Universidad de Puerto Rico
Recinto Universitario de Mayagüez
SENADO ACADEMICO
Mayagüez, Puerto Rico

CERTIFICACION NUM. 72-10

Yo, Gloria A. Viscasillas, Secretaria del Senado Académico del Recinto Universitario de Mayagüez de la Universidad de Puerto Rico, CERTIFICO:

Que en la reunión ordinaria celebrada el día 7 de marzo de 1972 este organismo aprobó por unanimidad la PROPUESTA para el establecimiento de un PROGRAMA GRADUADO conducente al GRADO DE MAESTRIA EN CIENCIAS EN INGENIERIA QUIMICA, con las modificaciones señaladas por el Comité de Asuntos Académicos del Senado.

Se incluyen como parte de este documento la Propuesta y el Informe del Comité de Asuntos Académicos.

Y para que así conste, expido y remito la presente certificación para ser considerada por las autoridades universitarias correspondientes.

En Mayagüez, Puerto Rico, a los ocho días del mes de marzo del año de mil novecientos setenta y dos.

Gloria A. Viscasillas
Secretaria

Anejo

Universidad de Puerto Rico
Recinto Universitario de Mayagüez
SENADO ACADEMICO
Mayagüez, Puerto Rico

INFORME

A : Señores Miembros del Senado Académico

De : Comité de Asuntos Académicos

Asunto: Propuesta para el establecimiento de un Programa Graduado conducente al grado de Maestría en Ciencias en Ingeniería Química.

El asunto de epígrafe fue referido a la consideración del Comité de Asuntos Académicos con fecha 26 de enero de 1971, después de haber sido aprobado por la Facultad de Ingeniería. Simultáneamente, fue enviado al Consejo Graduado para sus recomendaciones.

Durante el proceso de estudio de la propuesta por el Comité de Asuntos Académicos, se sostuvieron conservaciones sobre el particular con el actual Director del Departamento de Ingeniería Química, Dr. Raúl Chao, y con el Dr. Rafael Muñoz Candelario. El Comité examinó detenidamente los siguientes aspectos de la propuesta: a) necesidad del programa; b) programa de estudios; c) personal; d) recursos bibliotecarios; e) facilidades físicas; f) recursos financieros.

La necesidad del programa queda claramente indicada por el desarrollo marcado de la industria petroquímica en Puerto Rico además de la investigación en la tecnología de alimentos y la producción de rones, que hacen cada vez más imprescindible la preparación de personal adiestrado a nivel graduado en ingeniería química para hacerse cargo de la diversidad de trabajos que surgen como resultado. Ha habido expresión de interés por parte de las compañías petroquímicas y algunas agencias gubernamentales de Puerto Rico. Concretamente, el Departamento de Ingeniería Química

fue objeto de un donativo de $100,000 anuales otorgado por varias industrias petroquímicas de la isla por un período de cinco años que vence al finalizar el año 1972-73. También, la matrícula en el programa de bachillerato en ingeniería química en el Recinto se ha ido aumentando durante los últimos seis años, y actualmente el Departamento tiene un total de 285 estudiantes, más de cinco veces el número correspondiente al año 1965-66.

El programa de estudios propuesto está de acuerdo con las normas y los reglamentos de los estudios graduados en el Recinto en cuanto a número mínimo de créditos requeridos para el grado, requisito de tesis, requisito de examen de idioma extranjero y requisito de examen final. Como cuestión de hecho, la propuesta fue aprobada por unanimidad por el Consejo Graduado en su reunión del 4 de marzo de 1971.

En lo relacionado a personal, el Departamento de Ingeniería Química cuenta con un dedicado y experimentado grupo de profesores con preparación académica a nivel de doctorado, varios de los cuales tienen a su haber numerosas y significativas publicaciones en el área de su especialidad. Además, cursan estudios avanzados actualmente otros tres miembros de ese Departamento -- dos a nivel doctoral y uno a nivel de Maestría. Cabe señalar que el Departamento de Ingeniería Química recibió la acreditación del Consejo de Ingeniería para el Desarrollo Profesional en octubre de 1970.

De acuerdo a las normas establecidas por el Instituto Americano de Ingenieros Químicos respecto a recursos bibliotecarios, la colección de libros y revistas disponibles en el área de la ingeniería química y otras afines, complementada mediante arreglos especiales de préstamos interbibliotecarios, es adecuada para llevar a cabo el programa graduado propuesto, y estos recursos se van ampliando continuamente. Asimismo, resultan adecuadas las facilidades físicas existentes para la docencia y la investigación, entre las cuales se incluyen la colaboración del Centro Nuclear, del Departamento de Química y

del Centro de Cómputos -- los dos primeros en lo referente a facilidades de laboratorio y el último en lo relacionado a procesamiento de datos experimentales.

En sus comienzos, el programa propuesto en su parte investigativa se orientaría en torno a las facilidades existentes, porlo que no sería necesario adquirir equipo especializado de alto costo, mas habría que emplear un profesor nuevo para el Departamento.

En base a todo lo anterior y consciente de la importancia de los programas graduados para el crecimiento profesional de los departamentos, el Comité de Asuntos Académicos recomienda lo siguiente:

1. Que de acuerdo a las recomendaciones del Consejo Graduado, se modifique la propuesta como sigue:
    a. En las páginas 7 y 8, eliminar los requisitos especiales numerados del 1 al 5, por considerarlos innecesarios, no convenientes o contenidos en principio dentro de los reglamentos de Estudios Graduados.
    b. En la página 8, bajo CURRICULUM, sustituir la frase "A total of 30 credit hours" por "A minimum of 30 credit hours", para ser consistente con los reglamentos actuales de Estudios Graduados.
    c. En la página 52, cambiar el título del curso CHEG 690 de RESEARCH SEMINAR a GRADUATE SEMINAR, y asignarle al curso un número de horas crédito consistente con otros cursos análogos ofrecidos por los departamentos que en la actualidad conducen programas graduados.
2. Que se estudie la posibilidad de eliminar en un futuro no muy lejano los cursos CHEG 601 y CHEG 602: MATHEMATICAL TOPICS IN CHEMICAL ENGINEERING descritos en la página 49, por entender que los objetivos de los mismos podrían satisfacerse fundamentalmente mediante los cursos

MATH. 675-676 : MATHEMATICS OF MODERN SCIENCE.

3. Que este Senado Académico apruebe, con las modificaciones indicadas, la propuesta para el establecimiento de un programa graduado conducente al grado de Maestría en Ciencias en Ingeniería Química.

4. Que este programa comience a ofrecerse a partir del primer semestre del año académico de 1972-73.

Respetuosamente sometido,

COMITE DE ASUNTOS ACADEMICOS

Eugene A. Francis

Eugene A. Francis
Presidente

18 de enero de 1972

EAF/mvh

GRADUATE PROGRAM LEADING TO THE

DEGREE OF MASTER OF SCIENCE IN CHEMICAL ENGINEERING

as approved by the

FACULTY OF ENGINEERING OF THE UNIVERSITY OF PUERTO RICO

Submitted to the
Academic Senate

January 26, 1971

SUMMARY

The establishment of a graduate program in chemical engineering of the University of Puerto Rico is shown to be essential for the proper development of the island's chemical industries and for the advancement of all professional activities in which chemical engineering has an active role.

The resources available are shown to constitute an adequate support for the proposed program.

A curriculum leading to the degree of Master of Science in Chemical Engineering is defined within the regulations governing graduate studies at the institution.

It is proposed to start the graduate program in chemical engineering in the first semester of academic year 1971-72.

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PREAMBLE

CHEMICAL ENGINEERING IN PUERTO RICO

The chemical industry is at present the most vigorously growing sector of Puerto Rico's economy. Not only are locally available raw materials being utilized to a maximum, but imported ones are also being employed in a dramatic expansion of the island's manufacturing industry. The most striking development corresponds to the petroleum processing industries, which represent an investment of $500,000,000 in a 12 year period. Indications are that in the future the chemical industry will keep on growing in variety, magnitude, and complexity.

