UNIVERSITY OF MIAMI
FACULTY SENATE

The John Knoblock
Faculty Senate Office

Ashe Administration Building, #325
1252 Memorial Drive
Coral Gables, Florida 33146

facsen@miami.edu
fs.miami.edu
Ph: 305-284-3721
Fax: 305-284-5515

MEMORANDUM

To: Julio Frenk
University President

From: Linda L. Neider
Chair, Faculty Senate

Date: April 22, 2021

Subject: Faculty Senate Legislation #2020-88(B) – Creation of a Ph.D. in Chemical, Environmental, and Materials Engineering, College of Engineering.

Reference Legislation:
#2020-84(B) – Creation of a Department of Chemical Environmental, and Materials Engineering (CEM), College of Engineering.

#2020-85(B) – Name Change of the Department of Civil, Environmental and Architectural Engineering TO the Department of Civil and Architectural Engineering (CAE), College of Engineering

#2020-86(B) – Transfer of Undergraduate Program in Environmental Engineering (ENV) from the Department of Civil and Architectural Engineering (CAE) to the Department of Chemical Environmental, and Materials Engineering (CEM), Including the Bachelor of Science (B.S.) in ENV Inclusive of the B.S. within the 5-year B.S./M.S. program (B.S. in ENV/M.S. in Civil Engineering), plus the Minor in Environmental Engineering, College of Engineering

#2020-87(B) – Transfer Four Tenured Faculty Members Who Identify as Belonging in the Environmental Engineering (ENV) from the Department of Civil and Architectural Engineering (CAE) to the Department of Chemical Environmental, and Materials Engineering (CEM), College of Engineering

****

The Faculty Senate, at its April 21, 2021 meeting, had no objections to the creation of a Ph.D. in Chemical, Environmental, and Materials Engineering in the College of Engineering. This Ph.D. will provide high-quality undergraduate and graduate education in chemical, environmental, and materials engineering that will prepare graduates for professional careers and a lifetime of learning.

The proposal is enclosed for your reference.

This legislation is now forwarded to you for your action.

LLN/rh/va

Enclosure

cc: Jeffrey Duerk, Executive Vice President and Provost
Pratim Biswas, Dean, College of Engineering
Helena Solo-Gabriel, Professor, College of Engineering
Qingda Yang, Professor, College of Engineering

CAPSULE: Faculty Senate Legislation #2020-88(B) – Creation of a Ph.D. in Chemical, Environmental, and Materials Engineering, College of Engineering

PRESIDENT'S RESPONSE

APPROVED:  DATE: 4/22/21
(President's Signature)

OFFICE OR INDIVIDUAL TO IMPLEMENT: Pratim Biswas, Dean, College of Engineering

EFFECTIVE DATE OF LEGISLATION: IMMEDIATELY
(pending any additional approval by the Board of Trustees)

NOT APPROVED AND REFERRED TO: _____

REMARKS (IF NOT APPROVED):_____

: PHD IN CHEMICAL, ENVIRONMENTAL, AND MATERIALS ENGINEERING

In Workflow

1. PG Initial Review (pxm491@miami.edu)
2. PG University Accreditation (pxm491@miami.edu)
3. PG GR School (t.plantan@miami.edu; gprado@miami.edu; amas@miami.edu; jlopez4@miami.edu)
4. PG Graduate Council (amas@miami.edu; t.plantan@miami.edu; gprado@miami.edu; jlopez4@miami.edu)
5. PG GR Dean (gprado@miami.edu)
6. PG FS Office for GWC (rhardeman@miami.edu; yvaldes1@miami.edu; leslie.leonard@miami.edu)
7. PG FS GWC (rhardeman@miami.edu; yvaldes1@miami.edu; leslie.leonard@miami.edu)
8. PG Faculty Senate (rhardeman@miami.edu; yvaldes1@miami.edu; leslie.leonard@miami.edu)
9. PG FS for President (rhardeman@miami.edu; yvaldes1@miami.edu; leslie.leonard@miami.edu)
10. PG FS President Approved (rhardeman@miami.edu; yvaldes1@miami.edu; leslie.leonard@miami.edu)
11. PG Registrar (j.zwanziger@miami.edu; kbeckett@miami.edu; pquiles@miami.edu)

