PROPOSAL
TO ESTABLISH A
GRADUATE PROGRAM
LEADING TO THE

MASTER DEGREE

IN

MATERIALS SCIENCE AND ENGINEERING

AT THE
COLLEGE OF ENGINEERING
OF THE
UNIVERSITY OF PUERTO RICO MAYAGÜEZ

SUBMITTED BY:

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April, 2004
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1. INTRODUCTION

In the last five years, the government of Puerto Rico has identified Materials Science and Engineering (MSE) as one of the priority areas to develop in the island. In this context, the University of Puerto Rico (UPR) have different research groups, located at many academic units, working on MSE but none of them has developed a specific MSE graduate or undergraduate program. At the Mayagüez campus, where all the engineering programs of the UPR system are housed and where most of the research in engineering takes place there is no educational program in MSE.

By the request of the Puerto Rican government, on June 6, 2001 Dr. Manuel Gómez and Prof. José J. Villamil from UPR – Río Piedras produced a document titled “Puerto Rico’s Public Policy on Science and Technology.” In this consequential article, the authors underscored the urgent need of “Masters’ programs in fields, such as: medical technologies, information technologies, communications, sciences, and engineering, among others.” They advocate for the strategic creation of “PhD […] and other advanced degrees and [to] connect them synergistically with targeted research institutes in areas where Puerto Rico needs to develop key competencies […]. Examples of this are: Computational Sciences and Engineering degrees, […] Medical Biotechnology, Plastic Mold Design and Manufacturing Technology, Materials Science, […] Environmental Remediation, among others”, underlining the need for a formal academic program in MSE to support the strategic vision of the government.

The proposed MSE academic program will also contribute towards the development of a research oriented faculty, and the formation of inter-disciplinary groups at the University of Puerto Rico at Mayagüez (UPRM). UPRM is evolving from a teaching-oriented to a research-oriented institution and in this academic framework, research and securing external funds become essential parts of the faculty’s responsibilities.

The continuing growth of research in MSE at the UPRM through federally funded programs reflects the importance of this interdisciplinary field. However, except for introductory undergraduate courses, there is no formal training of students in this area. Researchers and local, namely, several large and medium-size companies established in Puerto Rico, have experienced a lack of professionals specialized in MSE.

This proposal aims to develop a Graduate Program in MSE. The program will bring the opportunities to establish a long-term research and educational relationship between UPRM and federal and private research funding agencies in this area. Envisioned as a unique opportunity, this collaboration will improve and engage the education and research capabilities of minorities in engineering. The proposed program will target at materials synthesis and processing, device modeling, device fabrication and applied and computational materials and mechanics. The establishment of the program includes the following key components:

1. Curriculum development
2. Infrastructure (classrooms and laboratories) development
3. Faculty development and/or other teaching related resources
4. Enhancement of research in the area of MSE

1.1 STATUS OF EXISTING MSE CURRICULA

The General Engineering Department (GED) at UPRM offers all the fundamental engineering courses, such as Statics, Dynamics, Solid and Fluid Mechanics, Computer Programming,
Engineering Graphics and Engineering Materials. In particular, the Materials Science and Engineering courses identified as INGE 3045, and INGE 4001 are administered regularly to students of various engineering disciplines. The department has a total of 33 full-time professors, 60% of whom have a PhD degree. However, GED is not a degree granting department at undergraduate or graduate level, and as a consequence it causes severe handicaps for its faculty in terms of advising graduate students (research) and limiting their ability to attract external funds for research and infrastructure development. In many cases, GED Faculty has been forced to do joint research with professors from other departments in order to have graduate students and to access research infrastructure. In effect, the lack of an appropriate research infrastructure has been pointed out in many rejected research proposals presented by GED faculty. As a natural consequence, the creation of a MSE program in GED will provide graduate students and will enhance the entire campus research infrastructure.

Other courses related to but not particularly focused on MSE are being offered throughout UPRM engineering campus: from theory of elasticity to advanced concrete technology, and theory of dislocations. Naturally, everyone involved in those areas throughout the Engineering faculty will benefit from the creation of an interdisciplinary MSE program.

The Mayagüez campus of the University of Puerto Rico consists of four colleges: Agricultural Sciences, Business Administration, Arts and Sciences and Engineering, with an enrollment exceeding 13,000 students. The College of Engineering (CoE) commands over 40% of the student population and its graduates find jobs in the industries, both in Puerto Rico and in mainland US. A MSE graduate program will enhance their job placement. In this respect, there is concern in the US about the small number of Hispanic students enrolled in engineering programs and, particularly, in materials engineering. Our program would help strengthen the positioning of Puerto Rican graduates in the global job market. At the same time, as federal agencies are interested in seeing this goal accomplished, financial resources would become readily available to efforts in that direction.

1.2 INSTITUTIONAL NEEDS OF THE MSE PROGRAM

MSE is a very broad discipline, which is basically being overlooked in Puerto Rico due to a lack of degree granting program in this field. Without an academic program, it is very difficult to encourage faculty and students to get involved in research activities that follow the current technical developments in materials synthesis, processing and engineering. As quality education is a primary goal of UPRM, it specifically needs to develop MSE curricula in GED, to boost all existing related research efforts on campus.

Recent social trends in the US with regards to the Affirmative Action, Equal Opportunity programs and the elimination of the quotas for minorities have vividly demonstrated how ill-prepared the nation’s minorities are to compete in the technical job market and to be admitted to the top universities in the US. State and private universities where admission quotas for minorities have been eliminated have reported a sharp decline in minority enrollment. In light of all this, the need to broaden the opportunity base (i.e., creation of new programs) and the need for better training of the minority engineers, which has become more compelling than ever.

It is a common observation that, after completing a particular engineering or science undergraduate program, students want to pursue a graduate studies in an interdisciplinary area. Students are looking for interdisciplinary programs that are capable of integrating the theoretical and experimental understanding of the science and engineering fields, such as MSE. To that end,
the proposed program will provide Hispanic graduates of diverse educational backgrounds with learning and training environments for the job challenges of this century. This is particularly important for minority institutions where students need more encouragement.

A proper location in Puerto Rico for such an interdisciplinary program should be where both science and engineering curricula coexist. The University of Puerto Rico-Mayagüez maximizes this benefit. This academic program will be complementary to the ongoing federally funded research programs in materials science and engineering. Additionally, the instructional infrastructure in MSE is relevant for the future trained work force, and is critical for the success of new professional engineers hired in PR and US industry and for our graduates to succeed at doctoral programs in the mainland.

1.3 PROGRAM TITLE AND THE DEGREES

The proposed title for the program is Materials Science and Engineering (MSE) and the degrees granted will be Master of Science in MSE and Master of Engineering in MSE. This program corresponds to Plan I of graduate studies at UPRM, which grant degrees with thesis, leading to the degree of Master of Science and to Plan II and III of the graduate studies at UPRM, which grant degrees with project and without thesis/project respectively, leading to the degree of Master of Engineering. It is understood that with this title traditional areas of materials sciences and engineering are covered (metals, ceramics, polymers, semiconductors, composites, magnetic materials, and their mechanical as well as physical and chemical behavior). These areas are of interdisciplinary character, that is, the topics covered are relevant to civil, mechanical, chemical, industrial electrical and civil engineering, as well as physics, chemistry and computer science.

1.4 PROGRAM DURATION

The minimum duration to grant the master degree without thesis is three semesters. It is expected that a typical student with or without thesis or project options will complete the degree requirements in four semesters. The maximum duration will be the one allowed by the graduate school regulations.

1.5 PROGRAM OPTIONS

There are three options in programs leading to the Master’s degrees at UPRM, as outlined below:

Plan I. With Thesis Requirement (Master of Science)

1. Approve a minimum of 28 credits as follows:
   a. A maximum of six credits in advanced undergraduate courses.
   b. A minimum of 21 credits in courses at the graduate level.
   c. A minimum of six credits in courses related to, but outside the area of specialization.
2. Carry out a research program, as specified in his/her Plan of Graduate Study and prepare thesis. The thesis will be equivalent to 6 credit hours of work.
3. Approve an oral exam on the thesis subject. In the event that the student fails the exam, he/she will have the opportunity to take a second exam in the same semester or in the next one. The result of the second exam is final.

This program will be more attractive to students aspiring to conduct research and/or prepare themselves for a doctoral program in materials or mechanics related disciplines. This is the only Plan available to students with non-engineering degrees. Plan I will lead to the degree of Master of Science in MSE.
Plan II. With Project Requirement (Master of Engineering)
A student shall complete all requirements specified in Plan I except that the minimum number of course credits are 31 and the work completed will lead to a project report of 3 credits instead of a thesis. An oral exam on the project will also be required. In the event that the student fails the exam, he/she will have the opportunity to take a second exam in the same semester or in the next one. The result of the second exam is final.

Students opting for this option may want to get employment in areas in industry related to materials science and engineering. Some exposure to research through their project will give them an edge over their colleagues to undertake research and development projects. Plan II will lead to the degree of Master of Engineering in MSE.

Plan III. Without Thesis or Project Requirement (Master of Engineering)
A student shall fulfill the following requirements:
1. Approve a minimum of 34 credits as follows:
   a. A maximum of six credits in advanced undergraduate courses.
   b. A minimum of 27 credits at the graduate level.
   c. A minimum of 21 credits in the major field of study.
   d. A minimum of six credits in courses related to, but outside the area of specialization.

2. Pass a written examination on the material covered in the major field courses. If the student fails, he/she may take a second exam in the same semester, or in the next one. The result of the second exam is final.

Plan III satisfies better the needs of the industry. It has been observed that engineers working in the private or public sector need a graduate program that fits their professional aspirations and do not require a research component. This program will be mainly attractive as a part time/evening program for working engineers. Plan III will lead to the degree of Master of Engineering in MSE.

1.6 Tentative Program Initiation Date
The tentative starting date of the proposed program is the first semester 2004-2005.

2. Justification

2.1 Relation of the Program with the Mission of UPRM
The relationship of the program with the UPRM mission provides for the university’s responsibility to the Puerto Rican Community to offer necessary education for the development of Puerto Rican industry and find solutions to its problems in order to maintain the rhythm of development and competitiveness of the island in the global market. The industry and government of Puerto Rico need professionals who can solve ever more complex problems and be equally efficient in a variety of engineering situations.

UPRM is the principal academic center for engineering professionals in the island. Its mission is to prepare professionals to meet the technical needs of industry and government sectors. Therefore, it is imperative for UPRM to take the leadership and develop programs of higher learning to meet that end.

The establishment of Master Degrees program in MSE is utterly consistent with the Strategic Plan of the UPRM CoE. In effect, among the goals set by that Strategic Plan there are:
- Maintain, strengthen and further develop a College of Engineering of excellence.
- Strengthen the Faculty leadership at national and international level.
- Consolidate research, development, service and dissemination.
- Comprehensive and continuous development of personnel.
- Provide community services.

As mentioned before, an MSE program would boost CoE advantage in all related areas, facilitate recognition of CoE Faculty through publications and presentations in congresses, help in the consolidation of a robust research environment in the CoE and the university, contribute to an enduring Faculty professional growth, and become an essential participant in further local and regional industry, which will contribute to the creation of new jobs.

Advancing UPRM research and development is at the core of the proposed program, reflecting one of the main goals of the Strategic Plan of the university. It also echoes other important goals such as, the contribution to the expansion of research infrastructure, promoting a close collaboration with the industry, and focusing on the students by furthering their education and preparing them in an extremely competitive MSE field.

2.1.1 Academic Reasons for the Establishment of the Program

The proposed MSE graduate program was initiated by faculty members of GED. Their intentions are to fully integrate the department into the research environment of CoE/UPRM. With that purpose, the present program was designed as an interdisciplinary venture that would attract highly qualified graduate students, considered as backbone of any research in academia.

Although there are many UPRM departments involved in MSE research, their faculty are not collaborating with each other, as there is no appealing accretion program available on this area. Without easy access to graduate students, it is virtually impossible for the faculty to justify the need to setup laboratories where they can conduct research.

As laid out in its Strategic Plan, the mission of the GED is to establish a graduate program in this area to further the development of its Faculty. The proposed program will offer specialization in the different fields of materials science such as materials selection, magnetic materials, electronic materials, bio-materials, materials testing, materials recycling, applied mechanics of materials, etc. Many of the courses offered in each of the concentrations will also be available to graduate students in other graduate programs.

Since the proposed program is of interdisciplinary nature, research laboratories will be housed in various departments throughout the UPRM campus. The proposed graduate program will utilize all available campus resources in terms of personnel and equipment and, therefore, would not be a serious financial burden on the institution. On the contrary, research funding received by GED and other faculty involved in this program will be beneficial to UPRM growth.

It is expected that the program will have considerable impact on the growth and development of Puerto Rican industry in design, fabrication and analysis of materials and products and in achieving so, it will be serving its community in vital areas, consistent with UPRM’s mission. Initial costs to set up the program are, therefore, a genuine investment in the future of this university and the Puerto Rican community.

2.1.2 Need for a New Program

Industrial environments are teamwork-oriented, where graduates from various conventional
engineering disciplines need to interact and work with each other. Therefore, many professionals prefer an interdisciplinary graduate program such as the one proposed. As mentioned, MSE shares many aspects of its discipline with civil, mechanical, electrical, industrial and chemical engineering, and with chemistry, mathematics and computer science, and physics among other basic sciences. Their respective departments or programs sometimes do not offer the environment where students can pursue special interests of interdisciplinary and multidisciplinary nature. The strong emphasis on research in this program is the key factor in the student success rate in industry or in a research institution.

Through externally funding projects, the professionals enrolled in our program could bring research problems from their respective place of employment, to be used as possible topics of their thesis. This would help the company, who in many cases will be the one sponsoring the education of a graduate student. Puerto Rican industry and government realize that a research base is required to gain competitiveness in the global market of the 21st century. MSE knowledge is critical in the world market today, as the demand for new materials such as, semiconductors, smart construction materials to high technology composite materials for aircrafts grows at an exponential rate. The mechanical behavior of materials makes the backbone of structural mechanics, machine design and biomechanics among others areas. Mechanical, structural, aerospace, materials, and chemical engineering, depend on the mechanics of materials to design, analyze and fabricate increasingly complex products.

Additionally, it is intended that the graduate program in MSE will benefit the private and government industry of Puerto Rico by offering the following:

1. Advanced technical skills and research experience in material selection, testing and design, materials engineering, device fabrication, smart materials and mechanic of materials.
2. A flexible graduate program where professionals from industry can customize their graduate studies, which can be completed within an attractive time-frame for the employers.
3. An inter- and multidisciplinary program where faculty and students of various science and engineering departments can participate, conduct research and learn from each other.
4. Prepare and stimulate future faculty in MSE related areas who can then be employed by Puerto Rican and US colleges and universities.
5. Attract well-prepared MSE faculty, making UPRM even more effective in academic research and community service in a high demand, highly profile and well funded field.

All these goals can be achieved with the proposed graduate program, placing PR students on equal footing with the rest of the professionals in the country. The master’s degree will also prepare and encourage students to pursue doctoral degrees.

2.2 EMPLOYMENT OPPORTUNITIES FOR THE GRADUATES

The program is designed principally to: a) prepare professionals with diverse engineering background who can successfully fit in the private and government industries, and b) improve the technical background of professional engineers in the areas of MSE who eventually will pursue a Ph.D. in MSE related discipline and seek employment in research and academia.

According to an internal survey in Puerto Rico and the US\textsuperscript{1}, there exist ample employment opportunities for engineers specialized in materials science. Many of UPRM graduates find jobs

\footnote{\textsuperscript{1} “Women Minorities and Persons with Disabilities in Science and Engineering: 2002” \url{http://www.nsf.gov/sbe/srs/nsf03312/start.htm}.}
in the private sector where materials processing and device fabrication is undertaken. The tremendous expansion experienced by materials science in the last decade turns any statistical survey of job availability in the field into a redundant issue. Specialized publications, such as *Journal of Materials* and *Advanced Materials & Processes* have several pages of employment opportunities for MSE graduates in different areas within the field. One of the major strengths of the field is the versatility of the graduates who outperform other engineers in the deep understanding of materials behavior. As most manufacturing companies permanently need to optimize their products, most often alternative, less expensive, more advanced materials are required. Hence, MSE becomes the backbone of any engineering design, whether it is in machine design, bridge design, computer hardware, fiber optics, electrical power plants or chemical refineries. As a similar MSE program does not exist in the UPR system, our graduates should not be expected to have same opportunities in the competitive global job market.

Some examples of possible employers of our graduating students in Puerto Rico are the pharmaceutical and biomedical industry, consulting companies, universities, government agencies, telecommunication companies, electrical and water agencies, highway department, etc. Companies like Baxter, Carborundum, Hewlett Packard, Stryker, Xerox Corp., SmithKline Beecham, Avon Latinoamérica, Guidant CPI, Vasallo Corporation, P.R. Cement and companies dedicated to recycling products are expected to obtain major benefits by the establishing of an MSE program in the island. These and other companies like them will benefit greatly as they would no longer need to import MSE specialties or technology from the mainland.

2.3 INTEGRATION WITH THE UPRM STRATEGIC PLAN

The proposed program strengthens the objectives as outlined in the UPRM strategic plan. This plan covers the critical issue of research in the graduate program as: development of innovative programs that meet the needs of the society and improve learning; strengthen the research by offering graduate courses that respond to the industrial and research needs of the nation; and develop collaboration with other universities, institutions, industry, local and federal government to promote research and development.

The proposed program meets the strategic plan criteria by creating a graduate program in MSE in Puerto Rico. It also coincides with the institutional goals of educating minority students to meet the challenges of the 21st century national and global job market. The benefits of this program are expected to clearly outweigh its moderate costs, as most of the research will be supported through external funds and because it will utilize professors and courses that exist already in other departments, especially in GED. Therefore, only three new faculty members will be hired to strengthen this program. GED currently has several tenure track positions open as some of the senior professors are retiring within the next five years. Most new faculty applicants will be required to have research background in MSE and be able to teach other engineering courses.

This program will also provide an opportunity for the students of science departments, such as, physics and chemistry to earn master’s degrees in MSE, which will enhance their employment opportunities in the industry. This has been long awaited opportunity to eliminate the employment restriction on many outstanding students with science degrees. Therefore, “science meets technological frontier” might be easily achieved with such an interdisciplinary program.

3. RELATION OF THE PROPOSED PROGRAM WITH THE EXISTING PROGRAM

3.1 EXISTING STATUS OF GED
The current status of GED is to offer some of the fundamental engineering science courses at the undergraduate level. GED does not have any degree-granting program. Most of the current and newly hired professors have PhD’s in various areas related to MSE. Their expertise will be fully realized with the creation of a graduate program. A graduate program in MSE will help them excel in their field of research and also provide them an opportunity to transfer their hard learned knowledge to the next generation.

GED faculty is truly multidisciplinary and it includes chemical, industrial, electrical, civil, mechanical and materials engineers as well as architects. Their main areas of specializations, other than engineering graphics, are: materials science, mechanics of materials, computational mechanics and fluid mechanics. The interdisciplinary program of MSE would incorporate all of these specialties under one umbrella. Due to the rapidly disappearing boundaries between traditional engineering fields, it is easy to integrate the different elements of the faculty specializations under a common MSE program. As an example, mechanics of materials is an essential part of MSE since it addresses an aspect of the physical and mechanical properties of materials that are needed for the behavioral modeling of all classes of materials, such as, metals, polymers, ceramics, electronic materials, and composite materials. Therefore, an MSE program appears incomplete without the mechanics of materials component.

It is necessary to emphasize that the MSE program is inherently multidisciplinary and that faculty participation in this program is not limited to GED but also to faculty from other UPRM departments. Because all engineering and related science departments (i.e. Chemistry and Physics) already have graduate programs, the MSE program will complement them by giving an opportunity to their graduate students to take specific courses in MSE that are not offered in their respective departments, enabling student and faculty cross-fertilization.

4. OTHER PROGRAMS

4.1 SIMILAR PROGRAMS IN THE UPR SYSTEM

In the entire UPR system there is no academic program on MSE. Materials Science is only a specialization area - not a program - in the Chemistry Department of UPR-Río Piedras. No specific interdisciplinary program has been developed in that university. Similarly, Mayagüez is the only campus in the UPR System that offers engineering programs. UPRM is by far the largest and the best engineering school in the island. It is therefore imperative the creation of an MSE program, which will naturally fit best in the Mayagüez campus.

4.2 OTHER ENGINEERING SCHOOLS

In Puerto Rico, Politécnica, Turabo and InterAmericana universities also offer engineering programs, however, none of them offer MSE undergraduate or graduate programs. UPRM-Mayagüez has the advantage of an engineering student population, which is far larger than all the other universities combined. In effect, in a recent issue of the Hispanic Engineer magazine, UPRM is ranked as one of the top US universities in number of Hispanic engineer graduates, considerably outranking University of El Paso-Texas, and Universidad Politécnica. In the island, CoE at UPRM has by far the highest percentage of professors with a PhD degree which makes it the best-positioned engineering school to do quality research. Hence, UPRM is the most promising place in PR where a graduate program in MSE could be favorably established.
5. DESCRIPTION OF THE PROGRAM

5.1 PHILOSOPHY AND OBJECTIVES OF THE PROGRAM

5.1.1 Philosophy

MSE as discipline requires the technical understanding that allows solving practical engineering problems and it is increasingly becoming a more demanding discipline as a result of new technical demands put forward by the rapid growth of the materials industry. If this development is not complemented by the growth of professional materials engineers, the results will be regretful. Most US universities recognize this need and have established sound interdisciplinary MSE programs since the mid 60’s. However, Puerto Rico has so far not answered that call. Only in the last years, reflecting PR government developmental policies, UPRM recognized the lack of such a program and accordingly made MSE a priority development area.

5.1.2 Objectives

The core of the proposed program is to offer Master Degrees that integrate the knowledge of various disciplines and provides the students an opportunity to get a deeper knowledge of materials to complement their undergraduate background. The various specialties within the MSE would allow the students to custom tailor their academic program to suit their specific professional goals. Therefore, the main objective is to offer an opportunity to graduate students to select a master’s degree program in areas suitable for the job market in the new millennium.

The program with thesis option (Plan I) will achieve the following objectives:

1. Prepare students with depth in their chosen technical field so they can go on to studying for their doctoral programs, conduct research and join the academia or industry R&D departments.
2. Prepare students to work for research institutes in PR and the US. An employee with a background in MSE could be an asset to many government agencies and research labs.
3. Make Puerto Rico more competitive in the national research arena. Puerto Rico is trying to become a technically advanced, self-sufficient island with a self-sustainable industrial environment. Without research and development capabilities, this goal is not possible.

The non-thesis option (Plans II and III of the graduate studies at UPRM) program will achieve the following objectives:

1. Offer a comprehensive program with courses taken to enhance technical expertise and develop professional capabilities. This program will be suitable for professionals / students who do not aspire to get involved in research.
2. Provide a master’s degree program with a more definite timetable that can be scheduled by the employers and the prospective students.
3. Provide a flexible interdisciplinary program where students will have choices and freedom to go the direction more beneficial to them and their employers.
4. Prepare professionals and consultants who can assume the role of technical leaders in a diverse private or government agencies.

5.2 PROFILE OF THE GRADUATES

On the MSE graduate and his/her field, one of the most famous materials scientists, R. W. Cahn stated: “materials science and engineering [is] a clearly distinct discipline which in practice doubles up as a multidiscipline, with a substantial number of independent academic departments
and research institutes spread around the world, with its own multifarious journals and textbooks, and a large number of professionals [...] who call themselves scientists and engineers and communicate with each other on that basis. We have a profession to be proud of.” (2)

Overall the MSE graduates will successfully deal with the complex materials engineering problems that a person with a bachelor’s degree is not equipped to handle. In effect, he/she will be capable of:

- researching, designing, developing and testing new materials;
- advising on the choice of materials for specific purposes and adaptability of particular processes
- supervising fabrication of advanced materials in a plant production environment;
- optimizing materials used in manufacturing;
- supervising the implementation of alternative, more economical materials;
- advising on materials inspection, maintenance and repair procedures of materials;
- liaising with materials suppliers, and the manufacturing and implementation teams.

One main feature of an MSE graduate is his/her highly inquisitive mind. This quality is provided by an intensive exposure to an interactive and ever expanding field that demands long-life learning goals. The proposed program will provide the appropriate to develop that highly desirable ability. The practice of this engineering and science field can be carried out at the atomic level through the millions of possible combinations of elements. Furthermore, it can be done on a larger scale to take advantage of unique composite properties that result from microscopic-scale combinations of metals, ceramics and polymers, such as in fiber reinforcement to make a graphite fishing rod or, on a slightly larger scale, for steel-belted radial tires. Finally, it can be practiced on an even larger scale with bridges, buildings, and appliances.

The proposed program will prepare professionals to carry out technical responsibilities in the areas of design and production of alloys, polymers, ceramics, composites, and semiconductors. The courses will be offered in a wide range of areas as outlined in the next section. Each course will develop a number of student technical skills according to Table A.1 in the Appendix A.

5.3 PROGRAM COMPONENTS

Initially, students will be trained in related physics and chemistry of solids, structure-property behavior, phase diagrams, growth of materials, device fabrications, mechanics of materials, and fracture mechanics. Laboratory demonstrations and experimentation will complement theory in lectures. The emphasis will also be placed on cooperative learning that would provide a unique experience to students.

The MSE program will be designed to accommodate a diverse group of graduates in engineering and/or physical sciences. A Master Degree graduate student is required to complete 34 semester-credit hours as outlined in section 1.5. Due to the diverse background of entering students, core courses (two) focusing in fundamentals in MSE will be assigned to the students by the graduate committee depending on the individual student’s background and his/her proposed plan of study (see typical core courses in Section 5.5-5.6). A very broad selection of elective courses will be allowed.