An evolutionary process has occured in the teaching of chemical engineering in Puerto Rico to enable the specialists in this field to meet successfully the technical demands of this fast-changing industry. The previous emphasis given to sugar technology has been replaced by an intensive training in Chemistry, physics, mathematics, and the principles of engineering which are common to all the different chemical operations conducted on an industrial scale. Interest in the study of chemical engineering has increased sharply, and a larger and better qualified teaching staff and improved physical facilities have been provided to handle the increased enrollment. Appendix 1, page 13, quantitatively describes this steady increase over the last years.

The profession of chemical engineering occupies a position of utmost prominence within the Puerto Rican community. It stands as a symbol of technical excellence and reliability. It is regarded as the backbone of the island's industrial economy. Perhaps the best evidence of this is the fact that the local petroleum industries joined their resources two and a half years ago to set up a special donation amounting to $100,000 a year over a 5-year period to the Department of Chemical Engineering of the University of Puerto Rico for its improvement and development.

The continuing improvement and development of the Department of Chemical Engineering and its undergraduate curriculum led to its accreditation in October 1970 by the Engineering Council for Professional Development, ECPD.

THE NEEDS TO BE FILLED BY A GRADUATE PROGRAM IN CHEMICAL ENGINEERING IN PUERTO RICO

The increased complexity and variety of Puerto Rico's chemical industry has generated a need for chemical engineers with academic qualifications superior to those of the Bachelor's degree. Graduate level education, with its corresponding research experience, will be required to develop further these skills essential to the first-class chemical industry the island will have in the future. Appendix 2, page 14, illustrates the support this program has from industry and government.

Research in food technology, in rum production, and in the utilization of agricultural by-products is conducted in Puerto Rico almost entirely by chemical engineers. These investigations would gain from the availability of better qualified personnel. The Scientific Community to be formed in Mayaguez would similarly need their services in implementing its applied research programs. All technological problems specific to our island could then be studied and solved more advantageously in their original environment.

A graduate program in chemical engineering at the University of Puerto Rico would probably attract Latin American students in significant numbers since language difficulties would be a minimum while U.S.A. standards of academic

rigor and resources are provided. This would further enhance the island's role as a cultural and scientific link between the Americas.

The graduate program in chemical engineering would also provide additional opportunities and facilities for research to the department's faculty members and thus contribute to the advancement of engineering and the strengthening of the faculty.

Economic, social, and intellectual benefits would therefore be the ultimate products of the proposed graduate program in chemical engineering.

RESOURCES AVAILABLE

THE HEART OF ANY TEACHING PROGRAM IS ITS FACULTY.....The staff of the Department of Chemical Engineering of the University of Puerto Rico consists of nine full-time professors. Each holds a doctoral degree and possesses ample professional qualifications. A wide spectrum of research interests and comprehensive areas of specialization are represented. (see Appendix 3, page 19). Three other professors are now pursuing doctoral degrees in the U.S.A. under leaves of absence with full pay from the school. A part time instructor has been recruited to start teaching undergraduate courses starting in August 1970.

Excellent laboratory facilities for teaching and research in chemical engineering and its related fields are available at the Mayaguez campus of the University of Puerto Rico. The Department of Chemical Engineering has modern and comprehensive equipment resources in the areas of mass and heat transfer, fluid mechanics, process dynamics and control, crushing and grinding, microbiology, and instrumental analysis. At the institution's Nuclear Center, first-class installations for advanced training and research in nuclear technology are available. The Department of Chemistry can provide the use of its complete Instrumental Analysis Laboratory and its source of cryogenic materials. High speed automatic computers at the Computation Center can be used for both research and teaching. Appendix 4, page 37, lists the major pieces of equipment available at these various sources for possible use in the proposed graduate program in chemical engineering.

Library resources in chemical engineering and its related fields have been increased sharply over the last three years through the use of the previously mentioned special donation from industry. The requirements for library facilities which the American Institute of Chemical Engineers establishes as essential for the proper support of an educational program in this field have been fully satisfied, and the collection is continuously up dated. A small library is also maintained at the Department of Chemical Engineering for reference purposes. Appendix 5, page 41, enumerates the most important periodicals available on chemical engineering and its allied fields.

PROPOSED PROGRAM OF STUDIES

REGULATIONS:

The regulations governing the program of studies leading to the degree of Master of Science in Chemical Engineering are those established by the Division of Graduate Studies for all graduate programs in the School. Appendix 6, pagee 44, contains these regulations.

Within these norms the following specific requirement is enacted in addition to those established by the curriculum:

1- Courses CH.EG. 601, CH.EG. 661, and CH.EG. 632 are required for the M. SC. degree.

CURRICULUM:

A minimum of 30 credit hours in graduate courses is required for the M. Sc. degree in Chemical Engineering. Of these, nine credit hours are required courses in the major field, six are thesis, nine are elective courses within the major field, and six are free electives at the graduate level outside the chemical engineering department.

The proposed graduate and advanced undergraduate-graduate offerings in chemical engineering are summarized here in after, with detailed descriptions appearing in Appendix 7, page 49.

A- Advanced Undergraduate and Graduate Courses

1- CH. EG. 558 Process Heat Transfer

2- CH. EG. 570 Comprehensive Projects in Chemical Engineering

B- Graduate Courses

1- CH EG 601 Mathematical Topics in Chemical Engineering I

2- CH EG 602 Mathematical Topics in Chemical Engineering II

3- CH EG 605 Chemical Engineering Graduate Laboratory

4- CH EG 611 Reactor Design

5- CH EG 614 Simulation of Chemical Processes

6- CH EG 615 Optimization of Chemical Processes

7- CH EG 617 Advanced Plant Design

8- CH EG 620 Water Desalination

9- CH EG 623 Chemical Engineering of High Polymers

10- CH EG 632 Transport Phenomena

11- CH EG 634 Analysis of Separation Processes

12- CH EG 658 Advanced Heat Transfer

13- CH EG 661 Advanced Thermodynamics

14- CH EG 662 Catalysis

15- CH EG 680 Instrumentation and Process Control

16- CH EG 690 Graduate Seminar

17- CH EG 699 Master Thesis

SCHEDULE OF OPERATIONS:

It is proposed that the graduate program in chemical engineering begin the first semester of the academic year 1971-72. Three graduate chemical engineering courses plus a seminar would be offered during each of the first two semesters, and thesis research would be carried out continuously from the second semester of the first year. Course offerings in subsequent years would vary to suit the prevailing demand.

A minimum enrollment of five students is foreseen for the first year of operation of the graduate program. This would be expected to increase to an average of ten students during the following years as funds for supported research projects increased and research followships became available.

ADDITIONAL RESOURCES REQUIRED

To be able to meet the demands of the proposed graduate program and the increasing undergraduate enrollment in chemical engineering, three new teaching staff members in addition to those in active service at the present time will be needed by August 1971. These new professors will also hold doctoral degrees in chemical engineering.

The physical facilities available within the institution are adequate enough to support the new suggested graduate program. Expenditures in specialized equipment for specific research projects can not be predicted accurately but during the first years, research endeavours will be oriented along lines compatible with the resources available. Any space insufficiencies would disappear upon the completion of the new Chemical Engineering Building to be completed in late 1972 within the new Engineering Complex.