Approval Path

1. Fri, 05 Mar 2021 15:55:47 GMT
   Patty Murphy (pxm491): Approved for PG Initial Review
2. Fri, 05 Mar 2021 15:57:16 GMT
   Patty Murphy (pxm491): Approved for PG University Accreditation
3. Tue, 09 Mar 2021 18:23:25 GMT
   Tiffany Plantan (tplantan): Approved for PG GR School
4. Fri, 19 Mar 2021 14:10:42 GMT
   Tiffany Plantan (tplantan): Approved for PG Graduate Council
5. Sat, 20 Mar 2021 19:10:31 GMT
   Guillermo Prado (gprado): Approved for PG GR Dean

New Program Proposal

Date Submitted: Fri, 05 Mar 2021 13:51:57 GMT

Viewing: PhD in Chemical, Environmental, and Materials Engineering :
Last edit: Fri, 05 Mar 2021 15:46:13 GMT

Changes proposed by: Helena Solo-Gabriele (hsolo)

Date Entered in CaneLink

Date Entered in CaneLink

Please list the authors of this proposal including name, rank/title, program/department, and school.

Proposer(s) Name

Pratim Biswas, Professor and Dean, College of Engineering

Career

Graduate

Academic Structure

School/ College	Department
College of Engineering	Engineering

Plan Type

Major and/or Degree

Degree Type

Doctorate

Degree Name

Doctor of Philosophy

Proposed Plan Code
CEM_PHD

Proposed CIP Code
14.0701 - Chemical Engineering.

Plan Name
PhD in Chemical, Environmental, and Materials Engineering

Will there be any subcomponents within the program such as concentrations, specializations, thesis/non-thesis options, or tracks?
Yes

Subcomponents

Subcomponent Type	Subcomponent Name
Concentration	Environmental Engineering

Effective Term
Fall 2021

First Term Valid
Fall 2021

Program Instruction Mode
In Person

Where is the program offered?

Location	Please provide the % of instruction at each location.
Coral Gables Campus	100%

Program Length (Years)
4

Total Credits
60

To Be Published in the Academic Bulletin

Program Overview

Overview

The Department of Chemical, Environmental, and Materials Engineering (CEM) offers a Doctor of Philosophy (Ph.D.) degree in Chemical, Environmental, and Materials Engineering with the following areas of emphasis:

- Chemical Engineering
- Environmental Engineering
- Materials Science and Engineering

The educational objectives of the Doctor of Philosophy program in Chemical, Environmental and Materials Engineering are to produce graduates whom:

1. Have advanced technical knowledge in at least one specialty area of chemical, environmental and materials engineering
2. Have advanced capability to apply advanced knowledge to engineering problems
3. Have made significant contributions in at least one specialty area of chemical, environmental, and materials engineering

The specialty areas of study for the Ph.D. include:

- Aerosols
- Water Systems
- Synthetic Biology
- Materials Synthesis

The College has embarked on six research thrust areas, and students can relate the above specialty areas to these and work on focused problems related to the six college wide research thrusts.

Students joining the PhD program in CEM will need 60 credits beyond a BS degree to graduate. Thirty of these will be course work units, and 30 will research credit units. For students who already have an earned Master of Science (in either civil, environmental, chemical, or materials engineering, or a closely related engineering field), the MS degree can count up to a maximum of 30 credits total, with approval of the Graduate Advisor and the student's PhD Committee. For students counting the maximum of 30 credits from an applicable MS degree, another 30 credits must be taken in residence at the University of Miami with a minimum of 15 of these 30 credits in course work units. All PhD students are required to engage in supervised research and defend a dissertation.

The following are the major requirements for the degree:

1. Take selected core classes in Year 1, and pass a Comprehensive Exam (first part of Qualifying Exam) at the end of Year 1
2. To demonstrate teaching participation, TA at least 2 classes, preferably in Year 2 or later.
3. Engage in research and defend a proposal by end of Year 2 (second part of Qualifying Exam), and be admitted to Candidacy.
4. Complete a PhD dissertation at end of program and defend the same to earn the degree. Students are encouraged to publish the results of their work in at least 1 refereed journal publication but preferentially 3.