Other engineering departments (Chemical, Electrical, Mechanical, and Civil), and non-

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engineering departments such as Chemistry, Physics and Biology Departments will have room to offer elective courses in the MSE program. The student may be required to make up certain deficiencies with undergraduate advanced courses, if necessary, for a particular field of specialization.

5.4 COURSE DESCRIPTION

The list of courses outlined in section 5.5 reflects the prominent courses that make up the traditional MSE program. In time, courses from other departments will be integrated in the program. The list shown below therefore is not exhaustive or comprehensive. Logically, new courses are required to accomplish the basic goals of the entire program. Most of these courses will provide laboratory demonstrations, in compass with the experimental trends in Materials Science. Moreover, the number of new courses cannot be reduced further without affecting the expected outcome of the MSE program.

As the program expands additional courses will be incorporated in specialized areas. For example, due to ongoing efforts, it is anticipated that biomaterials will become an important part of MSE research in GED and the rest of UPRM campus, prompting for the creation of courses focused on that subject.

As per university regulations, the courses will be coded with the word “MASE” corresponding to the first two letters of the first word and the first letter of the second and third word in Materials Science and Engineering.

5.5 LIST OF COURSES

The following courses are all 3 credit hour courses, except where it is noted otherwise. The corresponding new course syllabi are included in the Appendix B.

New courses (Core Graduate Level Courses)

MASE 6AMA Introduction to Advanced Materials

MASE 6AOF Structure and Properties of Materials

New courses (Elective Courses)

Undergraduate Level Elective Courses

INGE 5YYY Recycling of Materials
Graduate Level Elective Courses

MASE 6KRP Kinetics and Phase Transformation

MASE 6ANE Thermodynamics & Phase Equilibria

MASE 6CXD Diffractometry and Complementary Techniques

MASE 6DMM Computational Materials Science
Introduction to the computational techniques in materials science. Development of analysis tools for manufacturing process as well as the application of software systems of either a general or specific nature. Development of analytical models for components subjected to thermal processes or to stresses beyond the elastic limit. Problem analysis using the finite element method. Influence of processing on microstructural development and on final properties of the material.

MASE 6ENN Introduction to Polymer Science & Engineering
Basic classification and molecular structures, synthesis and molecular weight determination, solid-state properties (amorphous and crystalline states), degradation mechanisms, polymer reactions, network formation, copolymerization and blends/alloys. Mechanical properties of bulk polymers. Viscoelastic materials. Creep, stress relaxation, superposition, dynamic mechanical behavior, electrical behavior, miscellaneous mechanical properties, optical properties, transport properties.

MASE 6XXX Fundamentals of Materials Chemistry

MASE 6ZZZ Nanostructured Materials.

MASE 6MPE Materials Microprocessing and Engineering
Materials synthesis approaches, and process engineering, microstructure development, semiconductor growth, vapor phase and plasma processing.
MASE 6DPM Diffusion Phenomena in Materials
Diffusion mechanisms in crystals; Kirkendall effect; diffusion in ionic solids; diffusion in condensed media; kinetic of diffusion controlled processes.

MASE 6TPS Solidification Processing

MASE 6MSE Selected Topics in MSE
Students may register for more than one section per term. Subject matter varies from semester to semester, depending on the specialties of the instructor, such as: advanced ceramics, semiconductors, nanomaterials, biomaterials, etc.

MASE 6SEM Graduate Seminar (one credit hour)
Presentations and discussions in the areas of graduate studies and research. Faculty members, graduate students and visiting lecturers will participate in this course.

MASE 6MTR Master’s Thesis Research (variable credit hour course)
Students may register for more than one credit per term. MS thesis work under the supervision of a faculty member.

Existing Courses:

Advanced Undergraduate Elective Courses

INGLE 5XXX Materials Selection

QUIM 5125 Chemical Thermodynamics
Systematical analysis of the fundamental concepts of chemical thermodynamics and their applications.

QUIM 5165 Polymer Chemistry
Structure, properties, synthesis, reactions, and physical behavior of polymers. Experimental methods used in their analysis.

FISI 5037 Introduction to Solid State Physics
Introduction to X-ray diffraction, crystal structures, lattice energy and vibrations, thermal properties of solids, electrical and magnetic properties, free electron models of metals, superconductivity, photoconductivity and luminescence.

INME 5008 Corrosion
Electrochemical principles and corrosion mechanism; protection and prevention of corrosion in metals; the effects of temperature, environment, and metallurgical factors.

INME 5018 Materials Failure Analysis
Materials science concepts are used to identify, correct and prevent failure due to the improper use of materials or to problems in manufacturing processes. In depth study of failure mechanisms such as fatigue, wear, creep and corrosion.

INME 5025 Metals Fatigue
Nature of metals fatigue, modern approaches to design mechanical components under repeated loadings; importance of residua stresses and stress concentrations; analysis of cumulative damage and life prediction; cycle counting and sequence of events.

Graduate Level Elective Courses
INEL 6055 (FISI 5011) Introductory Solid State Devices
Solid state devices, dielectric, optical and magnetic properties of materials. Crystal structure and transport phenomena.

INEL 6075 Solid State Device Fabrication and Technology
Fabrication of solid state devices and integrated circuits, MOSFETs and microwave devices will be emphasized. Properties of materials such as, silicon and GaAS, lithographic process.

INME 6015 Dislocation Theory
Theory of dislocations in isotropic and anisotropic continua; dislocation reactions; the relation of theory to observed dislocation configurations.

INME 6019 Mechanical Metallurgy
Dislocation theory applied to the deformation of metal; including the mechanisms of glide, fatigue, creep and fracture.

INME 6016 Welding Metallurgy
Metallurgy of metals joining processes. Selection of processes and design of products manufactured by joining processes.

INME 6030 Mechanics of Composite Materials
Anisotropic elastic materials; stress analysis for isotropic materials. Strohs formalism for anisotropic materials, singularities at free edges, stress analysis in composites, wave propagation in composites.

INME 6009 Advanced Manufacturing Processes
Developments in the removal and deforming processes of materials. Applications of these processes to hard, brittle, conducting and non-conducting materials.

INME 6019 Fracture Mechanics
Application of fracture mechanics to structural integrity of engineering materials; prevention of fracture, relationship between materials toughness an, design stress and flaw size, microstructural and environmental effects; transition temperature; fatigue and failure analysis.

INME 6037 Finite Element Analysis I

INCI 6023 Analysis of Structures of Composite Materials
Study of composite materials related to civil engineering applications.

INCI 6064 Advanced Concrete Technology
Microstructure, physical and mechanical properties of concrete; fiber cementitious composites; fiber-reinforced shotcrete; fiber-reinforced plastics.

INCI 6057 Theory of Elasticity
Bending of prismatic bars subjected to axial and lateral loads; bucking of compression members on the elastic and inelastic ranges.

INCI 6018 Finite Element Analysis II
The finite element method and its application in the analysis of structures with elastic and non-linear behavior; solution of unitary stress and strain problems in flexion of plates, thin and thick shells, axisymmetric shells, and solids.

5.6 TYPICAL STUDENT PROGRAM
The table below shows a typical student academic load with thesis, leading to the Master Degree
in Materials Science and Engineering (Plan I):

<table>
<thead>
<tr>
<th>First Semester</th>
<th>9 crd</th>
</tr>
</thead>
<tbody>
<tr>
<td>MASE 6AMA Introduction to Advanced Materials</td>
<td>3 crd</td>
</tr>
<tr>
<td>MASE 6AOF Structure and Properties of Materials</td>
<td>3 crd</td>
</tr>
<tr>
<td>Elective Course</td>
<td>3 crd</td>
</tr>
<tr>
<td><strong>Second Semester</strong></td>
<td>9 crd</td>
</tr>
<tr>
<td>Elective Course</td>
<td>3 crd</td>
</tr>
<tr>
<td>Elective Course</td>
<td>3 crd</td>
</tr>
<tr>
<td>Elective Course</td>
<td>3 crd</td>
</tr>
<tr>
<td><strong>Third Semester</strong></td>
<td>10 crd</td>
</tr>
<tr>
<td>Elective Course</td>
<td>3 crd</td>
</tr>
<tr>
<td>Elective Course</td>
<td>3 crd</td>
</tr>
<tr>
<td>Elective Course</td>
<td>3 crd</td>
</tr>
<tr>
<td>MASE 6SEM Graduate Seminar</td>
<td>1 crd</td>
</tr>
<tr>
<td><strong>Fourth Semester</strong></td>
<td>6 crd</td>
</tr>
<tr>
<td>MASE 6MTR Master’s Thesis Research</td>
<td>6 crd</td>
</tr>
</tbody>
</table>

For students opting for the Plan II with Project Requirement and Plan III without thesis, the academic load in the fourth semester will change to a project (3 credits) plus a graduate level elective (3 credits) and two graduate level elective courses (6 credits) respectively.

5.7 **EDUCATIONAL METHODOLOGY**

The educational methodology for the proposed program will include conventional lectures with class projects, laboratory demonstrations, presentations. Emphasis will also be placed on multimedia interactive learning. In addition, weekly seminars and semester conferences will be held to allow students and faculty of UPRM and outside to present their research work. Students with non-thesis option will be required to take a semester long project while the thesis would take roughly a year to finish. Students will be simultaneously enrolled in their project/thesis and the courses they plan to take. Thesis/project will require literature search and while project option will require a design type of a problem, the thesis will require original research.

It will be program policy to allow senior students to enroll in graduate courses if they meet the necessary pre-requisites. Practicing engineers, who do not wish to pursue a degree but only wish to take some courses to improve certain aspect of their technical weakness, would be allowed to take courses of their choice.

Intensive collaboration with other department Faculty will be sought for in order to supervise students. The interaction among Faculty members from different departments through the supervision of students will generate a mutual benefit between those Faculty members and the ones in GED involved in the program. As other department professors are involved, they will be able to teach MSE graduate courses and can provide access to laboratory resources available only in their respective departments.

6. **ADMISSION AND REGISTRATION**

6.1 **ADMISSION REQUIREMENTS**

The admission requirements to the MSE program will be those established by the regulations of the graduate college at the University of Puerto Rico - Mayagüez (Section G: Certification 97-21 of the Academic Senate).
In addition to the requirements for admission of the graduate school, the applicant must comply with the following:

- Hold a bachelor’s degree in Engineering or Science. Applicants with Bachelor Degrees in Science can only apply to Plan I (With Thesis Requirements) to be granted a Master of Science in MSE. The granting of the Master of Science in MSE to bachelor science students should not be interpreted as conducive to a Professional Engineering (P.E.) License.

- On a scale of 4.0, students must have a minimum of 3.2 GPA during the last two years of B.S. and a minimum overall GPA of 3.0 for unconditional admission to the program.

Students not meeting the program GPA requirements may be admitted as student in Conditional Standing. A student in Conditional Standing is one who at the time of admission satisfies all requirements except for some deficiencies in undergraduate courses. Full standing status can be granted if the student approves deficiencies within the first two years of study. The maximum number of deficiencies is four courses which must be approved with a grade of C or better while maintaining a grade point average of 3.0 or better in the deficiencies.

Prospective students would be required to prove their English comprehension; they will also be advised to have working knowledge of Spanish as some courses may be taught in Spanish. Foreign students will be required to show proof of financial support.

6.2 **Estimated Registration for the Starting Years**

Student recruitment will be aggressive and it will not be limited to Puerto Rican students. Latin and North America and Asia will be targeted to get the best students. Based on an anticipated aggressive recruitment, 6 to 8 students are expected to enter the graduate program per year in MSE for the first five years. During the following years the student population is expected to increase. With more solicitation of funds by individual professors, more students from Puerto Rico and abroad will be attracted as graduate student population is a function of availability of funds. During starting years, departmental teaching assistantship will be relied upon to attract graduate students. For instance, currently 11 graduate students from other engineering programs are being supported as graduate assistants to teach or assist in a number of GED courses.

6.3 **Admission Application Forms**

Admission application forms can be solicited through the graduate college or the MSE Program. Application fees and all other pertaining documents will be as required by the UPRM Office of Graduate Studies. Admission forms and required documents will also be posted on the Internet.

7. **Graduation Requirements**

In accordance with the graduate college of the University of Puerto Rico - Mayagüez regulations (Certification 97-21 of the academic senate), the requirements of the program are the following:

1. Obtain a GPA of 3.0 on their approved course program
2. Complete the UPRM-Mayagüez residency requirement

7.1 **Required Credits**

In accordance with the regulations established by the graduate school at UPRM - Mayagüez (appendix D: certification 97-21 of the academic senate), the required credits for the three Graduate Study Plans are detailed in section 1.5 Program Options. The course credits required
will depend on the option selected by the student and they can be summarized as follows:

**Plan I. With Thesis Requirement (Conducive to a Master of Science)**

Approve a minimum of 28 credits as follows:
- a. A maximum of six credits in advanced undergraduate courses.
- b. A minimum of 21 credits in courses at the graduate level.
- c. A minimum of six credits in courses related to, but outside the area of specialization.

(*) Carry out a research program and prepare a thesis (6 credits)

**Plan II. With Project Requirement (Conducive to a Master of Engineering)**

A student shall complete all requirements specified in Plan I except that a minimum of 31 credits must be approved and the work completed will lead to project report of 3 credits instead of a thesis.

**Plan III. Without Thesis or Project Requirement (Conducive to a Master of Engineering)**

Approve a minimum of 34 credits as follows:
- a. A maximum of six credits in advanced undergraduate courses.
- b. A minimum of 24 credits at the graduate level.
- c. A minimum of 21 credits in the major field of study.
- d. A minimum of six credits in courses related to, but outside the area of specialization.

### 7.2 Grade Point Average

The minimum grade point average to graduate has been established by the graduate school of UPRM (Certification 97-21). In addition to a grade point average of 3.0, a student is not permitted to graduate if more than two grades of C or lower are obtained.

### 7.3 Transfers

Student transfer will be handled according to the regulations set forth by the graduate school of UPRM (Certification 97-21).

### 7.4 Duration of Study

Maximum time allowed to obtain the Master Degree has been established by the graduate school of UPRM (Certification 97-21).

### 7.5 Residence Time

The minimum residence time for graduation has been established by the graduate school of UPRM (Certification 97-21). Studying two academic semesters and approving 60 percent of the credits at the Mayagüez campus satisfies residence requirements for the Master’s degree.

### 8. Program Administration

The coordination and supervision of the graduate studies at UPRM is assigned to the Office for Graduate Studies of the Dean of Academic Affairs. The responsibility of the GED is to administer, offer and develop the courses and research activity among students and professors. All teaching and research administration will be the responsibility of GED. Student supervision is conducted at various levels by the faculty, the department and the Office of Graduate Studies (see Figure 1).
GED will administer and house the Master Degrees in MSE. Six faculty members (with 50% of academic load devoted to research; or 3 FTE) will be necessary for the proper running of the graduate program. GED has already available four faculty member for this program. Because elective courses are taught in several departments, a large pool of faculty is readily available.

![Organization Chart](image)

Figure 1. Organization Chart


9.1 New Faculty

Based on a study of the academic load, release time for research and faculty available to offer Masters Degrees Science in MSE, it will be necessary to hire three more new faculty members.

9.2 Faculty Development

Personal development of the professors will require a commitment on the part of the administration to provide faculty an environment where they can explore their full potential. This would include, among other factors: (a) release time for new and research faculty and help from the department in supporting their research; (b) summer faculty internships at reputable institutions; (c) faculty sabbaticals; (d) faculty exchanges with other universities; (e) participation in international conferences; (e) participation in continuing education modules through live video conferences.

9.3 Available Professors

Appendix C provides the available professors’ resumes while in Appendix D there is a list of professors with interest in materials science. All of these professors have indicated their interest in participating in this program. The professors of other departments will be considered for Joint Appointments with GED. Appendix D also provides the list of courses offered paired with the potential professors. The new course application forms are given in Appendix E.

9.4 Graduate Program Coordinator

The Graduate Program will have a Coordinator, whose requirements, functions and
responsibilities are detailed in Section C of the Certification 97-21 of the Academic Senate.

The Coordinator will get teaching release time and a compensation for the administration of this program. The compensation for the Program Coordinator is similar to an Associate Director bonus. This person will also be responsible of overseeing the affairs of faculty, graduate students, student admissions and recruitment, program web-portal and all matters concerned with the outreach of the program.

9.5 NEW STAFF REQUIREMENT

At present, GED has four full time secretaries. An Administrative Assistant will be hired to assist the Program Coordinator. Some of the duties can be described as follows:
- Collaborate with the Program Coordinator, Graduate Committee and Faculty on the recruitment of prospective students and their financial aid.
- Collaborate with the program Coordinator, Graduate Committee and Faculty on the administration of the courses and the smooth running of the program.

In addition, two trained technicians will be recruited to maintain the laboratories and operate the equipment.

9.6 CURRENTLY AVAILABLE EQUIPMENT

GED houses two computer laboratories for the teaching of Engineering Graphics and a well-equipped fluid mechanics laboratory. There is also a materials testing facility equipped with a polishing station, a microhardness testing unit, carbon coating unit, acoustic emission unit and a retrofitted uniaxial mechanical testing machine with state-of-the-art electronic controls. GED also owns a Scanning electron microscope which has been recently donated by Boeing Co, instrumented impact machine, a scanning probe microscope, stereo microscopes, light reflected microscope, a coreless induction-melting unit (currently housed in the Mechanical Engineering Building).

Several proposals are being written to request funds to establish a central facility for engineering research. The success of some of these proposals partially depends on the establishment of the present degree-granting program. Recently, representatives from Boeing Co. committed to provide additional equipment including optical microscopes, sample preparation units, and a differential thermal analysis system.

Additional equipment exists in other departments such as Mechanical Engineering (furnaces, optical microscopes, corrosion test units, etc.), Civil Engineering (mechanical testing units), Geology (x-ray diffractometer), among others. Access to the Materials Characterization Center (MCC), located on the UPR Rio Piedras campus, has been discussed with its Director Dr. Edgar Resto (see Appendix F). MCC owns state-of-the-art equipment (nuclear magnetic resonance unit, mass spectrometer, a SEM, and two x-ray diffractometers. The interaction between the MSE program and MCC will be exceptionally beneficial as researchers and their graduate students will have access to MCC at preferential academic rates, according to Dr. Resto.

9.7 NEW LABORATORY

GED has minimal existing facilities related to MSE. However, the colleges of engineering and sciences house many equipments related to MSE. These are “dedicated” in nature as they were setup by individual professors to pursue their specific lines of research. There is no fundamental materials science instruction laboratory on campus and its implementation will be indispensable for the successful development of the graduate program. Within the program, the laboratory has
an academic and a research purpose. It will serve as an indispensable support to the theoretical courses and it will be a catalyst for experimental research and location of research funds.

Although laboratory space is limited on UPRM campus, GED is making provision to adapt a regular classroom to an undergraduate teaching laboratory (1000sq-ft) and another one to a graduate research/teaching laboratory (2200sq-ft). Nevertheless, the proper running and growth of a MSE program with a large research experimental component would require at least a total area of 3,600sq-ft. Therefore, we expect that the administration will provide 1,400sq-ft of additional laboratory space.

Recently the US Department of Education has awarded a grant of $300,000 for a three-year period with $180,000 “in kind” matching funds by UPRM, to a group of GED faculty to create an undergraduate laboratory to support the introductory Materials Engineering courses taught in GED. The grant will be used to acquire equipment, improve teaching infrastructure and faculty development. The overall outcome of the project is tightly connected to the establishment of a graduate program on MSE in GED.

9.8 Funds Requested to Start the Program

A total of $3,297,380 is being requested for the first three years of operation and maintenance of the graduate program (see Table 9.1). The expenses are divided in recurrent ($1,552,624 or 47% of the total amount requested) and non-recurrent ($1,744,756 or 53% of the total amount requested).

Of the non-recurring expenses requested about $1,150,000 or 66% of the total requested have been allocated to purchase laboratory equipment to support research at UPRM. The MSE laboratory remodeling, construction and set-up account for $310,000 or 18% of the non-recurrent expenses. The seed money for the participating teaching faculty (6) and the assistantships for 6 graduate students account for $60,000 (4%) and $224,756 (13%) respectively of the non-recurrent expenses.

Of the recurrent expenses about $633,399 or 41% of the total requested is being allocated to the salaries and fringe benefits of three new hired faculties. Funds are also allocated to hire two laboratory technicians and one secretary. This accounts for $267,649 or 16% of the recurrent expenses. One of the larger expenses has been allocated to library resources $383,751 or 25%.

As these are the minimum amounts required, it is expected that participating faculty will contribute to the program through federal research funding in the following (a) purchase of additional research instrumentation; (b) obtaining funds for graduate assistantships and (c) collaborate with the proposal to establish a doctorate program in MSE.

It is important to mention that the proposed program will pave the way for a doctoral program in Materials Science and Engineering. The expenses of the later will be minimal as library resources, equipment and laboratory space will be available through the current MS program.
Table 9.1 Budget Description

<table>
<thead>
<tr>
<th>Description</th>
<th>First Year</th>
<th>Second Year</th>
<th>Third Year</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recurring Expenses</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Library Resources</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Science Direct</td>
<td>133,928</td>
<td>111,722</td>
<td>120,101</td>
<td>365,751</td>
</tr>
<tr>
<td>- Books and Audio-Visuals</td>
<td>6,000</td>
<td>6,000</td>
<td>6,000</td>
<td>18,000</td>
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<tr>
<td>Personnel</td>
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</tr>
<tr>
<td>Program Coordinator</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Compensation</td>
<td>9,000</td>
<td>9,000</td>
<td>9,000</td>
<td>27,000</td>
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<tr>
<td>- Time Release</td>
<td>38,146</td>
<td>39,557</td>
<td>41,022</td>
<td>118,725</td>
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<tr>
<td>New Faculty (3)</td>
<td>203,589</td>
<td>211,035</td>
<td>218,775</td>
<td>633,399</td>
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<tr>
<td>Technicians (2)</td>
<td>62,992</td>
<td>65,044</td>
<td>67,180</td>
<td>195,216</td>
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<td>Administrative Assistant (1)</td>
<td>23,431</td>
<td>24,135</td>
<td>24,867</td>
<td>72,433</td>
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<tr>
<td>Office supplies</td>
<td>9,700</td>
<td>8,700</td>
<td>6,700</td>
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<td>Equipment Maintenance</td>
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<td>15,000</td>
<td>15,000</td>
<td>50,000</td>
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<tr>
<td>Lab Supplies, such as, chemicals, sample preparation</td>
<td>20,000</td>
<td>14,000</td>
<td>13,000</td>
<td>47,000</td>
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<tr>
<td><strong>Total of Recurring Expenses</strong></td>
<td>526,786</td>
<td>504,193</td>
<td>521,645</td>
<td>1,552,624</td>
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<td><strong>Non-Recurring Expenses</strong></td>
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<tr>
<td>Seed money for Faculty (6 @ $10,000 each)</td>
<td>60,000</td>
<td></td>
<td>60,000</td>
<td></td>
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<tr>
<td>Graduate Assistants (6)</td>
<td>72,000</td>
<td>74,880</td>
<td>77,876</td>
<td>224,756</td>
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<tr>
<td>Construction of Lab Total (1,400 ft² @ $150/ft²)</td>
<td>210,000</td>
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<td>210,000</td>
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<tr>
<td>Lab Set-Up (chairs, desks, computers, printers, etc.)</td>
<td>50,000</td>
<td></td>
<td>50,000</td>
<td></td>
</tr>
<tr>
<td>Conditioning of the Lab (AC, water, etc.)</td>
<td>50,000</td>
<td></td>
<td>50,000</td>
<td></td>
</tr>
<tr>
<td><strong>Sub total</strong></td>
<td>442,000</td>
<td>74,880</td>
<td>77,876</td>
<td>594,756</td>
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<tr>
<td><strong>Lab Equipment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- X-Ray Diffractometer and accessories</td>
<td>180,000</td>
<td></td>
<td>180,000</td>
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</tr>
<tr>
<td>- High Temperature Vacuum Furnace</td>
<td>110,000</td>
<td></td>
<td>110,000</td>
<td></td>
</tr>
<tr>
<td>- Surface Area BET – Chemisorption</td>
<td></td>
<td>80,000</td>
<td>80,000</td>
<td></td>
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<tr>
<td>- High Temperature DTA/TGA (+computer)</td>
<td>90,000</td>
<td></td>
<td>90,000</td>
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<tr>
<td>- Scanning Electron Microscope + attachments</td>
<td>230,000</td>
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<td>230,000</td>
<td></td>
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<tr>
<td>- Scanning Probe Microscope (+ attachments)</td>
<td>160,000</td>
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<td>160,000</td>
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</tr>
<tr>
<td>- Mossbauer Spectrometer</td>
<td></td>
<td>60,000</td>
<td>60,000</td>
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</tr>
<tr>
<td>- Optical Microscope (transmitted &amp; reflected light)</td>
<td>72,000</td>
<td></td>
<td>72,000</td>
<td></td>
</tr>
<tr>
<td>- Microwave Plasma generator and equipment</td>
<td>160,000</td>
<td></td>
<td>160,000</td>
<td></td>
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<tr>
<td>- Other various</td>
<td>8,000</td>
<td></td>
<td>8,000</td>
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<tr>
<td><strong>Sub total</strong></td>
<td>418,000</td>
<td>432,000</td>
<td>300,000</td>
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<tr>
<td><strong>Total of Non-Recurring Lab Equipment Expenses</strong></td>
<td>860,000</td>
<td>506,880</td>
<td>377,876</td>
<td>1,744,756</td>
</tr>
<tr>
<td><strong>TOTAL…($)</strong></td>
<td>1,386,786</td>
<td>1,011,073</td>
<td>899,521</td>
<td>3,297,380</td>
</tr>
</tbody>
</table>

9.9 BUDGET JUSTIFICATION

Recurring Expenses ($1,552,624 in three years):

- Library Resources ($383,751 in three years):
  Due to the lack of an academic program in MSE in Puerto Rico, the present materials related library resources (books, conference proceedings, scientific journals, access to e-journal, etc) are nearly nonexistent. A brief description of the educational resources available at the UPRM library in Materials Science and related fields is given in Appendix G. As an institutional subscription to Science Direct is highly sought by the professors involved in this graduate program and it will be needed to carry out research at the graduate level, we have budgeted for
such a subscription. The itemized expenses for the subscription are shown below:

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<th>Item</th>
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<th>2005</th>
<th>2006</th>
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<tr>
<td>“Institutional” Annual Subscription</td>
<td>$70,502</td>
<td>$75,789</td>
<td>$81,473</td>
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<tr>
<td>“Subject” (Materials Science) Subscription</td>
<td>$33,426</td>
<td>$35,933</td>
<td>$38,628</td>
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<tr>
<td>Backfile Collection</td>
<td>$30,000</td>
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<td>------</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$133,928</td>
<td>$111,722</td>
<td>$120,101</td>
</tr>
</tbody>
</table>

Thus, most of the amount budgeted as Library Resources will go into the annual subscription to Science Direct (please see: http://www.sciencedirect.com/science/journals/materialsscience). This on-line scientific datafile will give us access to more than 60 international journals in Materials Science and Engineering, Physics, Chemistry, Mechanics of Materials, Polymers, etc in topics that ranges from polymers to catalysts to structural materials to nanotechnology. This is a vital resource needed to carry out literature surveys and research. Also, $18,000 has been budgeted in three years for books and audio-visual modules.