CONCLUSIONS AND RECOMMENDATIONS

The Faculty of the Department of Chemical Engineering considers that the department is adequately prepared to start a program leading to the degree of Master of Science in Chemical Engineering and recommends that this program be initiated during the first semester of academic year 1971-72

APPENDIX 1

ENROLLMENT IN THE DEPARTMENT OF CHEMICAL ENGINEERING OF THE UNIVERSITY OF PUERTO RICO

ENROLLMENT IN THE DEPARTMENT OF CHEMICAL ENGINEERING

OF THE UNIVERSITY OF PUERTO RICO

Academic Year	Total Enrollment Third to Fifth Years
1965-66	55
1966-67	60
1967-68	75
1968-69	107
1969-70	157
1970-71	238

APPENDIX 2

LETTERS OF SUPPORT FROM GOVERNMENT AND INDUSTRY

ESTADO LIBRE ASOCIADO DE PUERTO RICO

ADMINISTRACION DE FOMENTO ECONOMICO

G. P. O. APARTADO 2350

SAN JUAN, PUERTO RICO - 00936

20 de octubre de 1969

Dr. Rafael Muñoz, Catedrático
Departamento de Ingeniería Química
Colegio de Agricultura y Artes Mecánicas
Mayaguez, Puerto Rico

Estimado señor Muñoz:

En relación con su carta del día 6 de octubre deseo expresarle que nos agrada saber que se están iniciado los trámites preliminares para ofrecer en la Escuela de Ingeniería del Recinto Universitario de Mayaguez, un programa de estudios conducentes al grado de Master en Ciencias en Ingeniería Química.

Como es de su conocimiento, esta Administración auspicia un programa de becas para mejoramiento profesional en el cual está incluida la profesión de ingeniería química. Estoy seguro que lo que usted propone ayudará a mejorar las perspectivas de esa clase profesional y sera de gran provecho en el desarrollo industrial de Puerto Rico, especialmente de la industria química.

Hemos estado siempre en la mejor disposición de ofrecer a nuestro personal oportunidades de mejoramiento profesional, por lo que deseamos que nos mantenga informados del progreso de sus planes. Deseándole éxito, quedo de usted

Cordialmente,

Juan Rodríguez de Jesús
Administrador

PUERTO RICAN CEMENT COMPANY, INC.

SAN JUAN, PUERTO RICO

MAIN OFFICE
P. O. BOX A
PONCE, PUERTO RICO, 00732
TELEPHONES
GEN. OFF. 842-[illegible]
PLANT OFF. 842-3000
CABLE CEMENT

SAN JUAN OFFICE
P. O. BOX 2592
SAN JUAN, PUERTO RICO, 00903
TELEPHONES
GEN. OFF. 783-3000
SALES OFF. 783-3100
CABLE: CEMENT

16 de octubre de 1969

Sr. Rafael Muñoz, Catedrático
Departamento Ingeniería Química
Universidad de Puerto Rico
Colegio de Agricultura y Artes Mecánicas
Mayaguez, Puerto Rico 00708

Estimado señor Muñoz:

Agradezco mucho su carta del 7 de octubre de 1969, relacionada con el establecimiento de un programa de estudios conducentes al grado de Master en Ciencias en Ingeniería Química.

El establecimiento de un programa de Master en Ingeniería Química es en beneficio para Puerto Rico puesto que el desarrollo de la industria petroquímica que ha tenido Puerto Rico indica la necesidad presente y futura de ingenieros químicos con preparación de Master.

La Puerto Rican Cement tiene un programa de licencias que permite a sus empleados matricularse en programas graduados para mejorar su preparación técnica y administrativa. Confío en que nuestros ingenieros químicos puedan participar del programa de Master en Ingeniería Química que ustedes esperan establecer en un futuro cercano.

Cordialmente,

Antonio Luis Ferré
Presidente

ALF/EL/bpm
cc: Sr. Félix Aponte

TELEPHONE
864-1515

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PHILCOREGYA
386347

PHILLIPS PUERTO RICO CORE INC.
MANUFACTURING CENTER
BO LAS MAREAS
GUAYAMA, PUERTO RICO

P.O. BOX 518
GUAYAMA, P.R. 00654

October 17, 1969
PR-WEB-55-69

Professor Rafael Muñoz
Chemical Eng'g Dept.
University of Puerto Rico
College of Agriculture and Mechanic Arts
Mayaguez, Puerto Rico 00708

Dear Professor Muñoz:

Mr. Holland has asked me to answer your letter of October 3, 1969 regarding the possibility of starting a program of studies leading to the degree of Master of Science in the Chemical Engineering at the University of Puerto Rico in Mayaguez. We feel that an engineer with a master degree would certainly be an asset to our Company. As a matter of philosphy in our Company, we always try to hire engineers with the best possible qualifications. In general, we have paid an extra $50 per month starting salary to engineers with a master degree as compared to a bachelor degree; however, salaries are always subject to negotiation depending on the qualifications of the individual concerned.

When you are considering the curriculum for this program, I am sure that you will take into consideration the special needs of the petrochemical industries here in Puerto Rico. We have a Company policy which allows selected engineers to be considered for leaves of absence for the purpose of obtaining advanced degrees. You may also want to consider the possibility of an extension course that could be presented in Ponce, as you are doing now, which will enable our employees to further their education while at the same time earning a living.

We are looking forward to the establishment of a Master Degree program from your fine university.

Yours very truly,

W.E. Barr,
Plant Manager

WEB/cars

cc: T.R. Holland

Puerto Rico Chemical Co., Inc.

KM 72.2, CARRETERA 2, ARECIBO, P. R.

MAIL ADDRESS:
P. O BOX 157
ARECIBO, P. R. 00612

CABLE ADDRESS:
PUERTOCHEM
ARECIBO, P. R.

TELEPHONE:
878-1512

TELEX:
385613

October 9, 1969

Mr. Rafael Muñoz, Professor
Chemical Eng'g. Dept.
University of Puerto Rico
College of Agriculture and Mechanic Arts
Mayaguez, Puerto Rico 00709

Dear Doctor Muñoz:

Thank you for your letter of October 3, 1969 concerning your plans to establish a program of studies leading to the degree of Master of Science in Chemical Engineering.

While we are a small company engaged only in production, we certainly encourage your establishment of this program. With the present and projected expansion of chemical and petrochemical activities in Puerto Rico I think it is certain that industry will definitely benefit from such a program and Fomento will be provided with additional ammunition for its promotional efforts.

We now employ two chemical engineers, one of whom holds a Master's degree, and do not forsee any increase in this area. We presently have a system of tuition reimbursement for academic work of interest to the company. However, the ideas of leaves of absence and scholarships are interesting and certainly worth study. Such an idea is generally feasible, but it is perhaps a little early to comment in detail. You may be sure we will study the matter.

Our best wishes for your success in this venture.

Yours very truly,

PUERTO RICO CHEMICAL CO., INC.

C. L. Weeks, Vice President

ESTADO LIBRE ASOCIADO DE PUERTO RICO
AUTORIDAD DE ACUEDUCTOS Y ALCANTARILLADOS

14 de noviembre de 1969

Ing. Rafael Muñoz, Catedrático
Departamento de Ingeniería Química
Universidad de Puerto Rico
Recinto de Mayaguez

Estimado ingeniero Muñoz:

Tengo a bien referirme a su reciente comunicación en la que solicita nuestros puntos de vista sobre la conveniencia de iniciar un programa de estudios, conducentes al grado de Maestro en Ciencias en Ingeniería Química.

No cabe la menor duda de que un programa para el nivel profesional que ustedes proponen, será de gran provecho al desarrollo industrial de Puerto Rico.

Aunque la necesidad mayor nuestra es la de reclutar ingenieros civiles especializados en sanitaria, entendemos que el programa podría resultar en un recurso adicional valiosísimo para el crecimiento profesional especializado de nuestros ingenieros químicos.

Actualmente nuestras licencias para estudios están mayormente dirigidas a concentraciones en sanitaria, electricidad, hidráulica y hidráulica.

Agradezco mucho la oportunidad que nos han ofrecido para expresar nuestro sentir, respecto a la implantación del programa para la Maestría en Ciencias en Ingeniería Química.