The Program of Study is the student's specific set of coursework that defines the course requirements for graduation and must be approved by an advisory committee (known as the Supervisory Committee). Depending on whether the student already has an earned M.S. degree, the Ph.D. degree can typically be completed within two to five years.

Program Mission Statement

Mission

The mission of the Department of Chemical, Environmental, and Materials Engineering is to:

- Provide high-quality undergraduate and graduate education in chemical, environmental, and materials engineering that will prepare graduates for professional careers and a lifetime of learning.
- Conduct high-quality research that will advance the current body of knowledge and engage in new discoveries to improve the quality of human life; and
- Serve the engineering profession and society through active involvement in professional organizations and contribution of professional expertise.

The departmental mission will be accomplished by providing an integrated and multidisciplinary scientific education. Graduates from this department will be involved in the transfer of scientific discoveries to modern technologies and novel products that benefit society and minimize the impact on the environment. They will be trained to address multi-scale aspects of generating clean energy, producing novel and superior materials, and utilizing the biological revolution to manufacture new products. They will be involved in the development and manufacture of consumer products, as well as in design, operation, and control of processes in a variety of industries (e.g. petroleum, petrochemical, chemical, consumer products, semiconductor, environmental technologies, advanced materials, food, feed and pharmaceuticals).

Program Goals

Goals

The educational objectives of the Ph.D. program are to produce graduates whom:

- Have advanced technical knowledge in at least one specialty area of chemical, environmental, or materials engineering;
- Have advanced capability to apply advanced knowledge to engineering problems; and
- Have made significant contributions in at least one specialty area of chemical, environmental, or materials engineering.

Specialty areas include aerosols, water, synthetic biology, and materials synthesis.

Student Learning Outcomes

Student Learning Outcomes

- Students will demonstrate an advanced knowledge of the discipline (mathematics, science, and engineering), including methodology relevant to a specialty area.
- Students will demonstrate an advanced ability to identify, formulate, and solve engineering problems to carry out supervised research.
- Students will demonstrate an advanced ability to generate technical contributions and effectively communicate them to the scientific community.

Curriculum Requirements

Curriculum Requirements

Ph.D. in Chemical, Environmental, and Materials Engineering

Environmental Engineering Concentration

For a Ph.D. following an M.S.

For students who already have an earned M.S. (in civil, architectural, or environmental engineering), a minimum of 30 graduate-level credits are required beyond the M.S. degree with an average of "B" or better and no grade below a "C". Of the credits. The table presents an overview of the courses selection:

Code	Title	Credit Hours
At least 6 credits of lecture-based CEM courses at the 700-level (not Independent Study) such as the following:		**6**
CAE 730	Environmental Hydrology	
CAE 735	Water and Wastewater Engineering: Treatment and Reuse	
CAE 743	Risk Analysis	
Any lecture-based and/or Independent Study courses		**12**
CAE 630	Water Resources Engineering II	
CAE 631	Surface-Water Hydrology	
CAE 632	Ground-Water Hydrology	
CAE 633	Water-Quality Control in Natural Systems	
CAE 640	Environmental Chemistry	
CAE 641	Engineering Systems for Disease Control and Bioremediation	
CAE 642	Solid and Hazardous Waste Engineering	
CAE 730	Environmental Hydrology	
CAE 735	Water and Wastewater Engineering: Treatment and Reuse	
CAE 743	Risk Analysis	
Other courses with advisor approval such as the following:		
BME 635	Advanced Biomaterials	
BME 687	Finite Element Analysis for Engineers	
BME 695	Current Trends in Regenerative Medicine - COURSE PROPOSAL IN PROGRESS	
BME 702	Organs on Chips	
CAE 660	Sustainable Construction	
CAE 716	Fracture Mechanics	
ECE 643	BioNanotechnology	
MAE 632	Additive Manufacturing of Engineering Materials	
MAE 616	Introduction to Composite Materials	
ATM 624	Applied Data Analysis	
ATM 634	Introduction to Atmospheric Chemistry	
ATM 637	Natural Hazards: Atmosphere and Ocean	
ATM 651	Introduction to Atmospheric Dynamics	
ATM 652	Introduction to Atmospheric Physics	
ATM 731	Air-Sea Interaction	
ATM 732	Climate Dynamics	
ATM 762	Computer Models in Fluid Dynamics	
ATM 764	Atmospheric and Oceanic Turbulence	
RSM 611	Principles of Mass Spectrometry and Applications to Marine, Atmospheric, and Environmental Science	
RSM 672	Special Topics (Introduction to Science Policy)	
BMB 717	Nutrients, Enzymes, and Metabolic Flux	
CHM 641	Principles of Bonding and Reactivity in Inorganic Chemistry	
CHM 691	Topics in Chemistry (Organometallic Chemistry and Catalysis)	
12 credits of Doctoral Dissertation		**12**
CAE 830	Pre-Candidacy Doctoral Dissertation	
CAE 840	Post-Candidacy Doctoral Dissertation	
CAE 850	Research in Residence	
Total Credit Hours		30