All of the money allocated as Library Resources will be transferred to the spending account of our main library. The GED will do its outmost to maintain this expenditure as the intrinsic characteristics of the program (interdisciplinary with a strong experimental component) makes the library resource a strong and indispensable investment. Please note that most of the money allocated is for “institutional subscription”, that is, a wide variety of journals from medicine to electrical engineering will be available at the library for the whole campus. This is required because the “subject subscription” i.e. to materials science and engineering is only possible once the “institutional subscription” is in place.

- **Personnel**
  - **Program Coordinator ($145,725 in three years)**: As detailed in Section 9.4, the Coordinator of the Program will be a professor of UPRM. He/she will get time released and a compensation for the administration of this program. This person will be responsible of overseeing the affairs of faculty, graduate students, student admissions, program web-portal and all matters concern with the diffusion of the program and students recruitment.
  - **New Faculty (3 New Faculty, $633,399 in three years)**: Three new professors will be hired in the first three years of the running of the program. These professors should receive the financial facilities to have one graduate student per year during the first three years of the graduate program and in addition the amount of $10,000 as seed money. The calculations include base salary, fringe benefits and an annual salary increase of 4% starting at an Assistant Professor level.
  - **Technician (Two technicians $195,216 in three years)**: Two technicians will be hired during the first three years of the program. They will be responsible of the maintenance, supervision and administration of the research equipment in the laboratory. They will also have the responsibility of setting up demonstrations for visiting scholars and for the general public. Their budget calculation, starting at $21,000 annually, includes base salary, fringe benefits and an annual increase of 4%.
  - **Administrative Assistant (One; $72,433 in three years)**: The Administrative Assistant functions have been detailed in Section 9.5. The budget calculations, starting at $14,400 annually, include base salary, fringe benefits and an annual increase of 4%.
- **Office Supplies ($25,100 in three years)**
  Supplies needed for the proper administrative running of the program (paper, envelops, photocopies, printing expenses, phone calls, letters, etc.).

- **Equipment Maintenance ($50,000 in three years)**
  The equipment to be purchase requires some maintenance to be carried out annually by the manufacture. This is needed to ensure the proper running of these costly equipments. Some of the maintenance costs will be supported by the professors running projects that make use of the instrumentation. However, an average amount of $16,500 is needed annually.

- **Laboratory Supplies ($47,000 in three years)**
  Some laboratory supplies are needed to carry out the course experiments and demonstrations. Such as gases (nitrogen, argon, helium), powders (nickel, aluminum, etc), other materials to carry out demonstrations and laboratory experiences.

**Non-Recurring Expenses ($1,744,756 in three years):**

- **Seed Money for Faculty (6@$10,000 = $60,000 once only - Non-Recurring):** The strong research characteristics of the program points out towards the necessity of seed money for up to six professors (four already present at GED and two new professors to be hired during the first two years of the running program). These professors should be committed to the long term development of this program. The seed money is an investment that will help the faculty involved in setting up research programs for future funding by NSF, DOD, etc. It is expected that on time (less than three years) the university will have an appropriate return to its investment by these or other research funding agencies.

- **Graduate Assistants (6 graduates assistantships $224,756 in three years):** Each of the professors that are committed to the long term development of this program (six professors in total - four already present at GED) will receive one graduate assistantship per year during the first three years of the program. This will help the faculty involved in setting up research programs for future funding by NSF, DOD, DOE, Department of Education, etc. The budget calculations were made with a starting salary of $12,000 for each graduate student and a salary increase of 4% annually.

- **Laboratory Facilities ($210,000+$50,000+$50,000):** Laboratory facilities are needed to educate the student in the use of diverse experimental techniques (theory and methods) in a materials science context. Nowadays, it is no possible to visualize a MSE program without a strong experimental component. The laboratory is also intended to provide the facilities for post-graduate research, projects on materials and venues of academic communication between professors. The laboratory will provide a needed space where donated equipment can be located. In this context, equipment donations by industries such as Boeing, are taking place without a respective space allocation. It is expected that donations of equipment related to MSE by different industries will continue on the increase. It has been conservatively estimated that a total of 1,400ft$^2$ in laboratory space will be needed to fulfill the academic and research objectives of the materials science program. If any experiences in US mainland are taken into consideration, more floor space will soon be required to place the equipment acquired by research grants and industrial donations.

- **Equipment (1,150,000US$)**
  The equipment detailed in this section such as:
(a) **X-ray diffractometry** ($\theta - \theta$ + thin film collimator, monochromators, Cu and Co tubes + Gobel mirror + Eulerian Craddle, etc). This basic and important equipment in materials science allows us to identify materials through the structure identification, that is, how the atoms are ordered in space. Other attachments allow us to measure crystallite size, residual stresses, thin film thickness, percentage crystallinity, etc.

(b) **Scanning Electron Microscope** (+EDS + BSD + SED + Cathodo-luminescence). The SEM allows us to observe the surface of the sample through the interaction of the sample matter with the electrons. Surface morphology, particle size, fractography are a few techniques that make extensive use of surface observation. The interaction of electron with the sample surface also produces x-rays that can be used for chemical identification. Other available techniques are diffraction patterns and cathode-luminescence. This is one of the most widely use instrument in research.

(c) **Scanning Probe Microscopes**. The advances on atomic manipulation and nanomaterials are based on this technique. It allows us to obtain atomic resolution images of the materials surface, magnetic domains, variations in elastic constant, etc.

(d) **Thermogravimetric Analyzers**, Surface BET – Chemisorption and others

These are widely used materials characterization equipment. In a MSE context, they can be used to perform a series of analytical techniques that help materials scientist to relate microstructure, processes and performance of materials. They are indispensable equipment that will be used as educational tools and to support academic research.

### 9.10 **Student Financial Assistance**

Financial aid in the form of graduate assistantships and tuition scholarships/waivers will be available through the program. Recipients of assistantships may be assigned either teaching and/or other activities depending upon availability of funds, and departmental requirements. Currently 11 graduate students from other engineering programs are being supported as graduate assistants in a number of GED courses. Our own graduate students will progressively fill these assistantships. It is expected that several of the graduate students will be supported by federally funded research projects under the supervision of the faculty.

Annual stipends for graduate assistants are calculated as follows: $900 /month x 12 months (salary) + $75 /credit x 12 credits x 2 semesters (tuition) ≈ $12,000 / year. Priority of financial assistance will be given to the students enrolled in thesis option, through the individual professor’s research grant, teaching opportunity and federal and local fellowships.

### 10. **Expected Outcome**

The Master Degree program will increase the technical manpower needed in the industry. It will provide the students with new avenues of participation in materials engineering. The laboratory facilities and courses in the proposed program will facilitate engineering students to be updated in manufacturing activities taking place in the local and US industries, and more importantly to acquire essential technical skills required by the material science and engineering job market.

This program will provide research-motivated minority students an opportunity to compete for high tech jobs in the U.S. and Puerto Rico. This program will fill the gap that exists between the academic program and real industrial needs. It will contribute to the success of the recent science and technology policy of the government and supply trained personnel in the planned techno-economic corridor in Western Puerto Rico.
11. Evaluation

There will be several methods utilized to monitor the effectiveness and success of the graduate program. Both formative and summative evaluation will be developed and conducted throughout the program. The evaluation plan is based on student success, faculty teaching improvement, and research productivity as detailed in Table 11.1.

Periodically the department will evaluate the program in order to verify whether it meets the objectives set up. An advisory committee constituted by representatives of industry and research funding agencies will be organized to seek advice for the improvement of the program. The evaluation will take into account the number of students and graduates per year, the student satisfaction with the program, the impact of research in MSE and achievements of our graduates in the industry and academia.

Table 11.1 Evaluation Plan

<table>
<thead>
<tr>
<th>Factors</th>
<th>Objective</th>
<th>Assessment Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student success</td>
<td>100% of our graduates must find jobs (related to Materials Science) within one year after graduation</td>
<td>Surveys will be conducted by UPRM Office of Placement. Publication statistics will be conducted every year.</td>
</tr>
<tr>
<td></td>
<td>Increase the number of publications by our graduates.</td>
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<tr>
<td>Faculty teaching and</td>
<td>Promote broad application of new education technologies.</td>
<td>Exit surveys of graduates will be conducted by the departmental office.</td>
</tr>
<tr>
<td>research improvement</td>
<td>Conduct two faculty seminars per year related to educational strategies and proposal writing.</td>
<td>Proposal and publication statistics will be conducted.</td>
</tr>
<tr>
<td></td>
<td>Promote hiring of visiting faculty well known in the Materials Engineering field.</td>
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</tr>
<tr>
<td>Research productivity</td>
<td>Advocate for high quality – high volume of research proposal generated by the Faculty.</td>
<td>Proposal statistics will be conducted.</td>
</tr>
<tr>
<td></td>
<td>Establish a robust research environment by advancing a research mindset among the department faculty.</td>
<td>Publication statistics will be conducted every year.</td>
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<tr>
<td></td>
<td>Encourage each graduate to produce at least one research publication.</td>
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</tr>
<tr>
<td>Quality of the whole</td>
<td>Maintain at least ten graduate students in the program.</td>
<td>Evaluation conducted by CES and industry advisory committee.</td>
</tr>
<tr>
<td>graduate program</td>
<td>Establish research collaboration with a renowned US Materials Science &amp; Engineering graduate program as well as materials related industry.</td>
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<tr>
<td></td>
<td>Build up a laboratory research infrastructure plan and expansion.</td>
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</tbody>
</table>

The knowledge, quality of experience, and motivation obtained by students during and after the MSE program will be correlated. Student evaluation, based on the quality of the experience and accomplishments (laboratory and class instructions) will be performed at the end of each academic period. Faculty members will be encouraged to obtain student feedback during the academic year for the continuous improvement of their instruction. Faculty will also be able to monitor students' performance through laboratory reports, grades and retention statistics. For the students willing to pursue a PhD, an arrangement will be formulated with outside collaborating universities. Publications will be an indication of performance in research that students and advisors as a team might be able to accomplish. For the first five years, information will be rendered to the Dean of Engineering, the Director of the Office of Graduate Studies and the Chancellor about the progress of the program.
APPENDIX A

Graduates’ Technical Skills
<table>
<thead>
<tr>
<th>Core courses</th>
<th>Cr</th>
<th>Real-Life Application</th>
<th>Teamwork</th>
<th>Leadership skills</th>
<th>Decision-making</th>
<th>Communication</th>
<th>Interdisciplinary skills</th>
<th>Interpersonal skills</th>
<th>Literature Search</th>
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<th>Cr</th>
<th>Real-Life Application</th>
<th>Teamwork</th>
<th>Leadership skills</th>
<th>Decision-making</th>
<th>Communication</th>
<th>Interdisciplinary skills</th>
<th>Interpersonal skills</th>
<th>Literature Search</th>
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<th>Real-Life Application</th>
<th>Teamwork</th>
<th>Leadership skills</th>
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APPENDIX B

New Course Syllabi
COURSE SYLLABUS

1. General Information
Course Number: MASE 6AMA
Course Title: Introduction to Advanced Materials
Credit-Hours: 3

2. Course Description
Four credit hours. Three credit-hour lectures-discussions and one credit-hour seminar per week on the introduction to the fundamentals of materials for engineering applications based on the integrated approach. Review of ceramics, composites, electronic, metallic and polymer materials. Atomic scale and nanometer scale microstructures. Long range and short range order atomic arrangements. Crystal structures, noncrystalline and semicrystalline materials. Microstructural development from phase equilibrium. Kinetics and microstructural transformations. How the critical properties such as electrical, magnetic, mechanical, optical & dielectric, thermal effects, relate to different materials. Materials syntheses and design mythologies. Case studies of materials and engineering design principles.

3. Pre/Co-requisites
Graduate student with permission of the director.

4. Textbook, Supplies and Other Resources
- Other resources:

Relevant research articles will be incorporated as part of the general teaching strategy. The UPRM Library provides additional resources that the students are encouraged to comprehensively use.

5. Purpose
The Introduction to Advanced Materials course is designed to act as a refresher course for materials engineering graduate students with varied engineering backgrounds. The course focuses on different aspects of materials, their critical properties, basic processing techniques, modern applications with novel and emerging processing techniques.

6. General Objectives and Student Learning Outcomes
Upon completion of the course, the student should be able to:
- describe fundamental materials structures and the interplay between this and the generation of hybrid materials under the category of composites materials.
- analyze the basis for critical materials properties (such as the roles of structural defects, and methods of their control toward property and performance enhancement).
- integrate design approach in property enhancement based on expected materials need in a given system (engineering products).
- apply the principles of structure-property-processing-performance synergies in the development of advanced materials and their characterizations.

7. Requirements
All students are expected to:
- come to all classes and on time
- do all assignments and related homework
- do well in all tests to receive credit for the course.
8. Department / Campus Policies
Please refer to the Bulletin of Information for Graduate Studies. All the reasonable accommodations according to the Americans with Disability Act (ADA) law will be coordinated with the Dean of Students and in accordance with the particular needs of the student.

9. Campus Resources
General Library and the Engineering Computer Center have materials to supplement the course. Individual instructors will advise the students about the availability of these materials.

10. Course Outline

<table>
<thead>
<tr>
<th>TOPICS</th>
<th>OBJECTIVES AND SKILLS</th>
<th>HOURS</th>
<th>TEACHING/LEARNING STRATEGIES</th>
<th>ASSESSMENT STRATEGY AND TOOLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Introduction of materials categories, the science &amp; engineering of</td>
<td>- Apply the fundamental structure of materials in the quest for novel ones based on</td>
<td>8</td>
<td>Lectures (*)</td>
<td>Exams, Quizzes, Team Assignments (*)</td>
</tr>
<tr>
<td>materials. Structural bases of ceramics, composites, electronic,</td>
<td>the design approach.</td>
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<tr>
<td>metals and polymer materials. Engineering basis for reinforced</td>
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<tr>
<td>materials (e.g. CMC, MMC, PMC)</td>
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<tr>
<td>- Ceramics, metals, and polymer materials, and their composite</td>
<td>- Describe different categories of materials. Identify materials types and develop</td>
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</tr>
<tr>
<td>derivatives. Electronic materials.</td>
<td>criteria for their applications.</td>
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</tr>
<tr>
<td>- Transport phenomena based on electron interactions such as thermal</td>
<td>- Predict the expected properties of a material, based on its interaction with</td>
<td>6</td>
<td></td>
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</tr>
<tr>
<td>effects, optical effects, and electric field effects, and magnetic</td>
<td>electrons at different levels</td>
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<tr>
<td>fields effect.</td>
<td>- Describe how these effects could enhance properties in different materials (e.g.</td>
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<tr>
<td></td>
<td>Semiconductors).</td>
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</tr>
<tr>
<td>- Magnetic phenomena and magnetic properties. Anisotropic behaviors,</td>
<td>- Identify different phenomena at different levels e.g., subatomic and atomic levels,</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>magnetic phase transformation. Permanent magnets, soft and hard</td>
<td>microstructure induced and dependent effects.</td>
<td></td>
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</tr>
<tr>
<td>magnets.</td>
<td>- Describe thermal effects on magnetism.</td>
<td></td>
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</tr>
<tr>
<td>- Mechanical properties and relationship to structure. Effects of</td>
<td>- Describe tensile, fatigue, fracture and creep tests.</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>processing and use advanced techniques property enhancements.</td>
<td>- Compare materials based on these tests. Relate behavior to structure, and</td>
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<td></td>
<td>processing techniques.</td>
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<td></td>
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</tr>
<tr>
<td>- Electrical and dielectrical properties. Engineering materials based</td>
<td>- Define electric and dielectric properties based on structure.</td>
<td>6</td>
<td></td>
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</tr>
<tr>
<td>on these properties.</td>
<td>- Apply advanced processing techniques concepts for property enhancements in terms</td>
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<tr>
<td></td>
<td>of thermal / athermal relationships.</td>
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<tr>
<td></td>
<td>- Describe atomistically this phase transformation and the conditions for its</td>
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</tr>
<tr>
<td></td>
<td>occurrence.</td>
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</tr>
<tr>
<td>- Advanced materials developments</td>
<td>- Analyze high energy processes based upon kinetic / thermodynamic models</td>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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COURSE SYLLABUS

1. General Information
Course Number: MASE 6AOF
Course Title: Structure and Properties of Materials
Credit-Hours: 3

2. Course Description

3. Pre/Co-requisites
Graduate student with permission of the director of the department.

4. Textbook, Supplies and Other Resources
- Other resources:
  - C Kittel 'Introduction to Solid State Physics' Wiley 7th Edition
  - N Ashcroft and D Mermin 'Solid State Physics' Saunders
  - R. M. Hazen, ‘The Breakthrough: The Race for the Superconductor’
  - Rao and Goplkrishnan, "New Directions in Solid State Chemistry" (2nd edition)

The UPRM Library provides additional resources that the students are encouraged to comprehensively use.

5. Purpose
This course provides a basic understanding of what makes solids behave the way they do, how they are studied, and their basic interactions, starting from an atomistic level to the formation of crystals structures. It is uniquely designed around the direct connection between physical and chemical properties of materials, their synthesis and their structural properties.

6. General Objectives and Student Learning Outcomes
After completing the course, the student should be able to:
- explain the fundamental properties of electrons in solids.
- qualitatively describe the bonding scheme for a given material and its general physical properties, as well as possible applications
- have an overview of the commercial applications of the materials discussed.
- be aware of the range of synthetic methods available to synthetic solid state materials.
- relate the physical properties of the material to its processing and microstructure.

7. Requirements
All students are expected to:
- come to all classes and on time
- do all assignments and related homework
- do well in all tests to receive credit for the course
8. Department / Campus Policies
Please refer to the Bulletin of Information for Graduate Studies. All the reasonable accommodations according to the Americans with Disability Act (ADA) law will be coordinated with the Dean of Students and in accordance with the particular needs of the student.

9. Campus Resources
General Library and the Engineering Computer Center have materials to supplement the course. Individual instructors will advise the students about the availability of these materials.

10. Course Outline

<table>
<thead>
<tr>
<th>TOPIC</th>
<th>OBJECTIVES AND SKILLS</th>
<th>LECTURE HOURS</th>
<th>TEACHING/LEARNING STRATEGIES</th>
<th>ASSESSMENT STRATEGY AND TOOLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Introduction to solid state. Cohesion. Binding. Crystal Structure.</td>
<td>- Review physics and chemistry in the context of materials science.</td>
<td>5</td>
<td>Lectures (*)</td>
<td>Exams, Quizzes, Team Assignments (*)</td>
</tr>
<tr>
<td>- Defect structures. Stoichiometric defects and non-stoichiometric defects. Structures related to perovskite by crystal shear. High-Tc copper oxide structures.</td>
<td>- Relate periodicity, structure and properties of some important crystals.</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Defect interactions. p-n junctions, rectifier. Color centers. Lasers. Phosphors</td>
<td>- Provide a perspective on the ranges of properties displayed by defect interactions in solid state materials.</td>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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COURSE SYLLABUS

1. General Information
   Course Number: MASE 6ANE
   Course Title: Thermodynamics and Phase Equilibria
   Credit-Hours: 3

2. Course Description
   Three credit hours. Three lecture-discussions per week. Review of Thermodynamic
   and Interfaces – Thermodynamics. Fusion. Entropies and Gibbs energies of fusion and
   vaporization. Binary systems: Chemical potentials, Gibbs Phase rule, activity, G vs T vs X
   surfaces. Binary phase diagrams. Isomorphous, phase separation and spinoidal decomposition
   in metallic, ceramic and polymeric systems. Metastable phases. Stability in metallic and
   ceramic systems. Ternary Phase Diagrams - space model. Isothermal sections. Pseudo-binary
   systems.

3. Pre/Co-requisites

4. Textbook, Supplies and Other Resources
   • Textbook: R. M. Hazen, ‘The Phase Equilibria, Phase Diagrams and Phase Transformations: Their
   • Other resources:
     o E. S. Machlin, An Introduction to Aspects of Thermodynamics and Kinetics Relevant to Materials
       Science, Giro Press, Croton-on-Hudson, N.Y., 1999
   The UPRM Library provides additional resources that the students are encouraged to comprehensively use.

5. Purpose
   The aim of this course is extend the application of the laws of thermodynamics to phases of
   variable composition and to develop an understanding of the thermodynamic principles
   governing phase equilibrium in metallic, ceramic and polymeric materials. The students will use
   standard databases of thermodynamic quantities for predictive modeling of phase diagrams.

6. General Objectives and Student Learning Outcomes
   After completing the course, the student should be able to:
   • explain how P-T diagrams for single-component systems can be understood in terms of the
     variation of Gibbs free energy of the solid, liquid, and vapor phases as a function of pressure and
     temperature; predict the variation of melting and boiling points as a function of pressure.
   • explain how phase diagrams in metallic alloys, ceramics and polymers originate from the molar
     Gibbs energy-temperature-composition surfaces for the different phases and the way in which
     these surfaces intersect in Gm-T-x space.
   • use the principle of the Common Tangent Construction and explain why melting/solidification in
     binary systems occurs over a range of temperature and composition.
   • utilize standard databases of thermodynamic quantities for predictive modeling of phase diagrams,
     using available software package.
   • understand how the principles developed for binary systems can be extended via the Phase Rule to
     understanding, interpretation and modeling of ternary phase diagrams.

7. Requirements
   All students are expected to:
8. Department / Campus Policies
Please refer to the Bulletin of Information for Graduate Studies. All the reasonable accommodations according to the Americans with Disability Act (ADA) law will be coordinated with the Dean of Students and in accordance with the particular needs of the student.

9. Campus Resources
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10. Course Outline

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<th>TEACHING/LEARNING STRATEGIES</th>
<th>ASSESSMENT STRATEGY AND TOOLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Introduction. First and second law of thermodynamics. The Helmholtz and the Gibbs Free Energy. The third law of thermodynamics</td>
<td>- Relate the importance of thermodynamic principles to materials science.</td>
<td>8</td>
<td>Lectures and Computer Labs (*)</td>
<td></td>
</tr>
<tr>
<td>- The Gibbs-free energy and the equilibrium constant. Heterogeneous reactions. Sources of thermodynamic data. Free energy equations. - Electrochemical systems. Electrochemical cells thermodynamics. Electrolysis.</td>
<td>- Apply the Gibbs phase rule. - Evaluate the temperature dependence of $\Delta G$ and ‘k’ for reactions and phase transitions. - Identify and use sources of thermodynamic data. - Apply equilibrium concepts to electrochemical systems.</td>
<td>6</td>
<td>Exams, Team and Individual Assignments (*)</td>
<td></td>
</tr>
<tr>
<td>- Ternary Phase Diagrams. Ternary space model, Gibbs triangle. Isothermal sections, tie-lines. Ternary invariant reactions in metallic, ceramic and semiconductor systems. Pseudo-binary systems. Examples</td>
<td>- Apply thermodynamic principles to the construction of ternary phase diagrams. - Determine invariant reaction in ternary metallic, ceramic and semiconductor systems.</td>
<td>8</td>
<td></td>
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</tr>
</tbody>
</table>

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COURSE SYLLABUS

1. General Information
Course Number: MASE 6KRP
Course Title: Kinetics and Phase Transformation
Credit-Hours: 3

2. Course Description

3. Pre/Co-requisites
Graduate student with permission of the director.

4. Textbook, Supplies and Other Resources
- Other resources:
Relevant research articles are incorporated as part of the general teaching strategy. The UPRM Library provides additional resources that the students are encouraged to comprehensively use.

5. Purpose
The phase transformations course teaches students how solid state phase transformations occur in the atomic configurations, with thermodynamic driving forces and kinetic rates; how the microstructure of the material can be manipulated and how to predict the possible properties of the material based on microstructural changes.

6. General Objectives and Student Learning Outcomes
After completing the course, the student should be able to:
- fully describe the interrelationships between structural imperfections (point, line and surface) and the atomistic transport processes that control the evolution of material microstructure.
- apply thermodynamics and reaction kinetics to develop quantitative analyses of phase transformations in materials processing.
- apply the principles governing phase transformations in metallic, ceramic and polymeric materials systems in order to select materials and to design processes that yield desired microstructures and properties

7. Requirements
All students are expected to:
- come to all classes and on time
- do all assignments and related homework
- do well in all tests to receive credit for the course.
- have prior knowledge of chemical reactions, thermodynamics, phase diagrams, diffusion.
8. Department / Campus Policies
Please refer to the Bulletin of Information for Graduate Studies. All the reasonable accommodations according to the Americans with Disability Act (ADA) law will be coordinated with the Dean of Students and in accordance with the particular needs of the student.