Cordialmente,

Luis F. Vázquez
Jefe, Departamento de Personal

APPENDIX 3

THE FACULTY OF THE DEPARTMENT OF CHEMICAL ENGINEERING

OF THE UNIVERSITY OF PUERTO RICO

INFORMATION REGARDING FACULTY

Name	Chao, Raúl
Date of birth	December 21, 1939
Academic rank	Associate Professor, full time
Degrees	BSChE, UPR, 1961 PhD. ChE, Johns Hopkins Univ. 1965
Service on Faculty	2 1/2 years
Other experience	1961-63 Teaching Assistant, Johns Hopkins Univ. 1963-64 Research Assistant, Johns Hopkins Univ. 1964-68 Engineer, Research Engineer and Group Leader, Esso Research and Engineering, Co. Florham Park, New Jersey
States in which registered	New Jersey, No. 16403, 1967 Illinois, No. 17281, 1968
Principal publications of last five years	Chao, R. and Hoelscher, H. E. "Simultaneous Axial Dispersion and Adsorption in a Packed Bed", AIChE, J, 12, 271 (1966) Chao, R., and Heenan W., "Processing Seaweed for Natural Gum Extraction", accepted for publication by Process Biochemistry. Chao, R., Heenan W., "Extraction of Agar from Marine Algae", Revista CIAA, 20, 40 (1970)

	Chao, R., "Heat Transfer to Reacting Beds of Solids", submitted to Hydrocarbon Processing.
	U.S. Patent 3,540,868
Honors and awards	Magna Cum Laude, UPR, 1961 Gilman and Whitehead Fellow, Johns Hopkins University, 1962-63 1967 Esso Inventor, Esso Research and Engineering Co. 1968.
Other assigned duties	Director, Chemical Engineering Department, UPR Library Committee, University of Puerto Rico, R.U.M. Graduate Studies Committee, Department of Chemical Engineering, UPR
Programs participated in, to improve competence as teachers	Research Management Conference Conducted by the Graduate School of Business Administration, Boston College, Sept.-Oct. 1968
	Process Heat Transfer Course, AIChE, Washington, Nov. 1969
Research Interests	Heat Transfer, Kinetics, Reactors

INFORMATION REGARDING FACULTY

Name	Gomezplata, Alberto
Date of birth	July 2, 1930
Academic rank	Visiting professor
Degrees	B. Sc. Chemical Engineering, Polytechnic Institute of Brooklyn, 1952 M. Sc. Chemical Engineering, Polytechnic Institute of Brooklyn, 1954 Ph. D. Chemical Engineering, Polytechnic Institute of Brooklyn, 1959
Service on Faculty	New appointment
Other experiences	Assistant Professor of Chemical Engineering, Univ. of Maryland, 1958-62, Associate Professor of Chemical Engineering, Univ. of Maryland, 1962-68, Year-in-industry Professor, E. I. du Pont de Nemours, 1965-66 Professor of Chemical Engineering, University of Maryland, 1968-present
States in which Registered	Maryland
Principal publications	"Effective Dispersion in a Tubular Flow Reactor with Return Bends", A.I.Ch. E. Journal, 1966. "An Investigation of Solid Distribution, Mixing, and Contacting Characteristics of Gas-Solid Fluidized Beds", Part I and II, A.I.Ch.E. Journal, 1967

Alberto Gomezplata

Principal publications (cont....)	"Axial Dispersion Coefficient Measurement in Two-Phase Flow," A.I.Ch. E. Journal, 1968. "A Model to Predict Void-Fraction in Two-Phase Flow," Chem. Engr. Science, 1969. "On the Relationship between Slip Velocity, Void Fraction, and Particle Diameter in Two-Phase Flow Systems," Canadian Journal of Chemical Engineering, 1969. Axial Dispersion in a Tubular Flow Vessel with Bends", Canadian Journal of Chemical Engineering, 1970.
Membership in scientific and professional societies	American Institute of Chemical Engineers American Chemical Society American Society for Engr. Education New York Academy of Science Fellow, American Institute of Chemists

INFORMATION REGARDING FACULTY

Name	William A. Heenan
Date of birth	April 17, 1941
Academic rank	Assistant Professor, Full Time
Degrees	BChE, Univ. of Detroit, 1964 MSChE, Univ. of Detroit, 1967 D. Eng., Ch. E., Univ. of Detroit, 1967
Service on Faculty	Two years
Other experience	1962-64 Co-op Engineer, Ford Motor Co., Detroit Michigan 1964-67 Process Engineer and Manufacturing Supervisor, Monsanto Co. Trenton, Michigan
Principal publications of last five years	W. A. Heenan, and D. T. Camp, "The Design and Development of a Capillary valve for use in venting fission gases from fast breeder reactor control rods", APDA, 237, May 1969 W.A. Heenan and D.T. Camp, "A capillary valve for use in venting fission wastes", Nuclear Applications and Technology, to be published. W. A. Heenan and R. Chao, "The Production of Agar", Process Biochemistry, to Be Published. W. A. Heenan and R. Chao, "Agar Production", Journal of Puerto Rican Engineers, Architects, and Surveyors, Oct. 1970.
Scientific and Professional Societies of which member	A.I.Ch. E., ACS, Theta Tau
Research interest	Computation of Chemical Reaction Equilibrium, Optimization and Design of Chemical Processes.
Other duties	Research Committee of Faculty of Engineering

INFORMATION REGARDING FACULTY

Name	Martínez-Nadal, Noemí
Date of birth	August 15, 1917
Academic rank	Professor of Chemical Engineering and Research
Degrees	D. Sc. Organic Chemistry-Univ. of Paris, 1954
Service on Faculty	12 years
Other experience	Chemist, in charge of essential oil project, U. S. Federal Experiment Station, Mayaguez, Puerto Rico. 1937-1946 Chemist, in charge of chemical and biochemical investigations, Research Center UPR, Mayaguez P.R. 1954-1967. Undergraduate Research Program Director, NSF, Grant 1963-1966 Director of Research of Biochemical Laboratories-Faculty of Engineering, 1968 till present
Consulting work	Essential Oil Industry and Fomento Laboratories
Principal publication of last five years	III Cymopolia Barbata. Botanica Marina, Vol. IX, Fasc. 1/2, 1966. Low toxic effect of antimicrobial substances from marine algae. Botánica Marina, Vol.IX, Fasc. 1/2, 1966. Antimicrobial activities of Genipa americana. Bios, Vol. 37, No. 3, 1966. Control of plant pathogens using active antimicrobial substances isolated from marine algae. (Presented at the IX International Congress of Microbiology, Moscow, Russia, 1966.

Martínez Nadal, Noemí

Principal publications of last five years (cont.)	Presence of sarganin complex in members of the family Sargassaceae. Bios. Vol. 38, No. 1, 1967. Drugs from pollen. Revista Atenea, Año VI, 1969, 25-31, University of Pto. Rico Sarganin complex in the control of Hemophilus gallinarum. (Accepted for publication in Bios. Antimicrobial activity of Spirulina maxima. (Presented at the X International Congress of Microbiology, August 1970, Mexico. Sterols of Spirulina maxima. (Accepted for publication October 1970, Phytochemistry.)
Membership in scientific and professional societies	Fellow American Institute of Chemists American Society of Microbiology American Society for Engineering Education Association Official Agricultural Chemist American Institute of Chem. Enginners American Society for Advancement of Science
Honors and awards	Fellowship American Institute of Chemists American Men of Sciences Who's Who in the South and Southwest International Biography of Prominent Scientists Academic Senate (Faculty Representative 1965-66) Presidency, Dialysis Fermentation Section at X International Congress of Microbiology, August 1970, Mexico).
Other assigned duties	In charge of interdisciplinary laboratories carrying out research projects for participation of graduate and undergraduate students.