* At least 18 credits in CEM

** A total of 6 credits of transfer and/or exchange coursework may be taken at another institution and used to satisfy the requirements for the Ph.D. degree. Only credits that have not been used towards another degree can be transferred.

Note: All courses, except Dissertation, are 3 credit hours unless otherwise indicated. Refer to the Additional Details section (below) for additional options and restrictions.

For a Ph.D. without prior M.S.

For students who do not have an M.S. (in civil, architectural, or environmental engineering), a minimum of 60 graduate-level credits are required beyond the B.S. degree with an average of "B" or better and no grade below "C". Of the 60 credits. The table presents an overview of the course selection:

Code	Title	Credit Hours
At least 12 credits of lecture-based CEM or other approved courses at the 700-level (not Independent Study) such as the following:		**12**
CAE 730	Environmental Hydrology	
CAE 735	Water and Wastewater Engineering: Treatment and Reuse	
CAE 743	Risk Analysis	
Any lecture-based and/or Independent Study courses		**18**
CAE 630	Water Resources Engineering II	
CAE 631	Surface-Water Hydrology	
CAE 632	Ground-Water Hydrology	
CAE 633	Water-Quality Control in Natural Systems	
CAE 640	Environmental Chemistry	
CAE 641	Engineering Systems for Disease Control and Bioremediation	
CAE 642	Solid and Hazardous Waste Engineering	
CAE 730	Environmental Hydrology	
CAE 735	Water and Wastewater Engineering: Treatment and Reuse	
CAE 743	Risk Analysis	
Other courses with advisor approval such as the following:		
BME 635	Advanced Biomaterials	
BME 687	Finite Element Analysis for Engineers	
BME 695	Current Trends in Regenerative Medicine - COURSE PROPOSAL IN PROGRESS	
BME 702	Organs on Chips	
CAE 660	Sustainable Construction	
CAE 716	Fracture Mechanics	
ECE 643	BioNanotechnology	
MAE 632	Additive Manufacturing of Engineering Materials	
MAE 616	Introduction to Composite Materials	
ATM 624	Applied Data Analysis	
ATM 634	Introduction to Atmospheric Chemistry	
ATM 637	Natural Hazards: Atmosphere and Ocean	
ATM 651	Introduction to Atmospheric Dynamics	
ATM 652	Introduction to Atmospheric Physics	
ATM 731	Air-Sea Interaction	
ATM 732	Climate Dynamics	
ATM 762	Computer Models in Fluid Dynamics	
ATM 764	Atmospheric and Oceanic Turbulence	
RSM 611	Principles of Mass Spectrometry and Applications to Marine, Atmospheric, and Environmental Science	
RSM 672	Special Topics (Introduction to Science Policy)	
BMB 717	Nutrients, Enzymes, and Metabolic Flux	
CHM 641	Principles of Bonding and Reactivity in Inorganic Chemistry	
CHM 691	Topics in Chemistry (Organometallic Chemistry and Catalysis)	
30 credits of Doctoral Dissertation		**30**
CAE 830	Pre-Candidacy Doctoral Dissertation	
CAE 840	Post-Candidacy Doctoral Dissertation	
CAE 850	Research in Residence	
Total Credit Hours		60

* At least 30 credits in CEM

** A total of 12 credits of transfer and/or exchange coursework may be taken at another institution and used to satisfy the requirements for the Ph.D. degree. Only credits that have not been used towards another degree can be transferred.