9. Campus Resources
General Library and the Engineering Computer Center have materials to supplement the course. Individual instructors will advise the students about the availability of these materials.

10. Course Outline

<table>
<thead>
<tr>
<th>TOPICS</th>
<th>OBJECTIVES AND SKILLS</th>
<th>HOURS</th>
<th>TEACHING/ LEARNING STRATEGIES</th>
<th>ASSESSMENT STRATEGY AND TOOLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Thermodynamics and phase diagrams. Binary solutions.</td>
<td>- Apply thermodynamic concepts to solid-solid phase reactions.</td>
<td>4</td>
<td>Lectures (*)</td>
<td>Exams, Quizzes, Team Assignments (*)</td>
</tr>
<tr>
<td>Ternary solutions. Kinetics of phase transformation</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>- Diffusion Principles. Atomic Mechanisms. Trace Diffusion.</td>
<td>- Describe the use of diffusion principles in solid-solid state reactions.</td>
<td>4</td>
<td></td>
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<tr>
<td>High Diffusivity paths.</td>
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</tr>
<tr>
<td>- Solidification reactions - kinetics, segregation profiles and microstructure development.</td>
<td>- Predict solidification microstructure based on liquid and solid diffusion mechanisms.</td>
<td>6</td>
<td></td>
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</tr>
<tr>
<td>Annealing -relaxation, recrystallization and kinetics of grain growth.</td>
<td>- Predict solidification microstructure based on liquid and solid diffusion mechanisms.</td>
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</tr>
<tr>
<td>- Precipitation Age-Hardening. Eutectoid Transformations.</td>
<td>-Classify orientation relationships between new phases and parent phases. -Predict microstructural changes based upon local instabilities. -Select appropriate models to describe these processes.</td>
<td>10</td>
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<tr>
<td>Massive Transformations. Ordering Transformations</td>
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<tr>
<td>Precipitation reactions-kinetics, crystallography,</td>
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<tr>
<td>microstructural morphology and stability</td>
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</tr>
<tr>
<td>- Diffusionless Transformations. Characteristics of</td>
<td>-Define processes in terms of thermal / athermal relationships. -Differentiate among related driving forces. -Describe atomistically this phase transformation and the conditions for its occurrence.</td>
<td>6</td>
<td></td>
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</tr>
<tr>
<td>Diffusionless Transformations. Martensitic reaction.</td>
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<tr>
<td>Crystallography of martensitic reaction</td>
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</tr>
<tr>
<td>- Advanced materials developments</td>
<td>-Analyze high energy processes based upon kinetic / thermodynamic models</td>
<td>5</td>
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</tbody>
</table>

(*) Each instructor has the freedom to decide what additional teaching and learning strategies will be used for each topic beyond regular lectures and how those outcomes are to be evaluated (assessment tools) in addition to regular exams, quizzes and assignments.
1. General Information
Course Number: MASE 6CXD
Course Title: Diffractometry and Complementary Techniques
Credit-Hours: 3

2. Course Description

3. Pre/Co-requisites
Graduate students with permission of the director of the department.

4. Textbook, Supplies and Other Resources
- Other resources:

The UPRM Library provides additional resources that the students are encouraged to comprehensively use.

5. Purpose
This course serves to introduce students to the theory and methods of structural analyses based on crystallographic methods and applications of x-ray and electron diffraction methods in characterizing solids. Complimentary techniques such as, EDS, EXAFS, solid state NMR, Mössbauer, XPS and electron microscopy (with the emphasis on the nature of the information obtained not the technique) would be highlighted in order to help students gain understanding of potential applications.

6. General Objectives and Student Learning Outcomes
After completing the course, the student should be able to:
- analyze simple x-ray diffraction patterns for structure and chemical determination.
- mathematically describe crystal geometry in terms of lattice locations, directions and planes in the seven crystal systems.
- apply concepts regarding the physics of diffraction as to be in a position to make informed decisions concerning best methods for materials characterization based on x-ray diffraction techniques
- demonstrate a basic knowledge of physics of x-ray interactions with matter, and gain knowledge of these with respect to materials analysis and problem solving techniques
- apply basic knowledge of electron interaction and matter for image and chemical analysis determination
- apply basic knowledge of different experimental techniques to solve materials science problems.

7. Requirements
All students are expected to:
- come to all classes and on time
- do all assignments and related homework
- do well in all tests to receive credit for the course
- have basic knowledge of crystal structures and crystal symmetry.
8. Department / Campus Policies
Please refer to the Bulletin of Information for Graduate Studies. All the reasonable accommodations according to the Americans with Disability Act (ADA) law will be coordinated with the Dean of Students and in accordance with the particular needs of the student.

9. Campus Resources
General Library and the Engineering Computer Center have materials to supplement the course. Individual instructors will advise the students about the availability of these materials.

10. Course Outline

<table>
<thead>
<tr>
<th>TOPIC</th>
<th>OBJECTIVES &amp; SKILLS</th>
<th>LECTURE HOURS</th>
<th>LAB HOURS</th>
<th>TEACHING/LEARNING STRATEGIES</th>
<th>ASSESSMENT STRATEGY AND TOOLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Crystallography, symmetry operations. Crystallographic calculations; common crystal structures of engineering materials</td>
<td>Distinguish between crystalline and non-crystalline solids based on symmetry operations applications</td>
<td>5</td>
<td>0</td>
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</tr>
<tr>
<td>- Stereographic projection. Crystal Structure, X-ray Diffraction Theory. Calculation of structure. Reciprocal Lattice.</td>
<td>Identify crystal unit cells. Apply knowledge of Brillouin zones and extinction principles to structural determination.</td>
<td>4</td>
<td>5</td>
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</tr>
<tr>
<td>- X-ray physics, and x-ray spectra. X-ray production (conventional and synchrotron sources), X-ray absorption, X-ray fluorescence, and X-ray safety.</td>
<td>Apply knowledge of energy levels to determine the chemical composition of materials.</td>
<td>5</td>
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</tr>
<tr>
<td>- X-ray analysis techniques. Indexing of powder patterns, lattice parameter determination, phase identification, and determination of texture in materials.</td>
<td>Undertake the structural characterization or determination based on analyses of diffraction patterns, and its application in materials study.</td>
<td>4</td>
<td>10</td>
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</tbody>
</table>

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COURSE SYLLABUS

1. General Information
   Course Number: MASE 6DMM
   Course Title: Computational Materials Science
   Credit-Hours: 3

2. Course Description
   Three credit hours. Two credit-hour lectures/discussions and two credit-hour laboratory per week. Introduction to computational materials science techniques. Development of analysis tools for manufacturing process as well as the application of software systems of either a general or specific nature. Development of analytical models for components subjected to thermal processes or to stresses beyond the elastic limit. Problem analysis using the finite element method. Influence of processing on microstructural development and on final properties of the material.

3. Pre/Co-requisites
   INCI 6018 or INME 6037 or permission of the director.

4. Textbook, Supplies and Other Resources
   - Other resources:
     - Finite Element Code Manuals (ABAQUS, COSMOS, etc.).
   The UPRM Library provides additional resources that the students are encouraged to comprehensively use.

5. Purpose
   The purpose of this course is to provide the student with an understanding of the application of process modeling to materials and product manufacture; the analytical and numerical skills needed to model the response of a material during processing, applied to thermal processes, plastic deformation, and the evolution of microstructure and properties; and necessary knowledge to relate processing to the development of microstructure and final properties of the material.

6. General Objectives and Student Learning Outcomes
   After completing the course, the student should be able to:
   - apply numerical methods in modeling industrial thermal and thermomechanical processes.
   - implement plasticity concepts in forming operations.
   - model heat flows in a variety of materials processes.
   - identify the factors causing failure.

7. Requirements
All students are expected to:
- come to all classes and on time
- do all assignments and related homework
- do well in all tests to receive credit for the course
- have prior basic knowledge of finite element analysis and strong computation skills.

8. Department / Campus Policies

Please refer to the Bulletin of Information for Graduate Studies. All the reasonable accommodations according to the Americans with Disability Act (ADA) law will be coordinated with the Dean of Students and in accordance with the particular needs of the student.

9. Campus Resources

General Library and the Engineering Computer Center have materials to supplement the course. Individual instructors will advise the students about the availability of these materials.

10. Course Outline

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<th>ASSESSMENT STRATEGY AND TOOLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process modeling and its industrial context.</td>
<td>Describe the industrial need for process modeling, and identify the physical behaviors to be described for a given process, such as casting, forming and welding</td>
<td>3</td>
<td>0</td>
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<td>Lectures and Computer Laboratories (*)</td>
</tr>
<tr>
<td>Analytical plastic analysis of forming processes, using equilibrium equations and yield criteria, and upper bound methods.</td>
<td>Analyze the loads in idealized metal deforming operations (forging, wire drawing, rolling, extrusion, machining) using analytical plasticity (equilibrium equations and yield criteria, and upper bound methods).</td>
<td>7</td>
<td>5</td>
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</tr>
<tr>
<td>Analytical heat flow analysis in heat treatment and welding.</td>
<td>Analyze the heat flow and calculate temperature histories in idealized heat treatment, surface hardening of steels, and welding processes.</td>
<td>8</td>
<td>5</td>
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</tr>
<tr>
<td>Introduction to numerical methods (finite element analysis) for thermo-mechanical process modeling.</td>
<td>Identify the important issues (material properties, boundary conditions, choice of mesh) in setting up a finite element model of a process.</td>
<td>7</td>
<td>10</td>
<td></td>
<td>Exams, Team and Individual Assignments (*)</td>
</tr>
<tr>
<td>Modeling of microstructure evolution during thermo-mechanical processing and subsequent properties.</td>
<td>Apply knowledge of thermal and deformation history on the evolution of microstructure in materials and apply simple models of microstructure evolution in for example, phase transformation, grain growth and recrystallization.</td>
<td>3</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Processing as the origin of defects and failures (microstructure, damage, residual stress).</td>
<td>Identify the factors causing failure (microstructures, corrosion and residual stress). Evaluate the significance of processing as the origin of many component failures.</td>
<td>2</td>
<td>5</td>
<td></td>
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COURSE SYLLABUS

1. General Information
Course Number: MASE 6ENN
Course Title: Introduction to Polymer Science & Engineering
Credit-Hours: 3

2. Course Description
Three credit-hour lectures-discussions per week. Basic classification and molecular structures, synthesis, solution properties and molecular weight determination, solid-state properties (amorphous and crystalline states), degradation mechanisms, polymer reactions, network formation, copolymerization and blends/alloys. Mechanical properties of bulk polymers. Viscoelastic materials. Creep, stress relaxation, superposition, dynamic mechanical behavior, electrical behavior, miscellaneous mechanical properties, optical properties, transport properties.

3. Pre/Co-requisites
Graduate student with permission of the director of the department.

4. Textbook, Supplies and Other Resources
- Other resources:

The UPRM Library provides additional resources that the students are encouraged to comprehensively use.

5. Purpose
This course provides a foundation for industrial practice in polymer science and engineering. It teaches students an introduction to the mechanical and electrical properties of polymers and polymer-based composites, focusing on the importance of polymer synthesis and molecular structure.

6. General Objectives and Student Learning Outcomes
After completing the course, the student should be able to:
- apply knowledge of the chemical structure of a monomer, an polymerization mechanism to predict the resulting configuration.
- describe different engineering uses of polymeric materials and the underlying physical chemical properties that generate the necessary performance attributes for those uses.
- adapt general principles from chemical reaction engineering, thermodynamics and transport phenomena to describe the behavior of polymeric materials and the unit operations used to synthesize and process them.
- understand the molecular basis of the mechanical properties of an amorphous and semicrystalline polymer above and below the glass and melting point temperatures.

7. Requirements
All students are expected to:
- come to all classes and on time
- do all assignments and related homework
- do well in all tests to receive credit for the course
8. Department / Campus Policies
Please refer to the Bulletin of Information for Graduate Studies. All the reasonable accommodations according to the Americans with Disability Act (ADA) law will be coordinated with the Dean of Students and in accordance with the particular needs of the student.

9. Campus Resources
General Library and the Engineering Computer Center have materials to supplement the course. Individual instructors will advise the students about the availability of these materials.

10. Course Outline

<table>
<thead>
<tr>
<th>TOPIC</th>
<th>OBJECTIVES AND SKILLS</th>
<th>LECTURE HOURS</th>
<th>TEACHING/LEARNING STRATEGIES</th>
<th>ASSESSMENT STRATEGY AND TOOLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Polymer Classification. Ladder and spiro macromolecules. Homo- and hetero-chain polymers. Configurational isomerism.</td>
<td>- Relate polymer configuration to polymer properties.</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Polymer solutions. Thermodynamics and phase diagrams. Polymer chain conformations.</td>
<td>- Apply thermodynamic concepts to polymer solutions.</td>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| - Polymer Rheology and Processing. Measurement of viscosity, temperature and shear rate. Application to melts, filled systems and suspensions. Injection, extrusion, thermoforming, blow molding, etc. post-manufacturing operations | - Identify the parameters that control polymer processing.  
- Identify the different processes used in the conformations of polymers. | 10            |                             |                              |

(*) Each instructor has the freedom to decide what additional teaching and learning strategies will be used for each topic beyond regular lectures and how those outcomes are to be evaluated (assessment tools) in addition to regular exams, quizzes and assignments.
University of Puerto Rico
Mayagüez Campus
College of Engineering

Syllabus & Instructor Information Sheet

COURSE SYLLABUS

1. General Information

Course Number: MASE 6XXX
Course Title: Fundamentals of Materials Chemistry
Credit-Hours: 3

2. Course Description


3. Pre/Co-requisites

4. Textbook, Supplies and Other Resources

• Other resources:
  o Instructor’s notes

The UPRM Library provides additional resources that the students are encouraged to comprehensively use.

5. Purpose.

To provide the student the ability to analyze and discuss the physical and chemical origins of materials properties. The students will also be able to apply the physical-chemical fundamentals and principles of interfacial interactions in the design and synthesis of functional materials and the corresponding devices. Furthermore, solid state reaction occurring at high temperatures will be detailed.

6. General Objectives and Student Learning Outcomes.

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

• Identify, interpret and discuss the chemical and physico-chemical factors involved with the formation, structure and properties of materials at high and low temperature.
• describe and analyze methods of preparation of functional materials through chemical or mechanochemical-based approaches, their relationship with materials properties and their optimization.
• Apply chemical and physico-chemical principles and concepts in the development of new materials at low and high temperature.
• discuss current academic or technical literature on materials processing and their applications.

7. Requirements

All students are expected to:
- come to all classes and on time
- complete all assignments and related homework
- show a satisfactory performance in all duties to receive credit for the course.

8. Department / Campus Policies

Please refer to the Bulletin of Information for Graduate Studies. All the reasonable accommodations according to the Americans with Disability Act (ADA) law will be coordinated with the Dean of Students and in accordance with the particular needs of the student.

9. Campus Resources

General Library and the Engineering Computer Center have materials to supplement the course. Individual instructors will advise the students about the availability of these materials.

10. Course Outline

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<tr>
<th>TOPIC</th>
<th>OBJECTIVES &amp; SKILLS</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Physical and chemical principles of materials synthesis at low and high temperatures.</td>
<td>- analyze the physical and chemical principles in materials synthesis at low and high temperatures.</td>
<td>6</td>
</tr>
<tr>
<td>Structure and bonding. Electronic structures of atoms and molecules. Solids, liquids and gases.</td>
<td>- review the concepts of interfacial equilibria.</td>
<td>3</td>
</tr>
<tr>
<td>Equilibria and rate processes: Dissolution, precipitation and crystal growth. Particulate sols, gels, colloids and nanoparticles. Electrochemical systems.</td>
<td>- distinguish the characteristics and features of particulate materials. - apply electrochemical principles in materials synthesis</td>
<td>7</td>
</tr>
<tr>
<td>Mechnaocchemistry and mechanoactvation of materials.</td>
<td>- recognize the mechanisms of mechano-chemical processing routes.</td>
<td>5</td>
</tr>
<tr>
<td>Electrostatic and steric stabilization. Self assembly. Electrocapillary and electrokinetic measurements. Other surface characterization techniques.</td>
<td>- determine conditions to control particle growth and stabilize particles in suspension and thin films.</td>
<td>4</td>
</tr>
<tr>
<td>Film formation. Deposition conditions. Thin films. Chemical bath deposition (CBD), chemical vapor deposition (CVD), etc.</td>
<td>- determine the critical physical and chemical conditions leading to film formation.</td>
<td>5</td>
</tr>
<tr>
<td>High Temperature synthesis. Solid state reactions. Kinetics vs thermodynamic control of products. Synthesis of metastable materials. Topotactic reactions. Synthesis processes at high temperature.</td>
<td>- identify the conditions for processing and parameters that control the synthesis of materials at high temperature.</td>
<td>9</td>
</tr>
</tbody>
</table>

(*) Each instructor has the freedom to decide what additional teaching and learning strategies will be used for each topic beyond regular lectures and how those outcomes are to be evaluated (assessment tools) in addition to regular exams, quizzes and assignments.
COURSE SYLLABUS

1. General Information

Course Number: MASE 6ZZZ  
Course Title: Nanostructured Materials  
Credit-Hours: 3

2. Course Description


3. Pre/Co-requisites

Undergraduate students: INGE 4001 or INGE 3045 or INME 4007 or equivalent.  
Graduate students: with authorization of the director.

4. Textbook, Supplies and Other Resources

- Other resources:  
  - N. Kallay (Editor). *Interfacial Dynamics*. Marcel Dekker Inc. 1999  

The UPRM Library provides additional resources that the students are encouraged to comprehensively use.

5. Purpose.

The aim of this course is to provide students comprehensive education in the fundamentals and technological issues in fine particles and nanostructured materials processing. The course will cover the mechanisms that govern the formation and stability of particles (micro-, submicro- and nano-size scales) and discuss how these factors are related to the functional properties of modern and newly developed materials.

6. General Objectives and Student Learning Outcomes.

The course will offer comprehensive education in materials processing issues related to the submicro- and nanoscale level. The relationships synthesis-particle size-structure-properties-performance will be presented. After completing the course, the student should be able to:

- Identify the scientific and technological achievements and research challenges in the processing of ultrafine particles and nanomaterials.
- Understand the mechanisms involved with particle formation at different size levels.
- Analyze the different routes for size-controlled particles synthesis.
- Characterize the relationship between materials properties and particle size.
- Establish the environmental considerations involved in fine particles and nanomaterials processing.
- Develop research topics and proposals.

7. Requirements

All students are expected to:
- come to all classes and on time
- do all assignments and related homework
- do well in all tests to receive credit for the course

8. Department / Campus Policies
Please refer to the Bulletin of Information for Undergraduate and Graduate Studies. All the reasonable accommodations according to the Americans with Disability Act (ADA) law will be coordinated with the Dean of Students and in accordance with the particular needs of the student.

9. Campus Resources
General Library and the Engineering Computer Center have materials to supplement the course. Individual instructors will advise the students about the availability of these materials.

10. Course Outline

<table>
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<tr>
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<th>ASSESSMENT STRATEGY AND TOOLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction.</td>
<td>- Describe nano-world and nanotechnology perspectives.</td>
<td>2</td>
<td>Lectures and Computer Labs (*)</td>
<td>Exams, Team and Individual Assignments (*)</td>
</tr>
<tr>
<td>Fundamentals of particles formation I: Nucleation and particle growth</td>
<td>- Identify mechanisms involved in particle formation.</td>
<td>3</td>
<td></td>
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</tr>
<tr>
<td>Fundamentals of particles formation II: Recrystallization. Solid-solution formation.</td>
<td>- Analyze conditions conducive to the particle stability and formation of solid solutions.</td>
<td>5</td>
<td></td>
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</tr>
<tr>
<td>Ultrafine particles and monodisperse systems</td>
<td>- Discuss the options to produce and control monodisperse systems.</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Analyze the conditions for the formation and stabilization of clusters and nanoparticles.</td>
<td>- Identify particle synthesis routes, i.e. chemical alternative (colloids, micelles, polymers, glasses, zeolites hosts), mechanical alternative (mechanical attrition) and other physical routes.</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nanomaterials</td>
<td>- Discuss the options to control other particle characteristics, such as: morphology, structure, composition, layered structures, and surface modification.</td>
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</tr>
<tr>
<td>Characterization techniques for ultrafine particles</td>
<td>- Evaluate different characterization techniques to determine structures and crystal lattice, specific surface area, composition, morphology, and physical properties.</td>
<td>8</td>
<td></td>
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</tr>
<tr>
<td>Fundamental and industrial applications.</td>
<td>- Analyze measurement of zeta potential.</td>
<td>10</td>
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<tr>
<td>- Determine Hamaker constants.</td>
<td>- Analyze concepts of particle adhesion, and light scattering.</td>
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<tr>
<td>- Apply these concepts to photographic materials, ceramics, magnetic recording materials, catalysts, and pigments.</td>
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University of Puerto Rico  
Mayagüez Campus  
College of Engineering  

Syllabus & Instructor Information Sheet  

COURSE SYLLABUS  

1. General Information  
Course Number:  MASE 6MPE  
Course Title:  Materials Microprocessing and Engineering  
Credit-Hours:  3  

2. Course Description  
Three credit hours. Three lecture-discussions per week. Materials synthesis approaches, and process engineering, microstructure development, semiconductor growth, vapor phase and plasma processing.  

3. Pre/Co-requisites  
Graduate student with permission of the director of the department.  

4. Textbook, Supplies and Other Resources  
- Other resources:  
The UPRM Library provides additional resources that the students are encouraged to comprehensively use.  

5. Purpose  
This course will provide the students with a formal and systematic integration of materials science theory and materials engineering practice as applied to the processing of materials at the microscopic level.  

6. General Objectives and Student Learning Outcomes  
After completing the course, the student should be able to:  
- put into practice the physical and chemical principles of modern non-traditional materials manufacturing processes  
- correlate and characterize the microscopic (atomic-level) mechanisms of these processes and the resultant structure, properties and performance of processed materials  
- determine the advantages and disadvantages of each process in a modern manufacturing environment  
- design a process in order to fabricate specific materials and device structures.  

7. Requirements  
All students are expected to:  
- come to all classes and on time  
- do all assignments and related homework  
- do well in all tests to receive credit for the course  
- have prior knowledge of chemical reactions, thermodynamics, phase diagrams, diffusion.  

8. Department / Campus Policies  
Please refer to the Bulletin of Information for Undergraduate and Graduate Studies. All the reasonable accommodations according to the Americans with Disability Act (ADA) law will be coordinated with the Dean of Students and in accordance with the particular needs of the student.  

9. Campus Resources  
General Library and the Engineering Computer Center have materials to supplement the course. Individual
instructors will advise the students about the availability of these materials.

10. Course Outline

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</tr>
</thead>
<tbody>
<tr>
<td>- Single crystal substrates.</td>
<td>- Describe the making of single crystals.</td>
<td>3</td>
<td>Lectures (*)</td>
<td>Exams, Quizzes, Team Assignments (*)</td>
</tr>
<tr>
<td></td>
<td>- Differentiate metallurgical grades (MGS) from electronic grade Si (EGS).</td>
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<tr>
<td>- Review of diffusion.</td>
<td>- Identify means of accomplishing transport phenomena.</td>
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<tr>
<td>- Thermal oxidation</td>
<td>- Describe the guiding laws.</td>
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<tr>
<td>- Rapid thermal processing</td>
<td>- Explain the scientific bases for selection and application of phenomena in the fabrication process.</td>
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</tr>
<tr>
<td>- Optical and non-optical lithography (including photoresists)</td>
<td>- Describe pattern design and selection criteria.</td>
<td>12</td>
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<tr>
<td></td>
<td>- Identify limitations on the bases of IC fabrication.</td>
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<td></td>
<td>- Distinguish purely physical and purely chemical etching processes.</td>
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<tr>
<td>- Vacuum science and plasmas etching processes</td>
<td>- Explain the thermodynamics of vapor phase growth.</td>
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<td></td>
<td>- Describe techniques employed in the deposition of materials.</td>
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<td></td>
<td>- Explain evaporation processes as applied to different materials systems.</td>
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<td></td>
<td>- Identify deposition processes based on substrate temperatures.</td>
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<tr>
<td>- Physical vapor deposition</td>
<td>- Describe the making of single crystals.</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Chemical vapor deposition</td>
<td>- Differentiate metallurgical grades (MGS) from electronic grade Si (EGS).</td>
<td></td>
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</tr>
<tr>
<td>- Ion implantation</td>
<td>- Analyze surface phenomenon of film deposition.</td>
<td>3</td>
<td></td>
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<tr>
<td></td>
<td>- Characterize defects inherent to epitaxial growth.</td>
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<tr>
<td></td>
<td>- Describe some growth processes.</td>
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</tr>
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</table>

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University of Puerto Rico
Mayaguez Campus
College of Engineering

Syllabus & Instructor Information Sheet

COURSE SYLLABUS

1. General Information
   Course Number: MASE 6DPM
   Course Title: Diffusion Phenomena in Materials
   Credit-Hours: 3

2. Course Description

3. Pre/Co-requisites
   Graduate student with the permission of the director.

4. Textbook, Supplies and Other Resources
   - Other resources:

The UPRM Library provides additional resources that the students are encouraged to comprehensively use.

5. Purpose
   This course will provide the students with a detailed knowledge of phenomenology and laws of diffusion in crystalline solids. Linear diffusion equations will be discussed and solved applying different boundary conditions. Integral forms, source methods, use of Green’s functions are reviewed. Multicomponent diffusion processes and inverse methods are also discussed.