INFORMATION REGARDING FACULTY

Name	Molini, Alberto E.
Date of birth	October 25, 1924
Academic rank	Associate Professor, Full Time
Degrees	BSChE, Univ. of Michigan, 1952 MSChE, Univ. of Michigan, 1952 Ph. DCh.E., Univ. of Michigan, 1957
Service on Faculty	2 years, 6 months
Other experience	1952-55 Research Assistant, Univ. of Michigan Engineering Research Institute, 1956-68 Research Engineer, Sr. Research Engineer, and Research Associate, E.I. du Pont DeNemours & Co. 1968-70 Chairman, Department of Chemical Engineering, Univ. of Puerto Rico
Consulting work	Flanes Cedó, Inc. Mayaguez, Puerto Rico Víctor García & Associate, Inc. San Juan, Puerto Rico
States in which registered	Puerto Rico
Principal publications of last five years	"The Program of the University of Puerto Rico For meeting the Educational Demands of an Expanding Industry", Presented at the Third Joint meeting, AIChE-IIQPR, San Juan, Puerto Rico May 1970 "Ingeniería Química-Incumbencias y Atribuciones en Puerto Rico", Presented at the Fourth InterAmerican Congress of Chemical Engineering, Buenos Aires, Argentina April 1969. U.S. Patent NO. 3,216,187

Dr. Alberto E. Molini

Membership in Scientific and professional societies	Colegio de Ingenieros, Arquitectos, & Agrimensores de Puerto Rico American Institute of Chemical Engineers American Society for Engineering Education American Chemical Society, Colegio de Químicos de Puerto Rico Instituto de Ingenieros Químicos de Puerto Rico, Vice President Alpha Chi Sigma American Association for the Advancement of Science
Honors and awards	Sigma Xi, Phi Lambda Upsilon, Tau Beta Pi
Other assigned duties	Chairman, safety committee of the School of Engineering; Chairman, Graduate Studies Committee; Board of Directors, Puerto Rico Technical Information Center;
Programs participated in to improve competence as a teacher	Seminar on Rheology for Polymeric Materials, Wayne State University, 1966
Research Interests	Heat and Mass Transfer, Air Pollution, Water Desalination

INFORMATION REGARDING FACULTY

Name	Muñoz Candelario, Rafael
Date of birth	August 29, 1926
Academic rank	Professor, full time
Degress	BSChE, UPR 1947 MSChE, Univ. of Wisconsin, 1951 D. Ch.E. Polytechnic Institute of Brooklyn, 1956
Service on Faculty	11 years
Other experience	1947-50 Chemical Engineer, San José Sugar Co., Rio Piedras, Puerto Rico 1954-58 Head of Organic Chemistry Research Division, Economic Development Administration of Puerto Rico, San Juan 1954-58 Part time teacher, UPR, Rio Piedras 1958-59 Chemical Engineer, International Metalloids, Inc., Toa Alta, Puerto Rico 1959-68 Director, Chemical Engineer Department, UPR, Mayaguez 1968-69 Project Coordinator and Professor, UNESCO Project for the establishment of a graduate program at Universidad Industrial de Santander, Colombia
Consulting work	Tres Monjitas Dairy Co., San Juan, Puerto Rico International Metalloids, Inc. Toa Alta Terminal Products, Inc. Hormigueros, Puerto Rico Dept. of Health of Puerto Rico, San Juan Acueduct and Sewer Authority of Puerto Rico Catalytic Caribe, Inc.
States in which registered	Puerto Rico
Principal publications of last five years	"Chemical Engineering Curricula in the Americas"; UPR 1967 (senior author) "The Leaching of Uranium Ores Using Ultrasonics", Revista Politécnica, Ecuador, 1968 (junior author) "The Self-Purification Rates of Polluted Streams in Puerto Rico.", Water Resources Research Institute of the UPR. 1969(senior author)

Muñoz Candelario, Rafael

Membership in scientific and professional societies	American Institute of Chemical Engineers, American Society for Engineering Education College of Engineers, Architects and Surveyors of Puerto Rico Instituto de Ingenieros Químicos de Puerto Rico
Honors and awards	Cum Laude, UPR 1947 Member, Chemists Examiners Board of Puerto Rico, 1967 to date President and Founder, Institute of Chemical Engineers of Puerto Rico (President during 5 years) First President, Inter American Confederation of Chemical Engineers, 1961 Member, Academic Senate, C.A.A.M.
Programs participated in to, improve competence as teachers	NSF Summer Institute on Rocketry, Stanford Univ. 1961 NSF Summer Institute on Sanitary Eng'g. Univ. of West Virginia, '63 NSF Summer Institute on Nuclear Technology, Univ. of Michigan, '65 NSF Summer Institute on Advanced Physical Chemistry, Tufts Univ. '67
Research Interest	Water Pollution Control, Waste Disposal

INFORMATION REGARDING FACULTY

Name	Pedraja-Santos, Manuel
Date of birth	January 2, 1927
Academic rank	Assistant Professor (on leave)
Degrees	BSChE, UPR, 1949
Service on faculty	3 years
Other experience	Mercedita Mill, Process Engineer, 1949-53 Economic Development Administration of Puerto Rico, 1953-56 Caribe Nitrogen Corp. Asst. Superintendent 1956-65
Consulting work	Department of Health of Puerto Rico
States in which registered	Puerto Rico
Membership in scientific & professional society	P.R. Institute of Chemical Engineers Colegio de Ingenieros, Arquitectos, y Agrimensores
Publications	The Self-Purification Rates of Polluted Streams in Puerto Rico, Water Resources Research Institute (junior author)

INFORMATION REGARDING FACULTY

Name	Rodríguez, Abraham
Date of birth	February 26, 1938
Academic rank	Assistant Professor (on leave)
Degrees	BSChE, UPR - 1961 MSChE, Purdue U.- 1965
Service on Faculty	5 years
Other experience	Assistant-process engineer in the Technical Dept. of the CORCO, from 61-62.
Consulting work	Department of Health of Puerto Rico
State in which registered	Puerto Rico
Principal publications of last five years	Characteristics of Turbulent Temp. Fluctuations in Air , MSChE Thesis Purdue Univ. Library; The Self-Purification Rates of Polluted Streams in PR (co-author) Water Reseources Research Institute
Membership in scientific and professional societies	American Institute of Chemical Engineers Colegio de Ingenieros Arquitectos y Agrimensores, Institute of Chemical Engineers of P.R.
Honors and awards	Magna Com Laude, UPR, 1961

INFORMATION REGARDING FACULTY

Name	Santiago, Félix D.
Date of birth	January 28, 1936
Academic rank	Associate Professor-full time
Degrees	BSChE. UPR, 1959 MSChE, Univ. Wisconsin, 1961 PhDChE, Univ. Purdue, 1969
Service on faculty	11 years
Other experience	Engineer, Union Carbide, Summer 1960
Consulting work	Department of Health of Puerto Rico
State in which registered	None
Principal publications of last five years	"ESR Spectra and phosporescence of Chromia-Silica Catalyst", J. Phys Chem.
Membership in scientific & professional societies	American Instite of Chemical Engineers, P.R. Institute of Chemical Engineers
Honors and Awards	Magna Cum Laude, UPR 1959.
Other assigned duties	Engineering faculty committee work
Programs participated in, to improve competence as teachers	Summer Institute: "Mathematical Methods in Engineering"-Kansas State Univ. 1965; Summer Conference: "Mathematics in Chemical Engineering". Oklahoma State Univ. 1965; Summer Institute: "Experimental Teachniques in Reactor Physics" Rensselaer Inst. 1963; Conference: "ASEE Summer School Of Chemical Engineering Teachers" Boulder, Col. 1962.
Research Interest	Catalysis, Reaction Mechanisms

INFORMATION REGARDING FACULTY

Name	Serth, Robert W.
Date of Birth	August 30, 1941
Academic Rank	Assistant Professor - Full Time
Degrees	BSChE, Univ. of Rochester, 1963 MSChE, State Univ. of N. Y. at Buffalo, 1966 PhDChE, State Univ. of N. Y. At Buffalo, 1968 MA, Math, Univ. of Arizona, 1970
Service on Faculty	Began January 1971
Other Experience	Instructor of Mathematics, half-time, University of Arizona, 1968-1970.
Principle Publications of last five years	"A Solution of the Two-Dimensional Boundary Layer Equations for on Ostwald-deWaele Fluid", Chemical Eng. Sci., 22, p. 945, 1967. "The effect of Turbulence on Hot-Film Anemometer Response in Viscoelastic Fluids", A.I.Ch. E. Journal, March 1970. "Turbulence Spectra in Free Jets of Viscoelastic Fluids," Journal of Fluid Mechanics.
Research Interests	Applied Mathematics, Fluid Mechanics, Transport Phenomena.

