered years). Three credit hours. Three hours of lecture per week. Advanced theory and techniques of statistical sampling, including simple, stratified, systematic, and conglomerate sampling; comparison among these and corresponding problems of estimation; allocation problems.

ESMA 6616. LINEAR MODELS (I) (Odd numbered years). Three credit hours. Three hours of lecture per week. Prerequisite: authorization of the Director of the Department. Multivariate normal distribution; distribution of quadratic forms; theory of least squares; estimation and hypothesis testing in the general linear model, analysis of multiple classifications; components of variance models.

ESMA 6660. BIOSTATISTICAL ANALYSIS (On demand). Three credit hours. Three hours of lecture per week. Prerequisite: authorization of the Director of the Department. Descriptive and inferential statistical techniques, design of experiments, construction of biomathematical models, bio-essays and probit analysis.

ESMA 6661. THEORY OF STATISTICS I (II). Three credit hours. Three hours of lecture per
Sampling distributions, point and interval estimation, optimal properties of estimators, tests of simple and composite hypotheses, likelihood ratio tests, tests of goodness of fit, and analysis of contingency tables.

ESMA 6662. THEORY OF STATISTICS II (I). Three credit hours. Three hours of lecture per week. Prerequisite: ESMA 6661. Nonparametric tests, multivariate distributions, introduction to linear models, estimation and hypothesis testing in linear models, Bayesian methods, and statistical decision theory.

ESMA 6787. EXPERIMENTAL DESIGN (I) (Even numbered years). Three credit hours. Three hours of lecture per week. Principles of experimental design and hypothesis testing: randomized blocks, latin squares, 2n, 3n, and other factorial experiments; confounding, fractional factorials, response surface methodology, split plot and incomplete block designs.

ESMA 6788. ADVANCED PROBABILITY THEORY (On demand). Three credit hours. Three hours of lecture per week. Fundamentals of integration and measure theory; basic concepts of probability in the context of measure theory; conditional probability and conditional expectation; strong law of large numbers; theory of martingales and central limit theorem.

ESMA 6789. STOCHASTIC PROCESSES (II) (Odd numbered years). Three credit hours. Three hours of lecture per week. Probability spaces and convergence concepts; random walk; Markov chains; Poisson processes and purely discontinuous Markov processes; stationary processes; martingales; Brownian motion and diffusion stochastic processes.

Courses from the College of Engineering

ININ 6005. EXPERIMENTAL STATISTICS. Three credit hours. Three hours of lecture and/or discussion per week. Prerequisite: authorization of the Director of the Department. Applications of multiple regression to analysis of variance and experimental designs. Analysis of multiple classifications involving fixed, random, and mixed effects, including crossed and nested variables of classification. Emphasis on computer model applications.

ININ 6008. NETWORK FLOWS AND GRAPHS IN MANAGEMENT SCIENCE. Three credit hours. Three hours of lecture and discussion per week. Prerequisite: authorization of the Director of the Department. Principles of network flows and graphs theory and their applications in management science. Classical network flow problem formulations including maximal flow-minimal cut, assignment, transportation and others. Representation of optimization problems as network formulations, and the use of the out of kilter algorithm for their solution. Single versus multicommodity flow, as well as the relation of graphs and networks to combination problems.

ININ 6010. MULTIPLE REGRESSION ANALYSIS. Three credit hours. Three hours of lecture per week. Prerequisite: authorization of the Director of the Department. Analysis of unplanned experimental data to develop models for predicting complex systems behavior. Topics include: matrix formulation and properties of least squares estimators in multiple linear regression; analysis of residuals; diagnostics for influential data; strategies for variable selection;
diagnostics, effects, and corrective measures for problems with correlated predictor variables; biased regression and other estimation criteria; autocorrelated residuals; simultaneous inference, model validation; use of computer programs to analyze real data and to develop a model.

ININ 6020. QUEUEING THEORY AND APPLICATIONS. Three credit hours. Three hours of lecture per week. Prerequisite: authorization of the Director of the Department. Development and use of analytical models for the design of queuing systems. Introduction to stochastic-process models. Applications to analysis, design, and optimization of queuing systems in service and manufacturing organizations.

ININ 6025. LINEAR AND DISCRETE OPTIMIZATION. Three credit hours. Three hours of lecture and discussion per week. Prerequisite: authorization of the Director of the Department. Basic theory and development of the simplex method for solving linear programming problems with discrete variables. Dual problems and sensitivity analysis. Formulation of problems with discrete variables. Developments of implicit enumeration and related methods for integer problems. Application of linear and discrete optimization methods to problems of industry and government. Use of computer programs.

ININ 6036. INTRODUCTION TO TIME SERIES ANALYSIS. Three credit hours. Three hours of lecture per week. Prerequisite: authorization of the Director of the Department. Univariate and bivariate time series in frequency and time domain, use of autocorrelation and spectral analysis for model identification. Uses of model diagnostic and forecasting techniques, dynamic systems modeling and stochastic estimation by means of the Kalman filter.

CIIC 6005. COMPUTING FOUNDATIONS.
Three credit hours. Three hours of lecture per week.
Concepts and formal definitions of algorithmically solvable problems. Classification of problems by their computability in terms of the time and space required to solve them.