6. General Objectives and Student Learning Outcomes
   After completing the course, the student should be able to:
   - analyze diffusion and diffusivity of different diffusing species in different media.
   - use phase equilibria in the prediction of diffusion behavior
   - correlate crystal defects and diffusion
   - compute diffusivities based on experimental data
   - develop computational and mathematical models to predict diffusion behavior
   - apply diffusion knowledge to the real-life multicomponent systems.

7. Requirements
   All students are expected to:
   - come to all classes and on time
   - do all assignments and related homework
   - do well in all tests to receive credit for the course
   - have prior knowledge of crystal structures, phase transformations, heat transfer, differential equations and basic computational modeling.

8. Department / Campus Policies
   Please refer to the Bulletin of Information for Graduate Studies. All the reasonable accommodations according to the Americans with Disability Act (ADA) law will be coordinated with the Dean of Students and in accordance with the particular needs of the student.
9. Campus Resources
General Library and the Engineering Computer Center have materials to supplement the course. Individual instructors will advise the students about the availability of these materials.

10. Course Outline

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</tr>
</thead>
<tbody>
<tr>
<td>- Laws of diffusion</td>
<td>- Solve diffusion equations with different boundary conditions.</td>
<td>5</td>
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</tr>
<tr>
<td>- Diffusion in generalized media.</td>
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<tr>
<td>- Solutions to linear diffusion</td>
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<tr>
<td>- Green’s functions</td>
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<tr>
<td>- Diffusion couple</td>
<td>- Analyze diffusion couple concentration profiles</td>
<td>10</td>
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</tr>
<tr>
<td>- Diffusion in three dimensions</td>
<td>- Apply diffusion concepts in a realistic three-dimensional situation.</td>
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<tr>
<td>- Generalized sources</td>
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<tr>
<td>- Diffusion-reaction</td>
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<tr>
<td>- Spherical bodies</td>
<td>- Implement analysis in spherical coordinates to simulate particle diffusion.</td>
<td>5</td>
<td></td>
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</tr>
<tr>
<td>- Steady-state diffusion</td>
<td>- Use diffusion couples to predict behavior of diffusing species.</td>
<td></td>
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<tr>
<td>- Inverse methods</td>
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<tr>
<td>- Random walks</td>
<td>- Apply randomness concepts and vacancy concentration into the analysis of diffusion.</td>
<td>10</td>
<td></td>
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</tr>
<tr>
<td>- Crystal Structure and diffusion</td>
<td>- Adjust concepts of diffusion to real situations when defects are present.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Defects and diffusion</td>
<td></td>
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</tr>
<tr>
<td>- Diffusion in dilute alloys</td>
<td>- Characterize flow in a solvent crystal.</td>
<td>5</td>
<td></td>
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</tr>
<tr>
<td>- Kirkendall effect</td>
<td>- Predict interface motion.</td>
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</tr>
<tr>
<td>- Anelasticity</td>
<td>- Predict mechanical behavior based on interstitial solute mobility and in the presence of strain fields.</td>
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</tr>
<tr>
<td>- Field-assisted diffusion</td>
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</tr>
<tr>
<td>- Multicomponent diffusion</td>
<td>- Fully characterize diffusion in complex multicomponent systems.</td>
<td>10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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COURSE SYLLABUS

Course Number: MASE 6TPS
Course Title: Solidification Processes
Credit-Hours: 3

2. Course Description

3. Pre/Co-requisites
Graduate student with permission of the director.

4. Textbook, Supplies and Other Resources
- Other resources:
The UPRM Library provides additional resources that the students are encouraged to comprehensively use.

5. Purpose
This course will provide the students with a detailed knowledge of the concepts and analyses related to microstructure development in metals solidification. The interaction of events at the atomic, microscopic and macroscopic levels is studied in-depth. Both phenomenological and mathematical models for materials behavior will be discussed.

6. General Objectives and Student Learning Outcomes
After completing the course, the student should be able to:
- analyze microstructure development during solidification
- use phase equilibria in the prediction of solidification microstructures
- apply the knowledge of dendritic growth and eutectic solidification
- develop computational models of cast structures and alloy behavior during solidification
- apply solidification knowledge to the optimization of traditional materials and the development of novel materials.

7. Requirements
All students are expected to:
- come to all classes and on time
- do all assignments and related homework
- do well in all tests to receive credit for the course
- have prior knowledge of binary phase diagrams, basic diffusion in solids, basic heat transfer, differential equations, and basic computational modeling.

8. Department / Campus Policies
Please refer to the Bulletin of Information for Graduate Studies. All the reasonable accommodations according to the Americans with Disability Act (ADA) law will be coordinated with the Dean of Students and in accordance with the particular needs of the student.

9. Campus Resources
General Library and the Engineering Computer Center have materials to supplement the course. Individual
instructors will advise the students about the availability of these materials.

### 10. Course Outline

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</tr>
</thead>
</table>
| - Binary and Ternary Phase Diagrams  
- Multicomponent system and thermodynamics of condensed mixtures. | - Predict microstructure phase equilibria according to phase diagrams. | 10 | | |
| - Kinetics effect on crystallization  
- Solute redistribution | - Implement diffusion-related phenomena in the modeling of cast microstructures. | 10 | | |
| - Morphological stability analysis  
- Microstructure evolution  
- Cells and dendrites  
- Eutectic growth | - Relate different real life processing conditions to resulting cast structures  
- Analyze dendritic growth and eutectic solidification based on thermodynamic and kinetics considerations. | 10 | Lectures (*) | |
| - Modeling methods  
- Numerical modeling of casting solidification | - Develop mathematical models to incorporate physical phenomena during solidification processing.  
- Predict cast defects and verify designs based on computational modeling | 5 | Exams, Quizzes, Team Assignments (*) | |
| - Application of novel processing methods. | - Implement comprehensive knowledge on solidification to advanced casting methods and emerging technologies, such as microgravity solidification, single crystal growth, rapid solidification, directional solidification, etc. | 10 | | |

(*) Each instructor has the freedom to decide what additional teaching and learning strategies will be used for each topic beyond regular lectures and how those outcomes are to be evaluated (assessment tools) in addition to regular exams, quizzes and assignments.
University of Puerto Rico
Mayagüez Campus
College of Engineering

Syllabus & Instructor Information Sheet

COURSE SYLLABUS

Course Number: MASE 6MSE
Course Title: Selected Topics in Materials Science and Engineering
Credit-Hours: 3

2. Course Description
Subject matters related to Materials Science and Engineering may vary from semester to semester depending on the expertise field of the instructor.

3. Pre/Co-requisites
Graduate student with permission of the director of the department.

4. Textbook, Supplies and Other Resources
Each semester, the corresponding instructor will select the books and the suitable web resources that best cover the discussion matters. Research reports as well as relevant papers published in recognized journals and conference proceedings will also be an important part of the instruction material. The UPRM Library provides additional resources that the students are encouraged to comprehensively use.

5. Purpose
This course will provide the students with an exposure to each Materials Science and Engineering-affiliated professor’s area of expertise and research. The students will acquire a comprehensive range of knowledge, as expected in any interdisciplinary program.

6. General Objectives and Student Learning Outcomes
After completing the course, the student should be able to rationalize advanced concepts applied to specific research on materials processing and to evaluate the application of those concepts in benefit of their own research work.

7. Requirements
All students are expected to:
- come to all classes and on time
- do all assignments and related homework
- do well in all tests to receive credit for the course
Additional requirements may be included by each semester instructor.

8. Department / Campus Policies
Please refer to the Bulletin of Information for Graduate Studies. All the reasonable accommodations according to the Americans with Disability Act (ADA) law will be coordinated with the Dean of Students and in accordance with the particular needs of the student.

9. Campus Resources
General Library and the Engineering Computer Center have materials to supplement the course. Individual instructors will advise the students about the availability of these materials.

10. Course Outline
Each instructor will design a specific outline depending on the subjects matters. Any additional teaching and learning strategies, and how their corresponding outcomes will be evaluated (assessment tools) in addition to regular exams, quizzes, Seminars and assignments, will be established by the instructor.
COURSE SYLLABUS

Course Number: MASE 6SEM  
Course Title: Graduate Seminar  
Credit-Hours: 1  

2. Course Description
Presentation of a research topic to the Materials Science and Engineering Program faculty and students. The students register for 0 credits of seminar until their last semester in which they will present their research topic to receive one credit for the course.

3. Pre/Co-requisites
Graduate students with permission of the director of the department.

4. Textbook, Supplies and Other Resources
Other resources: Metallurgical and Materials Transactions A. ASM International.  
The students are strongly encouraged to use the resources available in the UPRM library to complement their preparation for the seminar.

5. Purpose
The purpose of the course is to help Master’s students to develop communication skills by presenting their research topic to the academic community.

6. General Objectives and Student Learning Outcomes
After completing the course, the student should have developed strong communication skills and research-related topics in Materials Science and Engineering. This includes synthesis, analysis, and presentation structure and skills while addressing a diverse audience.

7. Requirements
The student must be enrolled in the Materials Science and Engineering Master’s program. All students are expected to come to all seminars and on time.

8. Department / Campus Policies
Please refer to the Bulletin of Information for Graduate Studies.

9. Campus Resources
General Library and the Engineering Computer Center have materials to supplement the course. Individual instructors will advise the students about the availability of these materials.

10. Course Outline
Each student presentation will cover the topic related to the student’s research. Each presentation must have a duration of at least 45 minutes with 15 minutes allocated for questions and answers from the audience.
COURSE SYLLABUS

Course Number: MASE 6MTR
Course Title: Master’s Thesis
Credit-Hours: 0-6

2. Course Description
Development, preparation and defense of a thesis based upon an original research project in Materials Science and Engineering, which represents a valuable contribution to the knowledge of this discipline.

3. Pre/Co-requisites
Graduate student with authorization of the director.

4. Textbook, Supplies and Other Resources
The following books are recommended to prepare for thesis writing and defense:
Other resources: Metallurgical and Materials Transactions, ASM International.

5. Purpose
The purpose of this course is: a) to expose MS students to the basic methods and techniques of conducting independent and scholarly research and b) to prepare them to be proficient in conveying their knowledge in a professional manner.

6. General Objectives and Student Learning Outcomes
After completing the course the student should have able to:
- demonstrate ability to conduct independent research in a distinctive topic related to MSE or connected fields.
- develop skills to conduct effective scientific literature searches.
- develop skills required to produce original contributions to the field of MSE.
- develop the ability to document and report scientific findings.

7. Requirements
The student must be enrolled in the Materials Science and Engineering Master’s program. All students are expected to meet regularly with their corresponding thesis advisor and the other members of the Master’s committee.

8. Department / Campus Policies
Please refer to the Bulletin of Information for Graduate Studies. All the reasonable accommodations according to the Americans with Disability Act (ADA) law will be coordinated with the Dean of Students and in accordance with the particular needs of the student.

9. Campus Resources
General Library and the Engineering Computer Center have materials to supplement the course. Individual advisors will recommend their students the most appropriate literature related to the research topic.

10. Course Outline
Depends upon the Master of Science’s student’s project.
COURSE SYLLABUS

1. General Information
   Course Number: INGE 5YYY
   Course Title: Recycling of Materials
   Credit-Hours: 3

2. Course Description

3. Pre/Co-requisites
   Undergraduate students: INGE 4001, INGE 3045, INME 4007 or equivalent. Graduate students may register with permission from the director of the department.

4. Textbook, Supplies and Other Resources
   - Other Resources:
       (http://purl.access.gpo.gov/GPO/LPS919)
   The UPRM Library provides additional resources that the students are encouraged to comprehensively use.

5. Purpose
   To prepare students with an extensive training on recycling, and its multifarious aspects.

6. General Objectives and Student Learning Outcomes
   A clear understanding of the need to recycle and reuse of materials is expected. Special attention will be given to the application of this knowledge to the situation in Puerto Rico
   - Assess the feasibility of recycling specific materials in the Puerto Rican context.
   - Evaluate the effectiveness of recycling policies and propose their optimization
   - Analyze each material and its recyclability.
   - Work on projects to implement specific recycling methods.

7. Requirements
   All students are expected to:
   - come to all classes and on time
   - do all assignments and related homework
   - do well in all tests to receive credit for the course

8. Department / Campus Policies
   Please refer to the Bulletin of Information for Undergraduate and Graduate Studies. All the reasonable accommodations according to the Americans with Disability Act (ADA) law will be coordinated with the Dean of Students and in accordance with the particular needs of the student.
9. Campus Resources
General Library and the Engineering Computer Center have materials to supplement the course. Individual instructors will advise the students about the availability of these materials.

10. Course Outline

<table>
<thead>
<tr>
<th>TOPIC</th>
<th>OBJECTIVES &amp; SKILLS</th>
<th>HOURS</th>
<th>TEACHING/LEARNING STRATEGIES</th>
<th>ASSESSMENT STRATEGY AND TOOLS</th>
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<tbody>
<tr>
<td>Introduction to recycling of materials.</td>
<td>- develop an overall understanding of the recycling issue</td>
<td>10</td>
<td>Lectures, intensive teamwork and reports.</td>
<td>Presentations, quizzes, exams, team project outcomes, exams.</td>
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<td>- review the characteristics of most engineering materials from the recycling viewpoint.</td>
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<td>Legislative policies</td>
<td>- analyze in detail current legislation at a Puerto Rico and federal level.</td>
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<td>- propose changes.</td>
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<tr>
<td>Recyclng goals and policies</td>
<td>- set specific and general goals of recycling programs</td>
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<td>Separation and collection systems.</td>
<td>- design separation and collection centers based on logistics and economic considerations.</td>
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<td>Processing facilities</td>
<td>- plan processing facilities.</td>
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<td>Financial considerations</td>
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<tr>
<td>Specific materials:</td>
<td>- apply previous concepts to specific materials in a course project.</td>
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<td></td>
<td>- electronic devices</td>
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<td>- paper</td>
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<td>- aluminum cans</td>
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<td>- glass bottles</td>
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<td>- batteries</td>
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<td></td>
<td>- construction debris</td>
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<td>- hazardous wastes</td>
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</tbody>
</table>

(*) Each instructor has the freedom to decide what additional teaching and learning strategies will be used for each topic beyond regular lectures and how those outcomes are to be evaluated (assessment tools) in addition to regular exams, quizzes and assignments.
APPENDIX C

GED Faculty Resume
CURRICULUM VITAE

NAME AND ACADEMIC RANK:
Marco A. Arocha
Director, General Engineering Department

DEGREES WITH FIELDS, INSTITUTION, AND DATE:
Ph.D. Chemistry Engineering Department, University of California, 1995
MS Chemistry Engineering Department, UPR-RUM, 1989
BS Chemistry Engineering School, Instituto Politécnico Nacional, Mexico

SERVICE ON FACULTY:
2000-Department Director
1999-present, Associate Professor
1995-1998, Assistant Professor
1989, Instructor

OTHER RELATED EXPERIENCE:
1983-1985, Plant Manager; Grupo Industrial Intra

CONSULTING:
Summer 1998, Summer 1999, January-June 2000; Faculty Fellow Senior Researcher; R&D Warner Lambert
Company/Pfizer, Morris Plain, NJ

STATE IN WHICH REGISTERED:
Chemical Engineering License in Mexico

PRINCIPAL PUBLICATIONS OF THE LAST FIVE YEARS:
Vapor Phase Contaminant Transport in Soil with Micropores, Macropores, and Organic Matter: A Diffusion
Model for Sorption and Desorption Experiments; Environmental Science and Technology, submitted.
Arocha MA, Vargas FF, Ramirez-Vick JE. “Albumin Effect on the Permeability of Cultured Endothelium.”
submitted.
Numerical Analysis of Sorption and Diffusion in Soil with Micropores, Macropores, and Organic Matter. Computers
in Chemical Engineering, 1997, 21, 489-499
51, 131-149
Adsorption Kinetics of Toluene on Soil Agglomerates: Soil as Biporous Sorbent. Environmental Science and
Technology, 1996, 30, 1500-1507

SCIENTIFIC AND PROFESSIONAL SOCIETIES OF WHICH A MEMBER:
American Institute of Chemical Engineers (AIChE)
American Chemical Society (ACS)

HONORS AND AWARDS:
2000, Distinguished Professor, College of Engineering
1991, TOPS, University of California, Davis
1989, Dean’s List
1987, Ana G. Méndez Fellowship

INSTITUTIONAL AND PROFESSIONAL SERVICE IN THE LAST FIVE YEARS:
2000, Director of General Engineering Department
1998-present, Committee for MS. Program in Materials, member

PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST FIVE YEARS:
1996-Effective Strategies in Higher Education, Short Course
1997-Resource Seminar on Student Success and Retention
1998-Freshman Seminar Instructor Training
CURRICULUM VITAE

A. General Information

Name: José Ramón Arroyo-Caraballo, Ph.D., P.E.
Institution: University of Puerto Rico, Mayagüez Campus
Address: General Engineering Department
PO Box 9044
Mayagüez, PR 00681
Telephone: (787) 832 – 4040 x 3789
Fax: (787) 265 – 3816
E-mail: jose@ce.uprm.edu

Education:

Ph.D. in Civil Engineering, University of Puerto Rico, Mayagüez Campus, 1999.
Thesis Title: Nonlinear Seismic Response of Stratified Soil Deposits Using Higher Order Frequency Response Functions in the Frequency Domain

M.S. in Civil Engineering, University of Puerto Rico, Mayagüez Campus, 1995.
Thesis Title: Finite Elements Analysis of Damping Materials Modeled by the Fractional Derivative Method.

B.S. in Civil Engineering, University of Puerto Rico, Mayagüez Campus, 1992.

Professional Experience:

University of Puerto Rico, Mayagüez Campus.

1999-present       Assistant Professor of Dynamic of Rigid Body and Structural Dynamics
Instructor, Research and Teaching Assistant

Engineering Research and Development Center, USA Corps of Engineers, Vicksburg Mississippi.
Summer 2001 (Research Project)
Summer 2000 (Summer Faculty Research Program, ARMY Research Office)
Summer 1997 (Graduate Student)
Summer 1993 (Graduate Student)

Membership in Technical and Professional Associations:

Member, American Society of Civil Engineers
Member, International Conference of Building Officials
Member, Precast / Prestressed Concrete Institute
Member, Colegio de MASEnieros y Agrimensores de Puerto Rico

B. Research Publications and Presentations


C. Research Projects

Principal Investigator of the project “Improved Structural Analysis of Buildings With Added Dampers”. This research project is sponsored by FEMA with duration of two years. The graduate student Roberto Marte from Civil Engineering is working toward his master thesis in this topic. The project began in October 2000.

U.S. Army Summer Faculty Research and Engineering (SFRE) Program of the Army Research Office, summer 2000. During ten weeks I worked with Dr. Robert Hall, director of the Geotechnical and Structures Division of the Engineering Research and Development Center of the USA Corps of Engineers in Vicksburg, Mississippi. The research was related to the development of a soil-structure interaction model of dams.

U.S. Army Corps of Engineers, Research and Development Center, summer 2001. During ten weeks I worked with Dr. Robert Ebeling, ITL-ERDC in Vicksburg, Mississippi. The research was related to the development a numerical method for computing barge impact forces.

D. Other Technical Work

Chair of a technical session in the EM2000, Fourteenth Engineering Mechanics Conference, American Society of Civil Engineering, May 2000, held at the University of Texas, Austin, Texas.

CURRICULUM VITAE

NAME: Pablo Guillermo CACERES-VALENCIA.

EDUCATION

1971-77 Mechanical Engineering Department
Pontificia Universidad Católica del Perú, Lima - PERÚ.

1978-81 Metallurgy & Materials Science Dept.,
University College Cardiff, Wales - U.K.

1981-84 Metallurgy & Materials Science Dept.,
University College Cardiff, Wales - U.K.

(1) Scholarship awarded by the British Council.
(2) Fellowship awarded by the Royal Mint, Llantrisant, United Kingdom.


WORK EXPERIENCE

Oct 1997 to date: Professor and Coordinator of the Area of Materials and Master Degree in Materials Engineering, Área de Materiales - Sección Mecánica, Departamento de MASEnería, Pontificia Univ. Católica del Perú, Lima, Perú.


FELLOWSHIPS & AWARDS

Scholarship to carry out a B.Sc. in Metallurgy & Materials Science awarded by the British Council in 1978.

Newport & Metallurgical Society Award for oral presentation of a research topic, 1980 (The Institute of Metals, U.K.).

A.A. Read Award for best student, 1981 (University College Cardiff, U.K.).

Fellowship to carry out a Ph.D. awarded by the Royal Mint, Llantrisant, United Kingdom in 1981.

Joint First Merit Award in the Grant Project presentation for Financial Support by CONCYTEC-Lima-Perú. September 1998.
PUBLICATIONS

Referred International Journals:


14. P.G. Caceres and K. Habib; "Crystallization Behavior of Fe$_7$B$_2$Si$_2$; Fe$_8$B$_3$ Si$_3$C$_2$, Fe$_6$Co$_{18}$B$_{13}$Si and Fe$_{77}$Cr$_2$B$_{16}$Si$_5$"; Zeitschrift fur Metallkunde, 1996, v.87, N° 4, pp.300-304.


In Conferences with Proceedings:


OTHERS

- Writing of 15 national technical standards for INDECOPI-Lima-Peru.
- Consultant to more than 5 private and state industries including Christensen Co. of Salt Lake City, Utah.
- Preparing more than 60 analytical reports, including failure analysis and reports to more than 20 private and state industries in Peru.
- More than 200 quantitative analysis reports using EPMA, XRD, TGA, etc.

ASSOCIATIONS

- Associate Member of the Institute of Materials, U.K.
- Member of the American Ceramic Society, USA
CURRICULUM VITAE

NAME & ACADEMIC RANK:
Bárbara O. Calcagno Pizzarelli
Professor

DEGREES WITH FIELDS, INSTITUTION, AND DATE:
MS Chemical & Biochemical Engineering in the University of Pennsylvania, 1981
BS- Chemical Engineering Universidad de Simón Bolívar, Caracas, 1977

SERVICE ON FACULTY:
Professor - July 2001
Associate Professor- July 1995
Assistant Professor- July 1990
Instructor -November 1985

OTHER RELATED EXPERIENCE:
Teaching undergraduate courses: Fluid Mechanics, Materials Science for Engineers, Static, Algorithm and Programming, Thermodynamics.

CONSULTING:
Consultant for the Materials Testing Office of the Highway and Transportation Authority since 1992 to present. (In charge of the development and maintenance of the Materials Information System, SIMA, of the Materials Testing Office at the laboratory level around the island)

STATE IN WHICH REGISTERED:
Puerto Rico (#12305 – EIT)

PRINCIPAL PUBLICATIONS OF LAST FIVE YEARS:
None

SCIENTIFIC AND PROFESSIONAL SOCIETIES OF WHICH A MEMBER:
SWE: Society of Women Engineers
AICHE: American Institute of Chemical Engineers
SIGMA XI: The Scientific Research Society
ADK: Women in Education Society
CIAPR: Colegio de MASEniers y Agrimensores de Puerto Rico

INSTITUTIONAL AND PROFESSIONAL SERVICE IN THE LAST FIVE YEARS:
Participation in the following committees: Materials Science, Fluid Mechanics, Personnel, Library (President at the Faculty level), Search Committee for the Dean of Engineering
Institutional Committee of Journals Subscriptions
Member of the Academic Senate (March 2001 - present)
Counselor and Faculty Advisor of the SWE Student Section (Society of Women Engineers) (1996- )
Member of the Board of Directors of the Southwestern Educational Society (1995- 1998)
Participation in the Pre-Engineering Program for High school students (1997-1999)
Participation in the EXCITE program for 7th and 8th graders with the workshop: “Let’s work with Materials” (2000-2001)
Science Fair judge at local and regional level (1990 – present)

PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST FIVE YEARS:
Courses and workshops:
Implementation and Administration of local networks. (1st semester 1998-99)
Authorware Professional for Window, Workshop. (May 1999)
Mastering Microsoft Access Basics, Seminar. (March 2000)
Advanced Access, Seminar (March 2000)
1st Symposium of Plastics in Puerto Rico (October 2000)
NAME & ACADEMIC RANK:
Basir Shafiq, Ph.D.
Assistant Professor

DEGREES WITH FIELDS, INSTITUTION, AND DATE:
Ph.D. Engineering Mechanics, University of Illinois, Chicago, 1996
MS Engineering Mechanics, University of Illinois, Chicago, 1990
BS Engineering Mechanics, Southern Illinois University, 1989

SERVICE ON FACULTY:
Associate Professor July 2001 to date.
Assistant Professor July 1996 to June 2001.

OTHER RELATED EXPERIENCE:
Summer ’99, ’00, ’01  Research Fellow, Naval Air Warfare Center, Patuxent River, Maryland

CONSULTING:
None

STATE IN WHICH REGISTERED:
None

PRINCIPAL PUBLICATIONS OF LAST FIVE YEARS:
Corrosion Fatigue Crack Growth Behavior and Aircraft Structure Life Time Prediction, National Association of
Corrosion Engineers, March 2000
Corrosion Fatigue in Aircraft Aluminum Alloys, 4th International Workshop on Aircraft Corrosion, Maryland; August 2000
Scale Effect in Cementitious Materials, NSF 3-year report, 1999
Fiber Bridging in Brittle Heterogeneous Composites, 1999 SEM Annual Conference, June 1999
Crack Arrest in Brittle Matrix Composites Reinforced with Unidirectionally Aligned Fibers, Cement and Concrete
Research, v.26, n.8, pp. 1245-1256.