INFORMATION REGARDING FACULTY

Name	Schlossmacher, Edward J.
Date of birth	October 27, 1944
Academic rank	Assistant Professor, full time
Degrees	B.S.Ch.E. Illinois Institute of Technology, 1967 M.A.Ch.E . Princeton Univ. 1967 Ph. D. Ch.E. Princeton Univ. 1970
Service on faculty	One year
Other experience	East Ohio Gas, Co. Summers 1962-63; 64-65 AMOCO Chemical Co. Summers 1966, 67, 68, 69
Principal publications of last five years	Schlossmacher, Weinstein at al, "Perfect mixers in series model for fitting venoarterial indicator-dilution curves", Journal of Applied Physiology, 22(2):327-330 1967. Schlossmacher and L. Lapidus, "The Suboptimal Control of Non-Linear System Using Liapunov Like Functions". Submitted for publication to AIChE Journal. Schlossmacher, "Parameter Estimation Via the First Variation Technique".
Membership in scientific and professional societies	American Institute of Chemical Engineers American Chemical Society
Honors and awards	Tau Beta Pi
Other Assigned duties	Director of Process Control Laboratories
Research Interest	Applied Mathematics, Optimization

INFORMATION REGARDING FACULTY

Name	Taylor, Dan L.
Date of birth	Nov. 29, 1933
Academic rank	Associate Professor-Full Time
Degrees	BA & BSChE, Rice Univ. 1956 MSChE, Texas A & M, 1962 PhDChE, Texas A & M, 1964
Service on faculty	4 years
Other experience	Assistant Professor of Chemical Engineer South Dakota School of Mines & Tech. 1964-65; Lieutenant, US Navy, 1956-60; Senior Engineer, Humble Oil & Refining Co., Baytown, Texas, 1965,66; Engineer Union Carbide Caribe, Inc. Summer 1968
Principal publications of last five years	"A General Solution for Multicomponent Distillation Processes", Proceedings of International Symposium on Distillation, Sept. 1969, "Solutions for Distillation Processes Treating Petroleum Fractions." to be published in A.I.Ch.E. Journal.
Membership in scientific & Professional Societies	American Institute of Chemical Engineers American Chemical Society American Society for Engineering Education P.R. Institute of Chemical Engineers, Sigma Xi
Honors and awards	Phi Lambda Phi, Sigma Tau, Tau Beta Pi
Other assigned duties	Academic Affairs Committee, School of Engineering
Research Interests	Distillation

INFORMATION REGARDING FACULTY

Name	Benitez Rodríguez, Jaime
Date of birth	August 11, 1948
Academic rank	Graduate Assistant
Degrees	B.Sc. Chemical Engineering, UPR, 1970
Service on Faculty	New appointment
Other experience	Project Engineer, Union Carbide Caribe, Summer 1970 Assistant Process Engineer, Phillips P.R. Core, Summer 1969
Membership	Institute of Chemical Engineers of Puerto Rico American Institute of Chemical Engineeers Tau Beta Pi
Honors and Awards	Magna Cum Laude, UPR, 1970(highest grade index in his class)
Programs to improve	Studying towards M.Sc. in Nuclear Engineering at the University of Puerto Rico, (CAAM)

APPENDIX 4

MAJOR PHYSICAL FACILITIES AVAILABLE

MAJOR PHYSICAL FACILITIES AVAILABLE

A- Within the Department of Chemical Engineering:

1- Unit Operations:

Equipment available for experimental and / or pilot plant studies on absorption, extraction, distillation, drying, crushing and grinding, heat exchange, fluid flow, and drying.

2- Chemical processess:

A two-gallon, agitated, stainless steel reactor is available for operations up to 250 psig and 600° F.

3- Process control:

A two-tank system has been designed for studying the effects of various modes of control on a linear process.

4- Facilities in chemistry:

A fully equipped chemistry laboratory is maintained as a support facility for research and for teaching. Among its major furnishings are included an osmometer for determinations of molecular weights of high polymers, a gas chromatography unit, and an infrared spectrophotometer.

5- Computing facilities:

One EAI TR-24 analog computer is used for teaching and research purposes.

B- Department of Chemistry

1- Instrumental analysis:

Equipment available for chemical analysis by the following techniques: emission spectra; absorption spectra in ultraviolet, visible and infrared regions; Raman, X-ray, and microwave spectra; polagraphy, colorimetry, and chromatography.

C- Nuclear Center:

1- Reactors:

One 1-megawatt swimming-pool type reactor with neutron beam tubes, thermal column, gamma irradiation room, and major experimental equipment installations, including two semi-automatic spectrometers for neutron diffraction. A smaller 10-watt homogeneous enriched reactor is also available for training and research.

2- Other irradiation facilities:

A graphite-moderated neutral uranium subcritical pile, a 2,000 curie cobalt 60 gamma source, small neutron sources, and X-ray machines.

3- Special laboratories:

For work in radiochemistry, solid-state physics, and X-ray crystallography.

D- Research Center:

1- Laboratories:

Two chemistry laboratories and a microbiology laboratory adequately equipped for carrying out research projects in chemistry and in chemistry and in microbiology.

APPENDIX 5

LIBRARY RESOURCES IN CHEMICAL ENGINEERING

PARTIAL LIST OF PERIODICALS

PARTIAL LIST OF AVAILABLE PERIODICALS IN CHEMICAL ENGINEERING AND ITS RELATED FIELDS

Advanced Energy Coversion

American Chemical Society Journal

American Institute of Chemical Eng'rs. Journal

Analytical Chemistry

Biotechnology and Bioengineering

British Chemical Engineering

Canadian Journal of Chemical Engineering

Chemical Abstracts

Chemical and Engineering Data

Chemical Engineering

Chemical Engineering Progress

Chemical Engineering Science

Chemie-Ingenieor-Technik

Chemistry and Industry

Combustion

Combustion and Flame

Control Engineering

Corrosion

Cost Engineering

Cryogenics

Faraday Society

Environmental Science & Technology

Food Engineering

Fuel

Geochimica at Casmochimica Acta

Glass and Ceramics

Heating, Piping, and Air Conditioning

High Temperature

Industrial and Engineering Chemistry,

Process Design and Development

Industrial and Engineering Chemistry,

Product Research and Development

Inorganic Chemistry

Instruments and Control Systems

Internationa Chemical Engineering

International Journal of Air and Water Pollution

International Journal of Heat and Mass Transfer

International Series of Monographs of Nuclear Energy,

Division IV-Isotopes & Radiation

Journal of Air Pollution Control Association

Journal of Applied Polymer Science

Journal de Chimie Physique

Journal of Basic Engineering

Journal of Chemical Education

Journal of Chemical Physics

Journal of Heat Transfer

Journal of Metals

Journal of Inorganic & Nuclear Chemistry

Journal of Nuclear Science and Technology

Journal of Organic Chemistry

Journal of Physical Chemistry

Nuclear Energy

Oil, Paint, and Drug Reporter

Paper Industry

The Petroleum Engineer

Progress in Reaction Kinetics

Plastics Technology

Proceedings of the American Petroleum Institute

Radiochemistry

Solar Energy

Theoretical and Experimental Chemistry

Transaction of the Institution of Chemical Engineers

Water Pollution Control Federation, Journal

APPENDIX 6

GRADUATE SCHOOL REGULATIONS

UNIVERSITY OF PUERTO RICO
Mayaguez, Puerto Rico

Graduate Studies

REGULATIONS

ORGANIZATION

Graduate instructions at the College of Agriculture and Mechanic Arts of the University of Puerto Rico is organized to provide opportunities and facilities for advanced study and research in the fields of Agriculture, Biology, Chemistry, Mathematics, Nuclear Science and Technology, and Radiological Physics. The purpose of these graduate programs is to develop in advanced students a more adequate comprehension of the scope of knowledge in these special fields of learning and an understanding of the requirements and responsabilities essential for independent research investigations. In all graduate programs emphasis is placed on a high level of scholarship rather than on the satisfaction of specific course or credit requirements.