SCIENTIFIC AND PROFESSIONAL SOCIETIES OF WHICH A MEMBER:
American Society of Non-Destructive Testing (ASNT)  since 1994
American Society of Civil Engineers (ASCE)  since 1992
Society of Experimental Mechanics (SEM)  since 1987
American Society of Mechanical Engineers (ASME)  since 1986

HONORS AND AWARDS:
Dean’s List during senior year at Southern Illinois University (1988-89)

INSTITUTIONAL AND PROFESSIONAL SERVICE IN THE LAST FIVE YEARS:
University of Puerto Rico, Assistant Professor of Applied Mechanics 07-96 to present

PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST FIVE YEARS:
For further professional development, attended and participated in many conferences, such as, ACI, ASCE, ASME, and NACE, to mention a few.
Attended Workshop on Corrosion Fatigue of Aircraft Structural Materials.
CURRICULUM VITAE

NAME & ACADEMIC RANK:
Oswald N.C. Uwakweh
Associate Professor

DEGREES WITH FIELDS, INSTITUTION, AND DATE:
Ph.D. in Material Science & Engineering, Université de Nancy, France, 1990
MS in Material Science & Engineering, Université de Nancy, France, 1985
BS in Mechanical Engineering, University of Ibadan, Ibadan, Nigeria, 1981

SERVICE ON FACULTY:
August 2001 Associate Professor

OTHER RELATED EXPERIENCE:
September 1991-August 1998 Assistant Professor of Metallurgical Engineering Department of Material Science & Energy, University of Cincinnati, Ohio
September 1998-December 1998 Adjunct Professor of Metallurgical Energy, University of Cincinnati, Ohio

CONSULTING:
Miller Brewery, Trenton, Ohio

STATE IN WHICH REGISTERED:
None

PRINCIPAL PUBLICATIONS OF LAST FIVE YEARS:
“The Study of Mechanically Alloyed Fe-Zn-Si Intermetallic Phases”, Accepted for publication in “Journal of Materials Synthesis and Processing”, A. Jordan and O. N. C. Uwakweh
Uwakweh

SCIENTIFIC AND PROFESSIONAL SOCIETIES OF WHICH A MEMBER:
Member Phase Transformation Committee (ASM)
ASM
TMS

HONORS AND AWARDS:
NSF, DoE-AIM-Program, URC-University of Cincinnati; Rhône Poulenc

1. INSTITUTIONAL AND PROFESSIONAL SERVICE IN THE LAST FIVE YEARS:
Materials Science & Engineering Graduate Committee

2. PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST FIVE YEARS:
Instructional Technology and Relevant Applications (1998)
Visual Literacy Workshop (1997)
Incorporating Design in Engineering Curricula (1997)
The Practical Uses of Instructional Technology in the College Environment (1996)
CURRICULUM VITAE

NAME & ACADEMIC RANK:
Jeannette Santos-Cordero
Associate Professor

DEGREES WITH FIELDS, INSTITUTION, AND DATE:
Ph.D. Chemical Engineering, Louisiana State University, 1995
MS Chemical Engineering, University of Wisconsin, Madison, 1987
BS Chemical Engineering, University of Puerto Rico at Mayaguez, 1980

SERVICE ON FACULTY:
1985 January Substitute
1987 August Instructor
1991 July Transfer to Mayaguez
1991-1996 Ph. D. studies
1996 July Assistant Professor
July Tenure

OTHER RELATED EXPERIENCE:
Part time contract professor Interamerican University
1987 Process Engineer in the Upjohn Manufactory Company

CONSULTING:
Local Department of Education, Judge in the State Scientific Fair, April 1998

STATE IN WHICH REGISTERED:
Puerto Rico

PRINCIPAL PUBLICATIONS OF LAST FIVE YEARS:

SCIENTIFIC AND PROFESSIONAL SOCIETIES OF WHICH A MEMBER:
Society of Women Engineers (1998) Treasurer- local section (1999-2001)
College of Engineers and Surveyor of Puerto Rico, License 9294 (1984)
American Institute of Chemical Engineers Member 75540

HONORS AND AWARDS:
Honor Society of Engineer Tau Beta Phi
Honor Society Phi Kappa Phi
Honor Society of Chemical Engineering LSU Omega Chi Epsilon

INSTITUTIONAL AND PROFESSIONAL SERVICE IN THE LAST FIVE YEARS:

PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST FIVE YEARS:
Conference Frontiers in Education FIE99, Nov 1999
Workshop Active/Collaborative Learning & Teaming in the College Classroom-FIE99
Preparation of support material – Beyond the text book – Workshop, RUM/CEP, Oct., 1999
Authorware Professional for Windows – Workshop 15 hrs CEP May,1999
Incorporation of Ethics Aspects in the Engineering Curriculum - Workshop RUM April, 1999
The Process of Publication in Engineering – Workshop 19hrs Dr. Godoy March-April 1999
First Year Integration Experience –Conference CIC/CEP 1999
Introduction to Educative Investigation – Workshop CEP 1998
Effective Construction of Exams I y II – Workshop, RUM/CEP, 1997
Instructional Objectives I – Workshop  RUM/CEP, 1996
Cooperative Learning I y II – Workshop  RUM/CEP, 1996
CURRICULUM VITAE

NAME & ACADEMIC RANK:
Oscar Marcelo Suárez
Assistant Professor

DEGREES WITH FIELDS, INSTITUTION, AND DATE:
Ph.D. Metallurgical Engineering, Univ. of Wisconsin, Madison, 2000
MS. Metallurgical Engineering, Univ. of Wisconsin, Madison, 1993
BS Aeronautical and Mechanical Engineering, University of Córdoba, Argentina, 1984

SERVICE ON FACULTY:
Since August, 2000 – Assistant Professor

OTHER RELATED EXPERIENCE:
Lecturer (Course MS&E 361 “Materials Laboratory II”) at the Dept. of Materials Science and Engineering, Univ. of Wisconsin – Madison [Jan. 2000 -May 2000]
Teaching Assistant (Courses MS&E 361 “Materials Laboratory II” and MS&E 362 “Materials Laboratory III”) at the Dept. of Materials Sci. and Engr., Univ. of Wisconsin – Madison [1995 -1999]
Assistant Professor at the Dept. of Materials and Technology, at the Universidad Nacional de Córdoba, Argentina, [Sept. 1986-Aug. 1990]

PRINCIPAL PUBLICATIONS OF LAST FIVE YEARS:
SCIENTIFIC AND PROFESSIONAL SOCIETIES OF WHICH A MEMBER:
Sigma Xi Honor Society, American Foundry Society (AFS), American Society for Materials (ASM International), The Metallurgical, Mining and Materials Society (TMS), The International Metallographic Society (IMS), Foundry Educational Foundation (FEF), American Society for Engineering Education (ASEE)

HONORS AND AWARDS:
Excellence in Teaching Award in recognition for outstanding teaching at the Univ. of Wisconsin-Madison, conferred by the Graduate School, Univ. of Wisconsin-Madison, May 2000.
Outstanding Teaching Assistant awarded by Polygon Engineering Council of the College of Engineering, Univ. of Wisconsin-Madison, (for 5 consecutive years).
1999 Ronald W. Ruddle Memorial Scholarship awarded by Foseco Inc. and the Foundry Educational Foundation, for “outstanding academic achievement, dedication to cast metals research, and professional potential.”
First Prize “Excellence in Metallography” in the 1999 Merrill E. Scheil Metallography Contest organized by the American Society for Materials - Milwaukee Chapter for the poster “Electron Channeling Contrast Application to the Analysis of Grain Structures in Ceramic and Metallic Materials.”
Second Prize in the 1997 Merrill E. Scheil Metallography Contest organized by the American Society for Materials - Milwaukee Chapter for the poster “Microstructural Modifications of an Al - 32 wt. % Cu Alloy Through High Temperature Heat Treatment” submitted by Carol J. Schmidt and Oscar M. Suárez.

INSTITUTIONAL AND PROFESSIONAL SERVICE IN THE LAST FIVE YEARS:
Co-host of Puerto Rico Legislators’ Public Hearing: “The Need for the Creation of a Center to Study Materials Recycling at the University of Puerto Rico-Mayagüez,” held at the Univ. of Puerto Rico-Mayagüez, March 2002
Member of the Graduate Studies Committee of the College of Engineering, Univ. of Puerto Rico – Mayagüez [March 2001 to date]
Visiting Assistant Professor (honorary), at the Dept. of Materials Science and Engineering, Univ. of Wisconsin – Madison [Jan. 2001 – Jan. 2003]
Member of the Materials Science Committee dedicated to create a campus-wide multidisciplinary graduate program at the Univ. of Puerto Rico – Mayagüez [December 2000 to date].
Coordinator of the Engineering Materials Committee at the Dept. of General Engineering, Univ. of Puerto Rico – Mayagüez [Sept. 2000 to date]
Coordinator of the Megassections Committee at the Dept. of General Engineering, Univ. of Puerto Rico – Mayagüez [Jan. 2001 to date]
Member of the Committee for ABET 2002 of the College of Engineering, Univ. of Puerto Rico – Mayagüez [Sept. 2000 to date]

PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST FIVE YEARS:
FASTLANE Workshop ((UPRM-CID), February 2002; Ethics Across the Curriculum (UPRM-CoE), November 2001; Technology Opportunities Program (UPRM-CID), February 2001; Writing Proposals to NSF (UPRM-CID), January 2001; Use of Internet in the Classroom (UPRM-CEP), October 2000; Self-training in LabVIEW programming, WEBCT course development, Web-based instruction.
CURRICULUM VITAE

NAME & ACADEMIC RANK:
Marek Rysz,  
Professor

DEGREES WITH FIELDS, INSTITUTION, AND DATE:
Ph.D. Department of Mechanical Engineering Technical University of Cracow, Poland, 1981  
MS Department of Mechanical Engineering Technical University of Cracow, Poland, 1974.

SERVICE ON FACULTY:
Associate Professor-July 1989  
Professor-1995-present

OTHER RELATED EXPERIENCE:
1994-1999-Institut für Algemeine Mechanik and Festigkeist Lehre, Brocuuschweig, Germany; invited lecturer  
1996-2000-University of Iowa; Adjunct Professor

CONSULTING:
None

STATE IN WHICH REGISTERED:
None

PRINCIPAL PUBLICATIONS OF LAST FIVE YEARS:

SCIENTIFIC AND PROFESSIONAL SOCIETIES OF WHICH A MEMBER:
ASME  
ISSMO  
ASEE

HONORS AND AWARDS:
None

INSTITUTIONAL AND PROFESSIONAL SERVICE IN THE LAST FIVE YEARS:
Personnel Committee of General Engineering Department

PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST FIVE YEARS:
Seminars and Conferences
NAME & ACADEMIC RANK:
Megh R. Goyal,
Professor

DEGREES WITH FIELDS, INSTITUTION, AND DATE:
Ph.D Engineering, The Ohio State University, 1979
MS Engineering, The Ohio State University, 1977
BS Agricultural Engineering, Ludhiana, India, 1971

SERVICE ON FACULTY:
1979-Assistant Professor
1982-Associate Professor
1988-Professor

OTHER RELATED EXPERIENCE:
None

CONSULTING:
None

STATE IN WHICH REGISTERED:
Puerto Rico Lic. 9718-PE

PRINCIPAL PUBLICATIONS OF LAST FIVE YEARS:
None

SCIENTIFIC AND PROFESSIONAL SOCIETIES OF WHICH A MEMBER:
Life member American Society of Agriculture Engineers

HONORS AND AWARDS:
Biofluids Congress (2001) dedicated Young Engineer ASAE Award

INSTITUTIONAL AND PROFESSIONAL SERVICE IN THE LAST FIVE YEARS:
None

PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST FIVE YEARS:
Biofluids Mechanics Congress
CURRICULUM VITAE

NAME & ACADEMIC RANK:
Miguel A. Cruz Arocho
Professor

DEGREES WITH FIELDS, INSTITUTION, AND DATE:
1977- MSc EnvE-Georgia Tech; 1974-MScE, BScE-UPR- Mayagüez; Degrees in Environmental and Water Resources Engineering, respectively.

SERVICE ON FACULTY:
1974 – Instructor; 1982 - Assistant Professor
1987 - Associate Professor; 1993-Professor

OTHER RELATED EXPERIENCE:
Director of the Fluids Mechanics Lab.-March-Nov. 1987
Water Resources Specialist - Environmental Quality Board of PR - Jan -July- 1972

CONSULTING:
Private Consultant in Environmental, Surveying and Structural Engineering

STATE IN WHICH REGISTERED:
P.E. & Real Estate Broker - Puerto Rico

PRINCIPAL PUBLICATIONS OF LAST FIVE YEARS:
None

SCIENTIFIC AND PROFESSIONAL SOCIETIES OF WHICH A MEMBER:
College or Engineers and Surveyors of Puerto Rico (CESPR); American Water Works Association

HONORS AND AWARDS:
Distinguished Engineer 1993 (CESPR-Aguadilla)

INSTITUTIONAL AND PROFESSIONAL SERVICE IN THE LAST FIVE YEARS:
Member Governing Board of the College of Engineers and Surveyors of Puerto Rico (1994-96)
Member Campus Academic Senate (1995-97).

PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST FIVE YEARS:
Fourth Conference on Assessment – 1995-San Juan, PR – Sponsored by IAUPR
2nd Conference on Interactive Multimedia –1995 – San Juan - Sponsored by IAUPR
Structural Design an durability Implications Of High Performance Concrete in Bridge Structures, Feb. 1995, UPR-Mayagüez
NAME AND ACADEMIC RANK:
Mario Rivera- Borrero
Assistant Professor

DEGREES WITH FIELDS, INSTITUTION, AND DATE
Ph. D. in Engineering Mechanics, Virginia Polytechnic Institute, April 1997
Dissertation Title: Seismic Response of Structures with Flexible Floor Slabs by a Dynamic Condensation Approach
Master in Civil Engineering, University of Puerto Rico at Mayagüez, July 1983
Project Title: Elastoplastic Analysis of Structures Submitted to Dynamic Loads
Bachelor in Civil Engineering, University of Puerto Rico at Mayagüez, December 1978

SERVICE ON FACULTY:
Assistant Professor, June 1997 to present
Instructor, January 1990 to May 1997
Instructor, January 1981 to May 1984

OTHER RELATED EXPERIENCE:
Associate Director of the General Engineering Department, UPRM, January 1999- August 2000

CONSULTING: Regional Building Committee of JEHOVAH’S Witnesses - Installation of steel frames

PRINCIPAL PUBLICATIONS IN THE LAST FIVE YEARS:

SCIENTIFIC AND PROFESSIONAL SOCIETIES OF WHICH A MEMBER:
American Society of Civil Engineering (ASCE)
American Society for Engineering Education (ASEE)
American Institute of Aeronautics and Astronautics (AIAA)

HONORS AND AWARDS:
Listed in Who’s Who Among America’s Teachers 1998
Distinguished Professor 1996-1997, General Engineering Department, UPRM

INSTITUTIONAL AND PROFESSIONAL SERVICE IN THE LAST FIVE YEARS:
Member of the ABET 2000 Faculty Committee
Coordinator of the ABET 2000 Departmental Committee
Graduate School Representative in seven Master’s Degree final examinations
Member of four Advisory Committee of M. Sc. and Ph. D. Candidates in Civil Engineering
Search Committee for the Director of the General Engineering Department
Member of several Departmental Committees
Person in charge of the property and structures of the General Engineering Department in case of Natural Disasters or Emergencies, 1999-2000
Science Fair judge at local and regional level, 1999-2000

PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST FIVE YEARS:
ABET EC 2000 Workshop, UPRM, September 2001
Developing Assessment Tools, UPRM, June 2001
Developing an Outcome Based Course Syllabus Workshop, UPRM, April 2001
Ethics Across the Curriculum, UPRM, April 2001
ABET EC 2000 Engineering Faculty Workshop, PUPP, February 2001
Developing an Outcome Based Course Workshop, UPRM, September 2000
Multihazard Building Design Summer Institute – Earthquake, FEMA, August 2000
Wind Loads Provisions of the UBC (ASCE 7), CIAPR, September 1999
Authorware Professional for Windows, UPRM, May 1999
Introduction to the Computer Aided Design for Public for Agencies, UPRM, May 1997
CURRICULUM VITAE

NAME & ACADEMIC RANK:
Lionel R. Orama-Exclusa
Associate Professor

DEGREES WITH FIELDS, INSTITUTION, AND DATE:
Ph.D. Electrical Engineer, Rensselaer Polytechnic Institute, 1997
MS Electrical Engineer, Rensselaer Polytechnic Institute, 1994
BS Electrical Engineer, Universidad Politécnica de Puerto Rico, 1992

SERVICE ON FACULTY:
Special Assistant to the Chancellor, October 2001 to present
Associate Professor, September 2001 to present
Assistant Professor, January 1998 to September 2001

OTHER RELATED EXPERIENCE:


Inspector of Electrical Distribution Systems, Puerto Rico Electric Power Authority, December 1991 to December 1992. Inspection of electrical distribution systems of up to 38kV to comply with the NEC and PREPA's regulations.

CONSULTING:
Buffalo’s Café, Caguas, Puerto Rico. Under development. 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.

Iglesia de la Santa Cruz, Bayamón, Puerto Rico. July 1999. Design includes all exterior and interior distribution system with 225KVA substation, for restoration of the existing structure. Lighting design was also performed. The Church is a historic monument protected by the Conservation Bureau.

Consultant, expert witness, Rio Piedras, Puerto Rico. December 1999 to December 2000. Work with Mr. Charles Hey Maestre and Mr. José J. Nazario de la Cruz, attorneys at law, on a lawsuit regarding electrocution of a worker with a distribution transformer.


STATE IN WHICH REGISTER:
None

PRINCIPAL PUBLICATIONS OF LAST FIVE YEARS:
High Voltage Hybrid Circuit Breaker, under revision, Switchgear Committee, IEEE Transactions on Power Apparatus and Systems.
SCIENTIFIC AND PROFESSIONAL SOCIETIES:
Institute of Electrical and Electronic Engineers (IEEE)
Power Engineering Society (IEEE-PES)
Colegio de MASEnieros y Agrimensores de Puerto Rico (CIAPR)
Instituto de MASEnieros Electricistas (CIPR-IIE)
International Tesla Society (ITS)
Sociedad de MASEnieros Electricistas de Puerto Rico (SIEPR)

HONORS AND AWARDS:
GEM Fellowship Programs, Doctoral Fellow in Engineering, August 1994
December 1997.

PROFESSIONAL DEVELOPMENT ACTIVITIES:
Continuum Education Units: 7.1 CEU (1998-2001)
CURRICULUM VITAE

Name: Oscar Juan PERALES PEREZ

Present Position: Associate Professor

Education:
Completion of Master program in Metallurgy, National Engineering University, Graduated School. Lima, Perú, 1992.

Academic Honors:
Fellowship: The Japan International Cooperation Agency (JICA). August 1993
August 1994, Japan.
Fellowship: Ministry of Education, Science and Culture of Japan (Monbusho). August 1993
November 1998-November 1999 (Visiting Associate Professor.)

Academic & Research & Industrial experience (main positions):
Jan 1984 to April 1984: Research Assistant, Divisions of hydrometallurgy
Jan 1985 to April 1985: La Oroya Refinery, CENTROMIN-PERÚ (Large-scale Peruvian mining and metallurgical company). Junin, Perú.
July 1987 June 1990: Research Engineer, MINERO-PERÚ (Peruvian mining and metallurgical company, currently under Canadian management)
July 1989 to Dec 1990: Researcher. Universidad Nacional de MASEnieria (National Engineering University) Research Institute
Oct 1989 to present time: Assistant Professor, School of Metallurgy, National Engineering University. Lima, Perú.
Sep 1994 to Sep 1995: Project Engineer, SGS-Peruvian branch, Division of minerals and environment. Lima and Arequipa, Perú.

Oral Presentations:


Cu(II) ions removal from aqueous solutions by its incorporation into spinel-type compounds at 25°C. In: The Mining and Materials Processing Institute of Japan (MMIJ) Meeting, March 1998. Waseda University, Tokyo, Japan.


Precipitation of Zn ions as spinel-type compounds (Ferrites) from aqueous solutions at 25 °C. In: The Mining and Materials Processing Institute of Japan (MMIJ) Meeting, March 1999. Waseda University, Tokyo, Japan.


Effective size selection of Fe₃O₄ particles at the nanosize level: A novel route to obtain monodispersed particles. The 8th International Conference on Ferrites. 18-21 September 2000, Kyoto, Japan.


LIST OF MAIN PUBLICATIONS

In Spanish


80


In English and Japanese


Perales O. and Umetsu, Y. Precipitation of Zn ions as spinet-type compounds (Ferrites) from aqueous solutions at 25 °C. In: Proceedings of the Mining and Materials Processing Institute of Japan (MMIJ) Meeting, March 1999. Waseda University, Tokyo, Japan.


Perales O. and Umetsu, Y. Ambient-temperature precipitation of Zn ions as ferrite-type compounds from aqueous solution. Submitted to Hydrometallurgy.  
Perales O. and Umetsu, Y. Cd-bearing ferrite generation from aqueous solutions at 25°C. To be submitted.  
Perales O. and Umetsu, Y. Cu-bearing ferrite generation from aqueous solutions at 25°C. To be submitted.  
Perales O., Sasaki, H. and Umetsu, Y. Rapid solid-liquid separation of ultrafine magnetite from dilute suspensions. To be submitted.  
Perales O., Tohji, K., and Umetsu, Y. Relationship between the forming conditions and magnetic properties of various metal-bearing ferrites produced at 25°C (tentative title/in preparation).  
CURRICULUM VITAE

NAME & ACADEMIC RANK: .
Professor, full time

DEGREES WITH FIELDS, INSTITUTION, AND DATE:
M.S. Arch. Technology, Columbia U., 1969

SERVICE ON FACULTY:
20 years, full time
1978-86 Assistant Professor
1979-83; 1985-86-Leave for Ph.D. study
1986-91 Associate Professor
1991- Professor

OTHER RELATED EXPERIENCE:
Director and founder, Center for Hemis-pherical Cooperation, UPRM (1991- )

CONSULTING:
Owner-president of an Industrial Archeology consulting firm (1992- )
HVAC field supervision (1971-76)
A&E design coordination (1979)

PRINCIPAL PUBLICATIONS OF LAST FIVE YEARS:
Editor: CoHemis... update: bilingual newsletter, Hemispherical Center (1991- )
Co-editor: Rehabilitating and Repairing the Buildings and Bridges of the Americas: Proceedings of a Hemispheric Workshop for Future Directions. ASCE (is being printed)
Author: La Carretera Central, un viaje escénico a la historia de Puerto Rico, PR SHPO, San Juan, 1997. 92 pages, illus.

SCIENTIFIC AND PROFESSIONAL SOCIETIES OF WHICH A MEMBER:
Society for the History of Technology
Society for Industrial Archeology

HONORS AND AWARDS:
Productivity Award, UPR-Mayagüez Campus, 1998.
Phi Kappa Phi Honor Society: invited as Faculty Member, 1997
Distinguished Professor of the General Engineering Department, 1996
UPR: High Honors and Sports Medal (graduating varsity athlete with highest grade average), 1966.
Borden Co. Prize (Best Freshman student in the University of Puerto Rico system), 1961.
Applied Mechanics -- Statics (Day 3 lecture hours per week).

INSTITUTIONAL AND PROFESSIONAL SERVICES IN THE LAST FIVE YEARS:
Editorial Board: Revista Internacional de Desastres Naturales, Accidentes e Infraestructura Civil (2000- )
Executive Committee and Editorial Board of the International Association of Technology Assessment and Forecasting Institutions (IATAFI), Bergen, Norway (1993- )

PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST FIVE YEARS:
Creator & coordinator: CoHemis Consortium of universities and research centers -- 36 institutions in 18 countries (1994- )
Jaime E. Ramírez-Vick, Associate Professor  
General Engineering Department  
University of Puerto Rico  
P.O. Box 9044, Mayagüez, PR 00681-9044  
Phone (787) 832-4040 x3048  
Fax (787) 265-3816  
e-mail: jaime@ge.uprm.edu

EDUCATION/TRAINING
Postdoctorate, Cancer Genetics, Cancer Center, University of California, San Francisco, CA  
Postdoctorate, Lawrence Berkeley National Laboratory, Berkeley, CA  
Ph.D., Chemical Engineering, 1997, Arizona State University, Tempe, AZ  
M.S., Chemical Engineering, 1989, University of Puerto Rico, Mayagüez, PR  
B.S., Chemical Engineering, 1985, University of Puerto Rico, Mayagüez, PR

PROFESSIONAL EXPERIENCE
01/02-Present  
Associate Professor, General Engineering Department, University of Puerto Rico, Mayagüez, PR
05/01-Present  
President, Daedalus BioTechnologies, Berkeley, CA
04/00-04/01  
Chief Technology Officer, Genetic Profiling Systems, Berkeley, CA
01/99-03/00  
Director of Technology, Iris Biotechnologies, Inc., Santa Clara, CA
07/88-12/88  
Postdoctoral Fellow, Cancer Center, University of California, San Francisco, CA
11/97-06/98  
Lawrence Postdoctoral Fellow, Lawrence Berkeley National Laboratory, Berkeley, CA
08/94-10/97  
Research Associate, Chemical, Bio, and Materials Engineering, Arizona State University, Tempe, AZ
07/93-07/96  
Instructor and Course Developer, Continuing Education Courses for Industry, Mayagüez, PR
07/89-06/94  
Instructor, Chemical Engineering Department, University of Puerto Rico, Mayagüez, PR
01/86-06/89  
Research Assistant, Department of Physiology, Medical Sciences Campus, University of Puerto Rico, Rio Piedras, PR
08/88-05/89  
Laboratory Instructor of Classical Mechanics, Physics Department, University of Puerto Rico, Mayagüez, PR
01/86-05/89  
Laboratory Instructor of General Chemistry, Department of Chemistry, University of Puerto Rico, Mayagüez, PR

SELECTED HONORS
American Histochemical Society Travel Award, 1998.  
Lawrence Postdoctoral Fellowship, 1998.  
Phi Kappa Phi Honor Society, 1996.  
ASU Graduate Academic Scholarship, 1994.  
ASU Graduate Tuition Scholarship, 1994.  
GEM Ph.D. Fellowship, 1990.  