FACILITIES

The full resources of the College of Agriculture and Mechanic Arts, including its academic divisions and departments, the Agricultural Experiment Station, the Nuclear Center, the Research Center, the Institute of Marine Biology, and other dependencies, are available to all graduate students enrolled at this campus. This includes personnel, laboratories, equipment and other facilities needed for laboratory or field research. The high speed IBM computation system of the Computation Center and the X-Ray Diffraction and Spectographic Laboratory are also available for graduate instruction and research.

Library facilities, which include all the library resources of the University of Puerto Rico under a centralized system and a common card catalog currently being prepared, are also available.

ADMISSIONS

The applicant should obtain from the office of Graduate Studies the necessary forms on which to make his application. Transmission of these forms, together with three letters of recommendation from college faculty members who are acquainted with his academic qualifications, character and ability, and three official transcripts of all undergraduate and graduate work, normally completes an application for admission.

All credentials should be submitted to the office of Graduate Studies at least four weeks prior to the registration date for the semester or summer session which the applicant plans to attend. Applicants who have been away from school for several years may submit recommendations from persons acquainted with their work.

Admission to Graduate Studies is granted by the Graduate Council as upon the recommendation of the Department concerned, and is based primarily on the applicant's undergraduate record. Candidates elegible for admission to Graduate Studies will be sent a permit to register, which will state the conditions under which he may enter. Transcripts of applicants who are admitted become a permanent part of the university files and cannot be returned.

Graduates of institutions other than the University of Puerto Rico will submit the credentials listed above and in addition may be asked to take placement examinations in their major field to determine the quality of their previous training and to guide their counselors in determining the courses best suited for their particular program.

Admission to Graduate Studies may be as follows :

A - Full graduate standing

The requirements for admission to this category are :

1. A degree equivalent to the bachelor's degree granted by the University of Puerto Rico in the proposed field of study.

2. A general grade index of 2.5 or better (on the basis of A = 4.00), or of 3.00 in the major field subjects.

B- Admission with deficiencies.

If the applicant possesses a bachelor's degree but does not fully meet requirement A-1 above, he may be considered for admission with deficiencies. Students admitted in this category must make up these deficiencies during the first year of graduate work and may be required to spend more time in residence than that normally required for the degree sought.

C- Admission on probation

In exceptional cases students whose records show an undergraduate greade-point average slightly below 2.5, but who meet all other requirements for admission with full graduate standing, may be admitted on probation provided that other substantial evi-

dence of scholastic aptitude and or professional achievement are presented. A student who is admitted on probation must carry a full graduate program (12 to 15 credits for a normal semester or 3 to 6 credits for a summer session) during the first term of residence and must obtain an overall grade-index of 3.00 or better in order to be permitted to continue graduate studies.

D - Admission on Senior - Graduate basis

Seniors in the College of Agriculture and Mechanic Arts within 12 credits of graduation, who have earned a general grade-index of 3.00 or better and who can otherwise meet all requirements for admission to Graduate Studies with full standing, may be admitted under this category. The student may enroll for one semester in this status and may carry up to 6 credits of graduate work. He will receive graduate credit only if he completes the requirements for the bachelor's degree at the end of the semester during which he is so enrolled.

E - Unclassified

Under this category may be admitted candidates who otherwise qualify for admission but who do not seek a degree at the institution. The credits earned under this classificiation will not be counted toward residence.

GRADUATE GRADING SYSTEM

Unit of Instruction - One graduate credit consists of one hour of lecture discussion or two to four hours of laboratory or one to two hours of seminar or other work of similar nature per week during the semester.

Graduate Grades - The grades in graduate studies are as follows: A-Excellent; B-Good; C-Satisfactory- D-Deficient (carries no graduate credit); F-Failure; W-Withdrawal; I-Incomplete; P-Passed.

Graduate Grade Index - The graduate grade index serves as a basis for measuring and evaluating the academic performance of the student. It is computed by dividing the total number of honor points earned by the total number of credits in graduate subjects in which the student received a final grade including the grade of F but not the grades of W and P. Honor points are assigned to each grade as follows: A:4, B:3, C:2, D:1, F:0.

The graduate grade index is considered satisfactory when it is 3.00 or above, which is equivalent to an average of B.

Graduate Course Numbering System - All graduate courses are designated by a three digit number according to the following system: 551-599 - courses for advanced undergraduate and graduate students; 600 up - courses for graduate students only.

ADMISSION TO CANDIDACY FOR GRADUATE DEGREE

Admission to a graduate program does not constitute or imply admission to candidacy for a graduate degree. Application for admission to candidacy for a graduate degree must be submitted to the Graduate Council after the satisfactory completion of one full semester of graduate study but before the end of the first nine weeks of the last semester in residence. Approval of the application will be based on the quality of the graduate work of the student as certified by the major department.

REQUIREMENTS FOR THE MASTER OF SCIENCE DEGREE

The Master of Science Degree is awarded by the College of Agriculture and Mechanic Arts of the University of Puerto Rico after satisfactory completion of the course work required of the student, demonstration of the ability to read a foreign modern language, completion of a satisfactory thesis, and the passing of a comprehensive final examination. In addition to these requirements, the candidate for the degree is expected to maintain a high level of scholarship. Graduate work is distinguished from undergraduate instruction by its emphasis on research. Training is provided to give the student familiarity with the methods, ideals and goals of independent investigation. The student's program of study is planned with these ideals in mind and the administration of his program is under the supervision of a special advisory committee. His course work and the thesis problem selected mut be approved by this advisory committee and by the Graduate Council. The advisory committee will consist of at least three faculty members, appointed by the Graduate Council upon the recommendation of the Head of the major department. The advisory committee will meet with the student to prepare his program according to the student's graduate objectives. This program must be approved by the Director of the major department and the Graduate Council.

Hours of Credit - A minimum of thirty semester hours of credit in approved graduate courses is required for the Master's degree. Not more than six credit hours of "courses for advanced undergraduates and graduates" will be accepted toward the degree. At least fifteen credit hours shall be earned in the major subject and six credit hours shall be taken in graduate courses in related fields. At least 24 credit hours must be earned in graduate courses at the University of Puerto Rico (Mayaguez Campus). A maximum of six credit hours may be accepted from other graduate schools. Twelve

to fifteen credit hours constitute a full load for graduate students. Under no circumstances shall a graduate student be permitted to carry a higher load.

Residence - Residence at the University of Puerto Rico (Mayaguez Campus) for at least one academic year as a regular graduate student is required for the Master of Science Degree. An academic year of residence is defined as registration for and attendance in graduate courses aggregating not less than twenty four credit hours distributed over a period of not less than two semesters. Three summer sessions of six weeks may be considered the equivalent of one semester.

Grade Index - A minimum grade index of 3.00 must be obtained in all graduate courses taken. Failure to obtain this average in any semester will automatically place the student on probation. No graduate credit will be earned in courses approved with a grade of C in excess of six credits. Courses passed with a grade lower than C carry no graduate credit.

Language Requirements - A reading knowledge of a modern foreign language is required of candidates for a Master of Science degree. The specific language requirements are established by the different departments and programs. Knowledge is determined by the language departments on the basis of a reading examination given in cooperation with the student's major department on dates set forth and scheduled by the language departments. Students whose knowledge of the language is not adequate should confer with the directors of the language departments to formulate plans for meeting this requirements for the degree.