OUTSIDE COMMITTEES
1. Institutional Biosafety Committee, University of Puerto Rico at Mayagüez – Chairman, 2003-Present
2. Industrial Biotechnology Program, University of Puerto Rico at Mayagüez – Steering Committee, 2002-Present
3. Ph.D. Program in Biotechnology, University of Puerto Rico at Mayagüez – Steering Committee, 2002-Present
4. Puerto Rico TechnoEconomic Corridor - Biotechnology Cluster Think Tank Member, 2001-Present

PUBLICATIONS
Textbooks:
Peer-Reviewed Journals:


Patents:


INVITED TALKS

NAME AND ACADEMIC RANK:
Walter F. Silva-Araya
Professor

DEGREES WITH FIELDS, INSTITUTION, AND DATE:
Ph.D. Civil Engineering - Concentration in Hydraulic Engineering - 1993
Washington State University, Pullman, Washington
M.S. Civil Engineering - Concentration in Water Resources Engineering - 1986
University of Puerto Rico, Mayagüez, Puerto Rico
B.S. Civil Engineering - 1982
University of Costa Rica, San José, Costa Rica

SERVICE ON FACULTY:
1994 to 1997 Assistant Professor, Associate Professor: General Engineering Department, University of Puerto Rico, Mayagüez
1986-1989 Instructor, General Engineering Department, University of Puerto Rico, Mayaguez, Puerto Rico

OTHER RELATED EXPERIENCE:
1995 - present Director of the Fluid Mechanics Laboratory of the University of Puerto Rico, Mayagüez Campus.
Responsibilities: To continually improve the Laboratory facilities for teaching undergraduate courses and research in experimental fluid mechanics and hydraulics. Editor of the Fluid Mechanics Laboratory Manual for the course MASE-4016.
Consultant in Hydraulic/Hydrologic and Sediment Transport project for private firms and government agencies.

CONSULTING:
None

STATE IN WHICH REGISTERED:
Puerto Rico

PRINCIPAL PUBLICATIONS OF THE LAST FIVE YEARS:

SCIENTIFIC AND PROFESSIONAL SOCIETIES OF WHICH A MEMBER:
American Society of Civil Engineers
International Association of Hydraulic Research.
American Water Works Association
“Colegio de MASEnieres y Agrimensores de Puerto Rico”

HONORS AND AWARDS:
None

INSTITUTIONAL AND PROFESSIONAL SERVICE IN THE LAST FIVE YEARS:
Development of auto-instruction modules for fluid mechanics using AUTHORWARE for Windows.
Implementation of multi-media software for teaching fluid mechanics.
1 undergraduate student. Sponsored by General Eng. Depart. (Summer 95 to present)
Development of Computer Software for the Fluid Mechanics Laboratory course using Visual Basic System.
Sponsored by the UPR-RUM.
Editor and co-author of the Fluid Mechanics Laboratory Manual.
Associate Director of the Puerto Rico Water Resources Research Center, (August 1998 to present)
Co-Director of Center for Hemispherical Cooperation (COHEMIS) (August 1995 to 1997)

PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST FIVE YEARS:
None
APPENDIX D

Curriculum Courses and Example of Available Faculty
### Table D: Curriculum Courses and Example of Available Faculty*

<table>
<thead>
<tr>
<th>Courses offered in the MSE Program</th>
<th>Pablo Cáceres</th>
<th>Oscar Perales</th>
<th>Ossaiwat Usakwe</th>
<th>O. Marcelo Suárez</th>
<th>Paul Sundaram</th>
<th>Carlos Rinaldi</th>
<th>S.P. Singh</th>
<th>Jaime Ramirez</th>
<th>Marek Rysz</th>
<th>Mario Rivera</th>
<th>Megh Goyal</th>
<th>Y. Jia</th>
<th>Moses Borete</th>
<th>Luis E. Suárez</th>
<th>Manuel Toledo</th>
<th>Luis Godoy</th>
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<tr>
<td>MASE 6AMA Introduction to Advanced Materials</td>
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<td>MASE 6ANE Thermodynamics &amp; Phase Equilibria</td>
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<td>MASE 6ANF Structure &amp; Propert. of Materials</td>
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<td>MASE 6KRP Kinetics and Phase Transformation</td>
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<td>MASE 6ENN Introd. to Polymer Sc. &amp; Engineering</td>
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<td>MASE 5YYY Recycling of Materials</td>
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</table>

(*) This is only a partial list. Due to prior engagements in other Graduate Programs, not all the professors listed are expected to collaborate at the initial stages of the propose program. The Table illustrates the potentiality in Materials Science and Engineering at the UPRM Campus.
January 15, 2004

Dr. Sonia M. Bartolomei-Suárez  
Coordinator, Curricular Affairs Committee  
Academic Senate, UPRM

Ref.: Master Degree Program in Materials Science and Engineering

Dear Prof. Bartolomei-Suárez:

We, the undersigned Faculty members of the College of Engineering and College of Arts and Science, wish to lend our support and are willing to participate by either teaching, collaborative research or both for the establishment of an interdisciplinary Graduate Program in Materials Science and Engineering at our Mayagüez Campus.

The Graduate Program in Materials Science and Engineering seeks to uphold the tradition of UPRM as the primary institution for science and engineering research and education in the island. Thus, the Materials Science and Engineering Graduate program be the first academic program in this growing and exciting specialty in Puerto Rico.

As in most major universities, materials research and education can be found throughout science and engineering because the field is endorsed as being critical to the wellbeing of a country as well as to the mission of a university.

<table>
<thead>
<tr>
<th>Professor name</th>
<th>Signature</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>Félix J. Acosta</td>
<td></td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>Arsenio Cáceres</td>
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<td>Civil Engineering</td>
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<tr>
<td>Luis E. Suárez</td>
<td></td>
<td>Civil Engineering</td>
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<tr>
<td>Rogelio Prado</td>
<td></td>
<td>Electrical Eng.</td>
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<tr>
<td>Fernando Vega E</td>
<td></td>
<td>INEL/COM</td>
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APPENDIX E

New Course Application Forms
UNIVERSIDAD DE PUERTO RICO
ADMINISTRACIÓN CENTRAL
VICEPRESIDENCIA PARA ASUNTOS ACADÉMICOS E INVESTIGACIÓN
SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A¹

Unidad: _______ RUM                     Facultad: _______ Ingeniería

Departamento: _______ Ingeniería General                     Programa: _______ Maestría en Ciencias e Ingeniería de Materiales

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

Fecha de solicitud: _______ 18 de noviembre de 2003                     Fecha de vigencia del curso: _______

Título completo en español: _______ Introducción a los Materiales Avanzados
(Título abreviado a 26 espacios): _______ Materiales Avanz

Título completo en inglés: _______ Introduction to Advanced Materials
(Título abreviado a 26 espacios): _______ Adv Materials

Materia principal del curso (en clave alfa): _______ MASE 6AMA

Nivel del curso (marque con una X):

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

Curso de continuación: _______ Sí                     _______ No                     Número de créditos: _______

Codificación alfanumérica sugerida: _______ MASE 6

Tipo de créditos: _______ 3 Fijo                     _______ Variable

Puede repetirse con crédito: _______ Sí (máximo de créditos____)                     _______ No

Horas semanales de:

3 Conferencia                     6 Laboratorio                     0 Tutorías
1 Discusión                     2 Taller                     3 Investigación
2 Seminario                     1 Internado                     0 Tesis o
1 Estudio Independiente                     1 Práctica Supervisada                     0 Disertación

Modalidad de educación a distancia (si aplica):

Total de horas a reunirse por periodo lectivo: _______

Equivalencia en horas crédito para la tarea del profesor (carga académica):² ______ 4

Patrón académico en que se ofrece el curso:

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

Periodo: X S1  X S2  T1  T2  T3  C1  C2  C3  C4  Verano
Año:  1°  2°  3°  4°  5°  Otro (especifique) _________________

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): ______________________________________________________________________________

Número de estudiantes por sección: ______ Mínimo _______ Máximo

¿Conlleva cargos por laboratorios? _____ Sí ______ X ______ No

Descripción en español (que no exceda los 1,000 caracteres): 4


Descripción en inglés (que no exceda los 1,000 caracteres): 5

Introduction to the fundamentals of materials for engineering applications based on the integrated approach. Review of ceramics, composites, electronic, metallic and polymer materials. Atomic scale and nanometer scale microstructures. Long range and short range order atomic arrangements. Crystal structures, noncrystalline and semicrystalline materials. Microstructural development from phase equilibrium. Kinetics and microstructural transformations. How the critical properties such as electrical, magnetic, mechanical, optical & dielectric, thermal effects, relate to different materials. Materials syntheses and design mythologies. Case studies of materials and engineering design principles.

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<th>Curso prerequisitos</th>
<th>Cursos corequisitos</th>
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<tr>
<td>Estudiante graduado con autorización del Coordinador del programa de Ciencia e Ingeniería de Materiales.</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): ____________________________

______________________________________________________________________________

Equipo o instalaciones mínimas requeridas: ______________________________________

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)
¿Comprende contenido temático de otros cursos?

- Sí
- No

Especifique: ____________________________________________________________

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

- Sí
- X No

Especifique: ____________________________________________________________

### Aprobación a nivel de la unidad

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<td>Decano(a) de Estudios Graduados:(^8)</td>
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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.
Unidad: RUM
Facultad: Ingeniería

Departamento: Ingeniería General
Programa: Maestría en Ciencias e Ingeniería de Materiales

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

Fecha de solicitud: 18 de noviembre de 2003
Fecha de vigencia del curso: ___________________________

Título completo en español: Estructura y Propiedades de los Materiales
(Título abreviado a 26 espacios): Estr. Prop

Título completo en inglés: Structure and Properties of Materials
(Título abreviado a 26 espacios): ___Struct Prop

Materia principal del curso (en clave alfa): MASE 6AOF

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

Curso de continuación: _____ Sí _____ No  Número de créditos: ______________

Codificación alfanumérica sugerida: MASE 6

Tipo de créditos: _ 3 _ Fijo _  _ Variable

Puede repetirse con crédito: _________ Sí (máximo de créditos______) _____ No

Horas semanales de:

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: ______________________

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

Patrón académico en que se ofrece el curso:

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

Periodo: X S1 X S2 T1 T2 T3 C1 C2 C3 C4 Verano
Año: 1\(^{ero}\) 2\(^{ndo}\) 3\(^{ero}\) 4\(^{to}\) 5\(^{to}\) Otro (especifique) _________________

Tipo de curso:

X Requisito
Electivo
Eduación 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): ______________________________________________________________________________

Número de estudiantes por sección:

Mínimo
Máximo

¿Conlleva cargos por laboratorios?

Sí X No

Descripción en español (que no exceda los 1,000 caracteres): 4


Descripción en inglés (que no exceda los 1,000 caracteres): 5


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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): ______________________________________________________________________

____________________________________________________________________________________________________________

____________________________________________________________________________________________________________

Equipo o instalaciones mínimas requeridas: ______________________________________________________________________

____________________________________________________________________________________________________________

Sistema de calificación: 6

X Letra (A, B, C, D ó F)

Aprobado (S), No aprobado (NS)

Aprobado (p), No aprobado (NP)

Aprobado (P), Fracasado (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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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 Segúnd 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.
Unidad: RUM  
Facultad: Ingeniería

Departamento: Ingeniería General  
Programa: Maestría en Ciencias e Ingeniería de Materiales

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

Fecha de solicitud: 18 de noviembre de 2003  
Fecha de vigencia del curso: ___________________________

Título completo en español  
Termodinámica y Equilibrio de Fases

(Título abreviado a 26 espacios): Termod. Fases

Título completo en inglés  
Thermodynamics and Phase Equilibria

(Título abreviado a 26 espacios): Thermod. & Phase.

Materia principal del curso (en clave alfa): MASE 6XXX

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

Curso de continuación: Sí (máximo de créditos________) No

Número de créditos: ____________

Codificación alfanumérica sugerida: __________________________

Tipo de créditos: Fijo Variable

Puede repetirse con crédito: Sí (máximo de créditos_____)

Horas semanales de:

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

Modalidad de educación a distancia (si aplica): __________________________

Total de horas a reunirse por periodo lectivo: _______________________

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

Patrón académico en que se ofrece el curso:

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

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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):

Si

No

Cursos: _________________________________________________________________________________________________

Unidad(es) que lo ofrece(n): ______________________________________________________________________________

Número de estudiantes por sección: _____ Mínimo _____ Máximo

¿Conlleva cargos por laboratorios? _____ Si _____ No

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


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


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Equipo o instalaciones mínimas requeridas: ____________________________________________________________

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?

Si

No

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

_____ Sí  _____ X  ____ No

Especifique: __________________________________________________________________________________________
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<table>
<thead>
<tr>
<th>Aprobación a nivel de la unidad</th>
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<td>Decano(a) de Estudios Graduados:8</td>
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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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<td>Funcionario que procesó la solicitud:</td>
<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 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.
UNIVERSIDAD DE PUERTO RICO
ADMINISTRACIÓN CENTRAL
VICEPRESIDENCIA PARA ASUNTOS ACADÉMICOS E INVESTIGACIÓN
SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

Unidad: RUM Facultad: Ingeniería

Departamento: Ingeniería General Programa: Maestría en Ciencias e Ingeniería de Materiales.

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

Fecha de solicitud: 18 de noviembre de 2003 Fecha de vigencia del curso:

Título completo en español Cinética y Transformaciones de Fase

(Título abreviado a 26 espacios): Cinet. & Transf. Fase

Título completo en inglés Kinetics and Phase Transformation

(Título abreviado a 26 espacios): Kin & Phase Trans

Materia principal del curso (en clave alfa): MASE 6KRP

Nivel del curso (marque con una X):

Curso de continuación: Sí No Número de créditos:

Codificación alfanumérica sugerida: MASE 6

Tipo de créditos: Fijo Variable

Puede repetirse con crédito: Sí No

Horas semanales de:

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:

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

Patrón académico en que se ofrece el curso:

X Semestre T Trimestre Cuatrimestre Año Otro

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

Periodo: X S1 X S2 T1 T2 T3 C1 C2 C3 C4 Verano
Año: __1__ero __2__ndo __3__ero __4__to __5__to __Otro (especifique) _________________

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): ______________________________________________________________________________

Número de estudiantes por sección: _______ Mínimo _______ Máximo

¿Conlleva cargos por laboratorios? _______ Sí ___________ No


Descripción en inglés (que no exceda los 1,000 caracteres):^5 Fundamentals of Thermodynamics and diffusion. Diffusional Phase Transformations: Homogeneous and Heterogeneous nucleation thermally activated growth, kinetics, order of transformation, grain growth recovery, recrystallization, solidification, sintering, precipitation, hardening, spinoidal decomposition, order-disorder reactions, cellular transformations. Diffusionless phase transformation: martensitic transformation.

<table>
<thead>
<tr>
<th>Curso prerequisitos</th>
<th>Cursos corequisitos</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estudiante graduado con autorización del Coordinador del programa de Ciencia e Ingeniería de Materiales.</td>
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</tbody>
</table>

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

____________________________________________________________________________________________________________

____________________________________________________________________________________________________________

Equipo o instalaciones mínimas requeridas:

____________________________________________________________________________________________________________

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?\textsuperscript{7}

\begin{tabular}{ccc}
Sí & X & No
\end{tabular}

Especifique:

\begin{tabular}{|l|}
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\begin{center}
Aprobación a nivel de la unidad
\end{center}

\begin{tabular}{|l|c|}
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Director(a) del Departamento: & Fecha: \\
Decano(a) de la Facultad: & Fecha: \\
Decano(a) de Estudios Graduados:\textsuperscript{8} & Fecha: \\
Decano(a) de Asuntos Académicos: & Fecha: \\
\hline
\end{tabular}

\begin{center}
Para uso de la Vicepresidencia para Asuntos Académicos e Investigación. NO escriba bajo este renglón.
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Codificación: & Fecha de codificación: \\
Funcionario que procesó la solicitud: & Fecha de envío a unidad: \\
\hline
\end{tabular}

\textsuperscript{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.

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

\textsuperscript{3}Orden del curso según programa de estudios autorizados.

\textsuperscript{4}Debe coincidir con la descripción del curso en el Prontuario del mismo.

\textsuperscript{5}Debe coincidir con la descripción del curso en el Prontuario del mismo.

\textsuperscript{6}Deberá consultarse a la Oficina del Registrador de la unidad para constatar sistemas permitidos.

\textsuperscript{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 \textit{Solicitud de Inactivación o Eliminación de Cursos}.

\textsuperscript{8}Cuando aplique.
UNIVERSIDAD DE PUERTO RICO
ADMINISTRACIÓN CENTRAL
VICEPRESIDENCIA PARA ASUNTOS ACADÉMICOS E INVESTIGACIÓN
SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A

Unidad: RUM
Facultad: Ingeniería

Departamento: Ingeniería General
Programa: Maestría en Ciencias e Ingeniería de Materiales

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

Fecha de solicitud: 18 de noviembre de 2003
Fecha de vigencia del curso:

Título completo en español: Fundamentos de Química de Materiales
(Título abreviado a 26 espacios): Fund. de Quim. de Mat.

Título completo en inglés: Fundamentals of Materials Chemistry
(Título abreviado a 26 espacios): Fund. Mat. Chem

Materia principal del curso (en clave alfa): MASE 6XXX

Nivel del curso (marque con una X):

Subgraduado
Graduado

Curso de continuación: Sí
No
Número de créditos:

Codificación alfanumérica sugerida:

Tipo de créditos:

Fijo
 Variable

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

Horas semanales de:

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:

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

Patrón académico en que se ofrece el curso:

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

Periodo: X__S1   X__S2   ___T1   ___T2   ___T3   ___C1   ___C2   ___C3   ___C4   ___Verano
Año:       ___1ero ___2ndo ___3ero ___4to ___5to ___ Otro (especifique) ________________________

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):

  Número de estudiantes por sección:
      _______Mínimo   _______Máximo

¿Conlleva cargos por laboratorios?
  _______Sí   _____X____No

Descripción en español (que no exceda los 1,000 caracteres): 4


Descripción en inglés (que no exceda los 1,000 caracteres): 5


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

Equipo o instalaciones mínimas requeridas: ____________________________________________

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: ________________________________________________________________
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2 Segundo establecido por la Junta Universitaria en la Certificación Núm. 8, 1986-87.
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4 Debe coincidir con la descripción del curso en el Prontuario del mismo.
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8 Cuando aplique.
UNIVERSIDAD DE PUERTO RICO
ADMINISTRACIÓN CENTRAL
VICEPRESIDENCIA PARA ASUNTOS ACADÉMICOS E INVESTIGACIÓN

SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A

Unidad: RUM
Facultad: Ingeniería

Departamento: Ingeniería General
Programa: Maestría en Ciencias e Ingeniería de Materiales

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

Fecha de solicitud: 18 de noviembre de 2003
Fecha de vigencia del curso: 

Título completo en español: Ciencia de materiales computacional
(Título abreviado a 26 espacios): Cienc Mat Comput

Título completo en inglés: Computational materials science
(Título abreviado a 26 espacios): Comp mat science

Materia principal del curso (en clave alfa): MASE 6DMM

Nivel del curso (marque con una X):

Subgraduado  Graduado

Curso de continuación: Sí  X  No
Número de créditos: 

Codificación alfanumérica sugerida: 

Tipo de créditos: 3  Fijo  Variable

Puede repetirse con crédito: Sí (máximo de créditos_____)  No

Horas semanales de:

3  Conferencia  1  Laboratorio  X  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: 

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

Patrón académico en que se ofrece el curso:

X  Semestre  Trimestre  Cuatrimestre  Año  Otro
Secuencia Curricular (C = Cuatrimestre; T = Trimestre; S = Semestre)³
Periodo: X S1 X S2 X T1 T2 T3 C1 C2 C3 C4 Verano
Año: 1ºro 2ºdo 3ºro 4ºto 5ºto Otro (especifique) _________________

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): ______________________________________________________________________________

Número de estudiantes por sección:
- Mínimo
- Máximo

¿Conlleva cargos por laboratorios?
- Sí
- No

Descripción en español (que no exceda los 1,000 caracteres):⁴
Introducción técnicas de computación en ciencia e ingeniería de materiales. Desarrollo de herramientas analíticas utilizadas en procesos de manufactura y la aplicación de programas de computación. Desarrollo de modelos analíticos para componentes sujetos a procesos térmicos o esfuerzos por encima de su punto de fluencia. Análisis de problemas utilizando el método de elementos finitos. Influencia del procesamiento en el desarrollo microestructural del material y en sus propiedades finales.

Descripción en inglés (que no exceda los 1,000 caracteres):⁵

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<tr>
<th>Curso prerequisitos</th>
<th>Cursos corequisitos</th>
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<td>de Ciencia e Ingeniería de Materiales.</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): ______________________________________________________________________________________

Equipo o instalaciones mínimas requeridas: ______________________________________________________________________________________

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), 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: __________________________________________________________
______________________________________________________________________

Aprobación a nivel de la unidad

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<td>Fecha de envío a unidad:</td>
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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.
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8 Cuando aplique.
SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A

Unidad: RUM Facultad: Ingeniería

Departamento: Ingeniería General Programa: Maestría en Ciencias e Ingeniería de Materiales

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

Fecha de solicitud: 18 de noviembre de 2003 Fecha de vigencia del curso:

Título completo en español Difractometria y Técnicas Complementarias

(Título abreviado a 26 espacios): Difr Rayos X

Título completo en inglés Diffractometry and Complementary Techniques

(Título abreviado a 26 espacios): X-Ray Diff.

Materia principal del curso (en clave alfa): MASE 6CXD

Nivel del curso (marque con una X):

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<th>0 1 2 3 4 5</th>
<th>6 7 8 9</th>
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<tbody>
<tr>
<td>Subgraduado</td>
<td>Graduado</td>
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Curso de continuación: Sí No Número de créditos:

Codificación alfanumérica sugerida:

Tipo de créditos: Fijo Variable

Puede repetirse con crédito: Sí (máximo de créditos_____ No

Horas semanales de:

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<td>Discusión</td>
<td>Taller</td>
<td>Investigación</td>
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<td>Internado</td>
<td>Tesis o</td>
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<td></td>
<td>Estudio Independiente</td>
<td>Práctica Supervisada</td>
<td>Disertación</td>
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Modalidad de educación a distancia (si aplica):

Total de horas a reunirse por periodo lectivo:

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

Patrón académico en que se ofrece el curso:

<p>| | | | | |</p>
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<td>Trimestre</td>
<td>Cuatrimestre</td>
<td>Año</td>
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<td></td>
<td></td>
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<td></td>
<td>Otro</td>
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Secuencia Curricular (C = Cuatrimestre; T = Trimestre; S = Semestre)\(^3\)

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<td>2(^{\text{do}})</td>
<td>3(^{\text{er}})</td>
<td>4(^{\text{to}})</td>
<td>5(^{\text{to}})</td>
<td>Otro (especifique)</td>
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</table>

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): ______________________________________________________________________________

Número de estudiantes por sección: _______ Mínimo _______ Máximo

¿Conlleva cargos por laboratorios? _______ Sí _______ No

Descripción en español (que no exceda los 1,000 caracteres):\(^4\)


Descripción en inglés (que no exceda los 1,000 caracteres):\(^5\)


<table>
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<tr>
<th>Curso prerequisitos</th>
<th>Cursos corequisitos</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): ______________________________________________________________________

Equipo o instalaciones mínimas requeridas: ______________________________________________________________________

Sistema de calificación:\(^6\)

- X_ Letra (A, B, C, D ó F)
- Aprobado (S), No aprobado (NS)
- Aprobado (p), No aprobado (NP)
- Aprobado (P), Fracasado (F)
- Aprobado (PS, PN, PB), No aprobado (NP)
- Otro (Especifique: _________________)

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

Especifique: ______________________________________________________________________
¿Se inactivará o eliminará algún curso al crear éste?  
Sí  X No 
Especifique: ________________________________________________  
________________________________________________________________________________________  
________________________________________________________________________________________  

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

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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.
Unidad: RUM
Facultad: Ingeniería

Departamento: Ingeniería General
Programa: Maestría en Ciencias e Ingeniería de Materiales

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

Fecha de solicitud: 18 de noviembre de 2003
Fecha de vigencia del curso: ________________

Título completo en español: Fenómenos de difusión en materiales
(Título abreviado a 26 espacios): Fenom difus mater

Título completo en inglés: Diffusion phenomena in materials
(Título abreviado a 26 espacios): Diff phenom mater

Materia principal del curso (en clave alfa): MASE 6DPM

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

Curso de continuación: _ _ No Número de créditos: __________

Codificación alfanumérica sugerida: ____________________________

Tipo de créditos: 3 Fijo Variable

Puede repetirse con crédito: _ _ Sí (máximo de créditos ____) _ _ No

Horas semanales de:

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<th>Conferencia</th>
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<th>Tutorias</th>
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<td>Investigación</td>
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<td>Estudio Independiente</td>
<td>___________</td>
<td>Práctica Supervisada</td>
<td>Disertación</td>
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Modalidad de educación a distancia (si aplica):
__________________________________________________________________________

Total de horas a reunirse por periodo lectivo: ________________

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

Patrón académico en que se ofrece el curso:

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<th></th>
<th>Semestre</th>
<th>Trimestre</th>
<th>Cuatrimestre</th>
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Secuencia Curricular (C = Cuatrimestre; T = Trimestre; S = Semestre)

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<td>1°ro</td>
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<td>5°o</td>
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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):

Número de estudiantes por sección:
- Mínimo
- Máximo

¿Conlleva cargos por laboratorios?
- Sí
- No

Descripción en español (que no exceda los 1,000 caracteres):
- Cinética de procesos controlados por difusión.
- Descripción en inglés (que no exceda los 1,000 caracteres):

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<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):

Equipo o instalaciones mínimas requeridas:

Sistema de calificación:
- X Letra (A, B, C, D o 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:
¿Se inactivará o eliminará algún curso al crear éste?  