THESIS REQUIREMENT

All candidates for the Master of Science degree must present a thesis representing investigation or research. The subject of the thesis must be approved by the director of the student's major department and by the student's advisory committee. Three copies of the thesis in final form and three copies of the abstract must be filed in the office of the Graduate Council at least one week before the final examination. Detailed instructions as to the form and organization of the thesis may be obtained from the academic departments.

Examination Requirements - Requirements for a Master of Science degree are not measured solely in terms of accumulated credits. Each candidate must pass a final oral examination covering the general field of his major study, courses in related fields and his thesis. This examination cannot be held until all requirements are satisfied with the exception of the course work in progress. The examination will be conducted by the student's graduate

advisory committee and a representative from the Graduate Council at a date set forth by them. The date of the examination will be announced publicly, and members of the University faculty may attend. In special cases, a written examination may be substituted for the oral examination. In case of failure the candidate may not appear for re-examination until one semester has elapsed. The result of the second examination is final.

WITHDRAWALS AND DISMISSALS

A student will not be elegible for candidacy for the Master of Science degree and will be permanently suspended from Graduate Studies in the following cases:

1) If he receives a grade of C or lower in ten or more credits of graduate courses in his program of study.

2) If he receives a grade of D in any two graduate courses, or in one course in his major field.

3) If he receives a grade of F in any graduate course in his program of study.

4) If he fails the second time he takes a final examination.

5) If he fails to pass the foreign language proficiency test for the third time.

6) If he fails to fulfill all the requirements for graduation within six calendar years from the date of his admission to the Graduate School.

7) In any other circumstance specifically indicated by the Department in which the student is enrolled.

A graduate student should avoid as much as possible the dropping of courses. Nevertheless, he will be permitted to do so with the approval of his advisor. Except in case of illnes, certified by a competent physician, no student will be allowed to drop courses during the last eight weeks of a regular semester. An unauthorized withdrawal will impose the grade of F. A student who dropsall courses will automatically be withdrawn from Graduate Studies. Any student permanently suspended or who has withdrawn from Graduate Studies must apply for readmission if he intends to continue graduate work.

APPENDIX 7

DESCRIPTIONS OF COURSES

DESCRIPTION OF COURSES

A- Advanced Undergraduate and Graduate Courses

1- CH EG 558 Process Heat Transfer. Three credit hours. Two lectures and one two-hour computation period per week. Prerequisite: Ch Eg 402.

Design of heat exchangers for chemical processes. Condensers and condensation of multicomponent mixtures, natural and forced circulation evaporation, and extended surface heat exchangers. Conduction, convection, and steady and unsteady state heat transfer processes.

2- CH EG 570 Comprehensive Projects in Chemical Engineering. Two credit hours. Six hours of Laboratory work per week. Prerequisite: Ch Eg. 554.

Chemical Engineering problems which involve integration of knowledge previously acquired in this field.

B- Graduate Courses

1- CH EG. 601 Mathematical Topics in Chemical Engineering I. Three Credit Hours. Three one hour lecture-discussion periods per week. Correquisite: CHEG. 632 or CH EG 661

Methods of Mathematical analysis and formulation as applied in the solution of chemical engineering problems. Principles of linear algebra, Vector analysis and advanced solutions to ordinary differential equations.

2- CH. EG. 602 Mathematical Topics in Chemical Engineering II. Three Credit Hours. Three one-hour lecture-discussion periods per week. Prerequisite: CH EG. 601

A continuation of CH EG. 601 The formulation and solution of partial differential equations in process problems. Boundary value problems and orthogonal functions.

3- CH EG 605 Chemical Engineering Graduate Laboratory. Two Credit Hours. Two three hour laboratory periods per week. Correquisite: CH EG 632 or CH EG 661.

Advanced laboratory experiments on Unit Operations and Unit Processes, stressing the use of modern instrumentation and analytical techniques.

4- CH EG 611. Reactor Design. Three Credit Hours. Three lectures per week. Prerequisite: Ch Eg 511

Analysis and design of batch and continuous chemical reactors for homogeneous, catalytic and non-catalytic reactions. Residence time distributions; influence of mass and heat transport on yield and product distributions; other topics on reactor design.

5- CH EG 614. Simulation of Chemical Processes. Three credit hours. Three lectures per week. Prerequisite: Ch EG 359.

A study of modern numerical procedures suitable for digital and hybrid computer simulations. The numerical treatment of chemical engineering data via orthogonal and non-orthogonal expansions, non-linear estimation techniques, numerical solutions of linear and non-linear systems. Design of experiments.

6- CH EG 615 Optimization of Chemical Processes. Three credit hours. Three lectures per week. Prerequisite: Ch Eg 614.

Applications of dynamic programming, the maximum principle and gradient procedures to the control and optimization of chemical engineering systems. Error propagation and real time simulation by hybrid computers. Process modelling.

7- CH EG 617 Advanced Plant Design. Three credit hours. Three lectures per week. Prerequisite: Ch Eg 569.

An advanced course in chemical engineering process covering the creation and evaluation of design alternatives using systems techniques.

8- Ch EG 620 Water Desalination. Three credit hours. Three lectures per week Prerequisite: Ch Eg. 462, Ch. Eg. 432.

A thermodynamic and economic study of the production of domestic and agricultural water from the sea and brackish supplies.

9- CH EG 623 Chemical Engineering of High Polymers. Three credit hours. Three lectures per week. Prerequisite: Ch. Eg. 432 Ch. Eg. 661

The thermodynamics of high polymer solutions. Swelling of crosslinked polymers. Crystallization of polymers. Application of thermodynamic theory to molecular weight determinations, solvent evaluation, and polymer fractionation. Polymer processing.

10- CH.EG. 632 Transport Phenomena. Three credit hours. Three lectures per week. Prerequisite: Ch. Eg. 599 or parallel to it.

Advanced analysis of momentum, energy and mass transport in continous media. Topics covered include: analytical and approximate solutions to the equations of change, transport coefficients, boundary layer theory, overall balances, dimensional analysis, empirical treatments and simulaneous transport processes. Emphasis is on the modelling and characterization of systems of interest in chemical engineering.

11- CH EG 634 Analysis of Separation Processes. Three credit hours three lectures per week. Prerequisite: Ch. Eg. 632.

Principles and procedures for analysis of separation operations using the concept of the equilibrium stage. Machine computation methods for multicomponent separations. Differential description of phase change separations. Use of transform and characteristic methods.

12- CH EG 658 Advanced Heat Transfer. Three credit hours. Three lectures per week. Prerequisite: Ch. Eg. 632

Advanced studies in heat transmission and their application to equipment design and to chemical process calculations.

13- CH EG 661 Advanced Thermodynamics. Three credit hours. Three lectures per week. Ch. Eg. 462

Advanced topics in thermodynamics including the properties of real gases, non ideal solutions, phase and chemical equilibria of multicomponent systems. Elements of statistical thermodynamics and irreversible processes.

14- CH EG 662 Catalysis. Three credit hour s. Three lectures per week. Prerequisite: Ch. Eg. 661

A study of heterogeneous reactions, rate of reaction, catalyst activity and selectivity, and surface chemistry. An analysis of industrial catalysts with implications in the design of chemical reactors.

15- CH EG 680 Instrumentation and Process Control. Three credit hours. Three lectures per week. Prerequisite Ch. Eg. 580

A study of the principles of measurement and control of multidimensional processes. Analogue simulation and Laplace transform techniques. Direct digital methods of control are presented.

16- CH EG 690 Graduate Seminar. One credit hour. Meetings by arrangement. Prerequisite: Graduate student status.

Research presentations by graduate students and faculty members.

17- CH EG 699 Master Thesis. One to six credit hours.

A research project undertaken by graduate students under the direction of a faculty member. Topics and scope of the project may vary but in all cases the outcome should be a contribution of value to the Chemical Engineering profession.