_______ Sí ___X___ No

Especifique: ________________________________________________________________

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8 Cuando aplique.
Unidad: RUM Facultad: Ingeniería

Departamento: Ingeniería General Programa: Maestría en Ciencias e Ingeniería de Materiales

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

Fecha de solicitud: 18 de noviembre de 2003 Fecha de vigencia del curso: 

Título completo en español: Introducción a la Ciencia e Ingeniería de Polímeros
(Título abreviado a 26 espacios): Intro Polimero

Título completo en inglés: Introduction to Polymer Science & Engineering
(Título abreviado a 26 espacios): IntroPolymerSc

Materia principal del curso (en clave alfa): MASE 6ENN

Nivel del curso ( marque con una X): Subgraduado Graduado

Curso de continuación: Sí No Número de créditos: 

Codificación alfanumérica sugerida: 

Tipo de créditos: Fijo Variable

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

Horas semanales de:

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: 

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

Patrón académico en que se ofrece el curso:

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

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<th>T2</th>
<th>T3</th>
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<td>3°ro</td>
<td>4°to</td>
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<td>Otro (especifique)</td>
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</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): ______________________________________________________________________________

Número de estudiantes por sección: _______ Mínimo _______ Máximo

¿Conlleva cargos por laboratorios? _______ Sí _______ X No

Descripción en español (que no exceda los 1,000 caracteres):⁴
Clasificación, Estructuras moleculares, síntesis, propiedades de las soluciones y determinación del peso molecular, propiedades del estado sólido (estados amorfos y cristalinos), Mecanismos de degradación, reacciones polimétricas, formación de networks, copolimeracion, aleaciones. Propiedades mecánicas. Materiales visco elásticos. Fluencia lenta, relajación de esfuerzos, superposición, comportamiento dinámico, comportamiento eléctrico. Propiedades ópticas etc.

Descripción en inglés (que no exceda los 1,000 caracteres):⁵
Basic classification and molecular structures, synthesis, solution properties and molecular weight determination, solid-state properties (amorphous and crystalline states), degradation mechanisms, polymer reactions, network formation, copolymerization and blends/alloys. Mechanical properties of bulk polymers. Viscoelastic materials. Creep, stress relaxation, superposition, dynamic mechanical behavior, electrical behavior, miscellaneous mechanical properties, optical properties, transport properties.

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Equipo o instalaciones mínimas requeridas: ________________________________________________________________

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

_____________ Sí _____________ X __ No

Especifique: __________________________________________________________________________________________
____________________________________________________________________________________________________

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<td>Fecha de envío a unidad:</td>
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8Cuando aplique.
UNIVERSIDAD DE PUERTO RICO
ADMINISTRACIÓN CENTRAL
VICEPRESIDENCIA PARA ASUNTOS ACADÉMICOS E INVESTIGACIÓN

SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A

Unidad: RUM Facultad: Ingeniería

Departamento: Ingeniería General Programa: Maestría en Ciencias e Ingeniería de Materiales

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

Fecha de solicitud: 18 de noviembre de 2003 Fecha de vigencia del curso: 

Título completo en español Ingeniería y Microprocesamiento de Materiales (Título abreviado a 26 espacios):

Título completo en inglés Materials Microprocessing and Engineering (Título abreviado a 26 espacios):

Materia principal del curso (en clave alfa): MASE 6MPE

Nivel del curso (marque con una X):

Curso de continuación: Sí X No Número de créditos: 

Codificación alfanumérica sugerida: 

Tipo de créditos: 3 Fijo Variable

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

Horas semanales de:

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:

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

Patrón académico en que se ofrece el curso:

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

- Periodo: X S1 X S2 T1 T2 T3 C1 C2 C3 C4 Verano
- Año: 1er 2do 3ro 4to 5to Otro (especifique) _________________

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): ______________________________________________________________________________

Número de estudiantes por sección: _____ Mínimo _____ Máximo

¿Conlleva cargos por laboratorios? _____ Sí _____ No

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

Métodos de síntesis de materiales e ingeniería de proceso, desarrollo de estructuras, crecimiento de semiconductores, procesamiento con fase vapor y plasma.

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

Materials synthesis approaches, and process engineering, microstructure development, semiconductor growth, vapor phase and plasma processing.

<table>
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<tr>
<th>Curso prerequisitos</th>
<th>Cursos corequisitos</th>
</tr>
</thead>
<tbody>
<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): ______________________________________________________________________________

Equipo o instalaciones mínimas requeridas: ______________________________________________________________________________

Sistema de calificación:
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- Aprobado (S), No aprobado (NS)
- Aprobado (p), No aprobado (NP)
- Aprobado (P), Fracasado (F)

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

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

_____ Sí  

X No  

Especifique:  __________________________________________________________________________________________  
____________________________________________________________________________________________________

Aprobación a nivel de la unidad

<table>
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3 Orden del curso según programa de estudios autorizados.

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8 Cuando aplique.
UNIVERSIDAD DE PUERTO RICO
ADMINISTRACIÓN CENTRAL
VICEPRESIDENCIA PARA ASUNTOS ACADÉMICOS E INVESTIGACIÓN
SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A

Unidad: RUM 
Facultad: Ingeniería

Departamento: Ingeniería General 
Programa: Maestría en Ciencias e Ingeniería de Materiales

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

Fecha de solicitud: 18 de noviembre de 2003 
Fecha de vigencia del curso:

Título completo en español Materiales Nano-estructurales 
(Título abreviado a 26 espacios): Nano Materiales

Título completo en inglés Nanostructured Materials 
(Título abreviado a 26 espacios): Nano Materials

Materia principal del curso (en clave alfa): MASE 6ZZZ

Nivel del curso (marque con una X):

Subgraduado
Graduado

Curso de continuación:
Sí
No

Número de créditos:

Codificación alfanumérica sugerida:

Tipo de créditos:
Fijo
Variable

Puede repetirse con crédito:
Sí (máximo de créditos___)
No

Horas semanales de:

Confconería __________ 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:

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

Patrón académico en que se ofrece el curso:

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

Periodo: X S1  X_S2  T1  T2  T3  C1  C2  C3  C4  Verano
Año:  1°  2°  3°  4°  5°  Otro (especifique) _________________

Tipo de curso:

Requisito  X  Electivo  X  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): ______________________________________________________________________________

Número de estudiantes por sección: _____ Mínimo  _______ Máximo

¿Conlleva cargos por laboratorios? _____ Sí  X  No

Descripción en español (que no exceda los 1,000 caracteres):⁴

Perspectivas de la nanotecnología y de los nanomateriales. Principios fundamentales de la nucleación y crecimiento de partículas. Soluciones sólidas. Control del tamaño de partícula, morfología, estructura, composición, modificación superficial, etc. en partículas a la micro y nano escala. Nanomateriales industriales: cerámicos, magnéticos, semiconductores, ferroeléctricos, ópticos, dieléctricos, piezoelectricos, catalizadores, pigmentos, etc.

Descripción en inglés (que no exceda los 1,000 caracteres):⁵


<table>
<thead>
<tr>
<th>Curso prerequisitos</th>
<th>Cursos corequisitos</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estudiante graduado con autorización del Coordinador del programa de Ciencia e Ingeniería de Materiales.</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): _____________________________

Equipo o instalaciones mínimas requeridas: ____________________________________________

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), Fracaso (F)  Otro (Especifique: ________________________________________)

¿Comprende contenido temático de otros cursos?

Sí  X  No

Especifique: _____________________________________

---

3. Secuencia Curricular
4. Descripción en español
5. Descripción en inglés
6. Sistema de calificación
¿Se inactivará o eliminará algún curso al crear éste? 

Sí  
X  No 

Especifique: __________________________________________________________________________________________ 
____________________________________________________________________________________________________

<table>
<thead>
<tr>
<th>Aprobación a nivel de la unidad</th>
</tr>
</thead>
<tbody>
<tr>
<td>Director(a) del Departamento:</td>
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<td>Decano(a) de la Facultad:</td>
</tr>
<tr>
<td>Decano(a) de Estudios Graduados:&lt;sup&gt;8&lt;/sup&gt;</td>
</tr>
<tr>
<td>Decano(a) de Asuntos Académicos:</td>
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<table>
<thead>
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<th>Para uso de la Vicepresidencia para Asuntos Académicos e Investigación. NO escriba bajo este renglón.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Codificación:</td>
</tr>
<tr>
<td>Funcionario que procesó la solicitud:</td>
</tr>
</tbody>
</table>

<sup>1</sup>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.

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

<sup>3</sup>Orden del curso según programa de estudios autorizados.

<sup>4</sup>Debe coincidir con la descripción del curso en el Prontuario del mismo.

<sup>5</sup>Debe coincidir con la descripción del curso en el Prontuario del mismo.

<sup>6</sup>Deberá consultarse a la Oficina del Registrador de la unidad para constatar sistemas permitidos.

<sup>7</sup>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.

<sup>8</sup>Cuando aplique.
UNIVERSIDAD DE PUERTO RICO
ADMINISTRACIÓN CENTRAL
VICEPRESIDENCIA PARA ASUNTOS ACADÉMICOS E INVESTIGACIÓN

SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A

Unidad: _______ RUM

Facultad: _______ Ingeniería

Departamento: _______ Ingeniería General
Programa: _______ Maestría en Ciencias e Ingeniería de Materiales

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

Fecha de solicitud: 18 de noviembre de 2003
Fecha de vigencia del curso: ________________

Título completo en español: Procesos de Solidificación

(Título abreviado a 26 espacios) Proc Solidificación

Título completo en inglés: Solidification Processes

(Título abreviado a 26 espacios) Solidif Processes

Materia principal del curso (en clave alfa): MASE 6TPS

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: ______________

Codificación alfanumérica sugerida: _________________________________________

Tipo de créditos: _______ 3 Fijo _______ Variable

Puede repetirse con crédito: _______ Sí (máximo de créditos_____) _______ No

Horas semanales de:

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: ________________

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

Patrón académico en que se ofrece el curso:

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

Periodo:  X  S1  X  S2  X  T1  X  T2  X  T3  C1  C2  C3  C4  Verano
Año:  1er  2do  3ro  4to  5to  Otro (especifique) __________

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): ______________________________________________________________________________

Número de estudiantes por sección: _______ Mínimo  _______ Máximo

¿Conlleva cargos por laboratorios? _______ Sí  _______ No

Descripción en español (que no exceda los 1,000 caracteres):
Transferencia de calor y masa en el proceso de solidificación. Propiedades de los moldes y contenedores del material. Metalurgia de las aleaciones fundidas y fundición de compuestos de matriz metálica. Simulación por computadora de procesos de solidificación. 

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

<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): 

Equipo o instalaciones mínimas requeridas: 

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<td>X   Letra (A, B, C, D ó F)</td>
</tr>
<tr>
<td>Aprobado (p), No aprobado (NP)</td>
</tr>
<tr>
<td>Aprobado (P), Fracasado (F)</td>
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¿Comprende contenido temático de otros cursos?
- Sí
- No

Especifique: 

<table>
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<td>Aprobado (S), No aprobado (NS)</td>
</tr>
<tr>
<td>Aprobado (PS, PN, PB), No aprobado (NP)</td>
</tr>
<tr>
<td>Otro (Especifique: __________)</td>
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</table>
¿Se inactivará o eliminará algún curso al crear éste?

- Sí
- X No

Especifique: ____________________________________________

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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.

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8 Cuando aplique.
UNIVERSIDAD DE PUERTO RICO
ADMINISTRACIÓN CENTRAL
VICEPRESIDENCIA PARA ASUNTOS ACADÉMICOS E INVESTIGACIÓN
SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A

Unidad: RUM
Facultad: Ingeniería

Departamento: Ingeniería General
Programa: Maestría en Ciencias e Ingeniería de Materiales

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

Fecha de solicitud: 18 de noviembre de 2003
Fecha de vigencia del curso: 

Título completo en español: Topicos Selectos en Ciencia e Ingeniería de Materiales
(Título abreviado a 26 espacios) Topic Selec en CIM

Título completo en inglés: Selected Topics in MSE
(Título abreviado a 26 espacios): Selec Topics in MSE

Materia principal del curso (en clave alfa): MASE 6MSE

Nivel del curso (marque con una X):

Subgraduado
Graduado

Curso de continuación: ___________ Sí ___________ No
Número de créditos: ___________

Codificación alfanumérica sugerida:

Tipo de créditos: ___ Fijo ___ Variable

Puede repetirse con crédito: ___ Sí (máximo de créditos ___) ___ No

Horas semanales de:

Conf. 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: 

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

Patrón académico en que se ofrece el curso:

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

Periodo: X S1 X S2 X T1 X T2 X T3 X C1 X C2 X C3 X C4 X Verano

Año: 1°ro 2°do 3°ro 4°to 5°to Otro (especifique) _________________

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): ______________________________________________________________________________

Número de estudiantes por sección: Mínimo Máximo

¿Conlleva cargos por laboratorios? Sí X No

Descripción en español (que no exceda los 1,000 caracteres):
El tema del curso varía de semestre a semestre dependiendo de la especialidad del instructor, tal como: cerámicos avanzados, semiconductores, nanomateriales, biomateriales, etc.

Descripción en inglés (que no exceda los 1,000 caracteres):
Subject matter varies from semester to semester, depending on the specialties of the instructor, such as: advanced ceramics, semiconductors, nanomaterials, biomaterials, etc.

<table>
<thead>
<tr>
<th>Curso prerequisitos</th>
<th>Cursos corequisitos</th>
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</thead>
<tbody>
<tr>
<td>Estudiante graduado con autorización del Coordinador del programa de Ciencia e Ingeniería de Materiales.</td>
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</table>

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

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
- No

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

____ ___ Sí ______ X _ No

Especifique: _____________________________________________________________

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<td>Funcionario que procesó la solicitud:</td>
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<td>Fecha de envío a unidad:</td>
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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.
**SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS**

**PARTE A**

<table>
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<tr>
<th>Unidad:</th>
<th>RUM</th>
<th>Facultad:</th>
<th>Ingeniería</th>
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<tr>
<td>Departamento:</td>
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<td>Programa:</td>
<td>Maestría en Ciencias e Ingeniería de Materiales</td>
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<td>Junta de Síndicos</td>
<td>Consejo de Educación Superior</td>
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<td>Fecha de solicitud:</td>
<td>18 de noviembre de 2003</td>
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**Materia principal del curso (en clave alfa):** MASE 5YYY

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<td>Número de créditos:</td>
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<th>Variable</th>
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| Puede repetirse con crédito: | Sí (máximo de créditos ______) | No |
|-------------------------------|-----------------------------|

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<tr>
<td>3 Conferencia</td>
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<td>3 Discusión</td>
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<td>3 Seminario</td>
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<td>2 Estudio Independiente</td>
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<tr>
<th>Total de horas a reunirse por periodo lectivo:</th>
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| Equivalencia en horas crédito para la tarea del profesor (carga académica): | 3 |
|------------------------------------------------------------------------------|

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<th>Patrón académico en que se ofrece el curso:</th>
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<tbody>
<tr>
<td>X Semestre</td>
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Secuencia Curricular (C = Cuatrimestre; T = Trimestre; S = Semestre)

Periodo: X S1 X S2 T1 T2 T3 C1 C2 C3 C4 Verano
Año: 1°ro 2°do 3°ro 4°to 5°to Otro (especifique) _________________

Tipo de curso:
    Requisito     X Electivo     X 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): ______________________________________________________________________________

Número de estudiantes por sección: ______ Mínimo ______ Máximo

¿Conlleva cargos por laboratorios? ______ Sí     X No

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

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

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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): ____________________________________________________________________________________________

Equipo o instalaciones mínimas requeridas: ____________________________________________________________________________________________

Sistema de calificación:
    X Letra (A, B, C, D ó F)     X 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>
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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.
SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS

PARTE A

Unidad: RUM Facultad: Ingeniería
Departamento: Ingeniería General Programa: Maestría en Ciencias e Ingeniería de Materiales
Certificación de autorización del programa por: Junta de Síndicos Consejo de Educación Superior
Fecha de solicitud: 18 de noviembre de 2003 Fecha de vigencia del curso:

Título completo en español Seminario Graduado
(Título abreviado a 26 espacios) Semin Graduado
Título completo en inglés Graduate seminal
(Título abreviado a 26 espacios): Grad seminal

Materia principal del curso (en clave alfa): MASE 6SEM

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

Curso de continuidad: Sí X No Número de créditos:

Codificación alfanumérica sugerida:

Tipo de créditos: Fijo X Variable

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

Horas semanales de:

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

Total de horas a reunirse por periodo lectivo: 

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

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

<table>
<thead>
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<th>X 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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<td>2\textsuperscript{do}</td>
<td>3\textsuperscript{ro}</td>
<td>4\textsuperscript{to}</td>
<td>5\textsuperscript{to}</td>
<td>Otro (especifique)</td>
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<td></td>
<td></td>
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Tipo de curso:
- \( \square \) Requisito
- \( \square \) Electivo
- \( \square \) Educación Continua
- \( \square \) Temporero o Experimental (fecha de inactivación: __________)

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

Cursos: _________________________________________________________________________________________________

Unidad(es) que lo ofrece(n): ______________________________________________________________________________

Número de estudiantes por sección: _____ Mínimo _____ Máximo

¿Conlleva cargos por laboratorios? _____ Sí _____ No

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

Presentación de un tema de investigación en Ciencia e Ingeniería de Materiales ante la facultad y los estudiantes del programa. Los estudiantes se registran por 0 créditos de seminario hasta el último semestre en el que presentarán su trabajo de investigación para recibir un crédito por el curso.

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

Presentation of a research topic to the MSE Program faculty and students. The students register for 0 credits of seminar until their last semester in which they will present their research topic to receive one credit for the course.

<table>
<thead>
<tr>
<th>Curso prerequisitos</th>
<th>Cursos corequisitos</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estudiante graduado con autorización del Coordinador del programa de Ciencia e Ingeniería de Materiales.</td>
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</tr>
</tbody>
</table>

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

Equipo o instalaciones mínimas requeridas: __________________________________________________________________________

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

¿Comprende contenido temático de otros cursos?
- \( \square \) Sí
- \( \square \) No

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

Sí [ ]  X [ ]  No 

Especifique: ________________________________________________________________

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

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<tbody>
<tr>
<td>Funcionario que procesó la solicitud:</td>
<td>Fecha de envío a unidad:</td>
</tr>
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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.
UNIVERSIDAD DE PUERTO RICO  
ADMINISTRACIÓN CENTRAL  
VICEPRESIDENCIA PARA ASUNTOS ACADÉMICOS E INVESTIGACIÓN  
SOLICITUD DE REGISTRO Y CODIFICACIÓN DE CURSOS  

PARTE A

Unidad: RUM  
Facultad: Ingeniería  

Departamento: Ingeniería General  
Programa: Maestría en Ciencias e Ingeniería de Materiales  

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

Fecha de solicitud: 18 de noviembre de 2003  
Fecha de vigencia del curso:  

Título completo en español  Tesis de Maestría  
(Título abreviado a 26 espacios  Tesis Maestría  
Título completo en inglés  Master’s Thesis  
(Título abreviado a 26 espacios)  Master Thesis  

Materia principal del curso (en clave alfa): MASE 6MTR  

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:  

Codificación alfanumérica sugerida:  

Tipo de créditos:  Fijo  0-6 Variable  
Puede repetirse con crédito:  Sí (máximo de créditos )  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:  

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

Patrón académico en que se ofrece el curso:  
X Semestre  Trimestre  Cuatrimestre  Año  Otro  


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

Periodo: X S1 __ X S2 __ T1 __ T2 __ T3 __ C1 __ C2 __ C3 __ C4 __ Verano

Año: ___ 1\textsuperscript{ero} ___ 2\textsuperscript{ndo} ___ 3\textsuperscript{ero} ___ 4\textsuperscript{to} ___ 5\textsuperscript{to} ___ Otro (especifique) ________________

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): ____________________________________________________________________________

Número de estudiantes por sección: ________ Mínimo ________ Máximo

¿Conlleva cargos por laboratorios? ________ Sí ________ X No

Descripción en español (que no exceda los 1,000 caracteres):
Desarrollo, preparación y defensa de una tesis basada en un proyecto original de investigación en Ciencia e Ingeniería de Materiales, que representa una contribución relevante al conocimiento de esta disciplina.

Descripción en inglés (que no exceda los 1,000 caracteres):
Development, preparation and defense of a thesis based upon an original research project in Materials Science and Engineering, which represents a valuable contribution to the knowledge of this discipline.

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Equipo o instalaciones mínimas requeridas: _______________________________________________________________________

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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8 Cuando aplique.
APPENDIX F

Cooperation with other Institutions
March 9, 2004

Prof. Pablo G. Caceres-Valencia
Coordinator,
Materials Science and Engineering Graduate Program
General Engineering Department, Engineering Faculty,
UPR-Mayaguez, Mayaguez, PR 00681-9044

Re: Master Degree Program in Materials Science and Engineering

Dear Prof. Caceres-Valencia

The Materials Characterization Center, Inc. (MCC), jointly operated through an alliance of INDUNIV and the UPR-Rio Piedras College of Natural Sciences, wish to lend its support and is willing to participate by either teaching, collaborative research or both to the establishment of an interdisciplinary Graduate Program in Materials Science and Engineering at your Mayaguez Campus.

The Graduate Program in Materials Science and Engineering seeks to uphold the tradition of UPRM as the primary institution for science and engineering research and education in the island. Thus, the Materials Science and Engineering Graduate Program will be the first academic program in this growing and exciting specialty in Puerto Rico.

As in most major universities, materials research and education can be found throughout science and engineering because the field is endorsed as being critical to the economic wellbeing of the society as well as to the mission of a university.

Moreover, MCC and related laboratories is fully aware of the power to be gained from UPRM Graduate Program approaches to product development and looks forward to working with the University in developing Puerto Rico’s research and development capacity by using new tools, therefore, we recommend it warmly.

Please contact us if additional information is required.

Yours Faithfully

Edgard Resto, PhD
Executive Director
APPENDIX G

Resources Available at the UPRM Library
Resources Available at the UPRM Library

TA368 .A517  AMERICAN SOCIETY FOR TESTING AND MATERIALS. ASTM STANDARDIZATION NEWS.
0090-1210 p d   2257428   ADH-7836
RUM    PERIODIC 1 v. 1-12 1973-1984

TA368 .A519  STANDARDIZATION NEWS : SN.
0090-1210 p c   ADW-7102
RUM    PERIODIC 1 v. 13- 1985-

TA401 .A296  ADVANCED MATERIALS & PROCESSES.
0882-7958 p c   14392500   AEO-0342
RUM    PERIODIC 1 v. 132:2-134:1 1987-1988

TA401 .A653  AMERICAN SOCIETY FOR TESTING AND MATERIALS. ANNUAL BOOK OF
0192-2998   c   9075126   ADH-7850
RUM    PERIODIC 1 v. 1970-

TA401 .E9    EXPERIMENTAL MECHANICS.
0014-4851 p c   ADH-2740
RUM    PERIODIC 1 v. 3- 1963-

TA401 I615 B92  MATERIAUX ET CONSTRUCTIONS. MATERIALS AND STRUCTURES.
0025-5432 p c   AEK-9750
RUM    PERIODIC 1 v. 1-2,4-12 1968-1969, 1971-1979

TA401 .J61   THE JOURNAL OF MATERIALS EDUCATION.
0738-7989 p c   ADC-4874
RUM    PERIODIC 1 v. 5- 1983-

TA401 .J672  JOURNAL OF TESTING AND EVALUATION.
0090-3973 p c   2444759   ADH-7837
RUM    PERIODIC 1 v. 2,4-5 1974,1976-1977

TA401 .J677  JOURNAL OF MATERIALS IN CIVIL ENGINEERING.
0899-1561 p c   AEK-6949
RUM    PERIODIC 1 v. 1- 1989-

TA401 .J68   JOURNAL OF MATERIALS CHEMISTRY.
0959-9428 p c   AFB-1391
RUM    PERIODIC 1 v. 6- 1996-

TA401 .M38   MATERIALS RESEARCH AND STANDARDS.
0025-5394 p d   ADW-7033

TA401 .M383  MATERIALS SCIENCE & ENGINEERING. B, SOLID-STATE MATERIALS FOR
ADVANCED TECHNOLOGY.
0921-5107 p c   ADI-7710
RUM    PERIODIC 1 v. 1- 1988-

TA401 .M3833 MATERIALS SCIENCE & ENGINEERING. C, BIOMIMETIC MATERIALS, SENSORS
AND SYSTEMS.
0928-4931 p c   AFX-2355
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<th>ISSN</th>
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<td>MATERIALS SCIENCE AND ENGINEERING.</td>
<td>0025-5416 p d 1704720</td>
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<td>TA401 .M3844</td>
<td>MATERIALS SCIENCE &amp; ENGINEERING. A, STRUCTURAL MATERIALS: PROPERTIES, MICROSTRUCTURE AND PROCESSING.</td>
<td>0921-5093 p c</td>
<td>ADI-7707</td>
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<td>MATERIALS SCIENCE &amp; ENGINEERING. R, REPORTS.</td>
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<td>0038-5565 p d</td>
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<td>TA404.8 .J6</td>
<td>THE JOURNAL OF STRAIN ANALYSIS FOR ENGINEERING DESIGN / JBCSA.</td>
<td>0309-3247 p c</td>
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<td>TA405 .P752</td>
<td>STRENGTH OF MATERIALS.</td>
<td>0039-2316 p c</td>
<td>ADF-2229</td>
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<td>TA406.5 .N81</td>
<td>MATERIALS EVALUATION.</td>
<td>0025-5327 p c 2448478</td>
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<td>TA418 .G46</td>
<td>GEOTEXTILES AND GEOMEMBRANES : AN INTERNATIONAL JOURNAL</td>
<td>0266-1144 p c</td>
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