Note: All courses, except Dissertation, are 3 credit hours unless otherwise indicated. Refer to the Additional Details section (below) for additional options and restrictions.

Comprehensive Examination

A Ph.D. student must pass a Comprehensive Examination, generally taken at the end of the first year of study, before being allowed to defend a dissertation proposal. The Comprehensive Examination, administered by the student's Supervisory Committee, must consist of a written component, and may also include an oral component if deemed appropriate by the Supervisory Committee. Three outcomes of the examination are possible: *Pass, Fail,* and *Fail with option to re-take once*. For students retaking the exam, the Committee will determine a suitable time frame, but not to exceed 6 months.

Dissertation Proposal Defense

Subsequent to passage of the Comprehensive Examination, the student can defend his/her Dissertation Proposal to their Dissertation Committee. The Dissertation Proposal Defense is considered to represent the second part of the Qualifying Exam. Students may proceed to Admission to Candidacy upon successful completion of the Qualifying Exam. The Dissertation Committee is typically the same as the student's Supervisory Committee or, if not, has makeup equivalent to the Supervisory Committee. All Committee members must approve the Proposal.

Admission to Candidacy

Admission of the student to Candidacy is subject to passage of the Qualifying Exam which includes, the passage of the Comprehensive Examination and passage of the oral Dissertation Proposal Defense.

Dissertation Defense

The Ph.D. thesis must be defended to, approved by, and signed by the student's Dissertation Committee, which is typically the same as the student's Supervisory Committee or, if not, has a composition that is equivalent to the Supervisory Committee.

Additional Details

- Master's Design Project (e.g., CAE 604 (https://bulletin.miami.edu/search/?P=CAE%20604)) *will not* count towards the Ph.D. degree requirements.
- Internships, Practical Training, workshops, or other types of practicum are neither required nor optional credit-earning components in the established graduate curriculum (Program of Study). Credit earned through these experiences (such as UMI 605 (https://bulletin.miami.edu/search/?P=UMI%20605)) *will not* count towards any CEM degree requirements.
- At a minimum, a comprehensive exam and a final public oral examination in defense of the thesis are required.
- The Supervisory Committee (and Dissertation Committee) must have a minimum of 4 members, including:
- Committee Chair (Advisor) shall be full-time CEM faculty and a member of the Graduate Faculty.
- CEM faculty and a member of the Graduate Faculty
- A member of the University of Miami Graduate Faculty
- Non-CEM member with an earned PhD

Plan of Study

Suggested Plan of Study

Ph.D. in Chemical, Environmental, and Materials Engineering

Environmental Engineering Concentration
M.S. to Ph.D. Pathway - Fall Admission

Year One		
Fall		**Credit Hours**
CAE 640	Environmental Chemistry	3
CAE 735	Water and Wastewater Engineering: Treatment and Reuse	3
CAE 830	Pre-Candidacy Doctoral Dissertation	1
	Credit Hours	7
Spring		
CAE 642	Solid and Hazardous Waste Engineering	3
CAE 743	Risk Analysis	3
CAE 830	Pre-Candidacy Doctoral Dissertation	1
	Credit Hours	7
Summer		
Comprehensive Examination (August)		
	Credit Hours	0
Year Two		
Fall		
CAE 641	Engineering Systems for Disease Control and Bioremediation	3
CAE 830	Pre-Candidacy Doctoral Dissertation	4
	Credit Hours	7

Spring		
CAE 730	Environmental Hydrology	3
CAE 830	Pre-Candidacy Doctoral Dissertation	4
Dissertation Proposal (Admission to Candidacy)		
	Credit Hours	7
Summer		
Research		
	Credit Hours	0
Year Three		
Fall		
CAE 840	Post-Candidacy Doctoral Dissertation	1
	Credit Hours	1
Spring		
CAE 840	Post-Candidacy Doctoral Dissertation	1
	Credit Hours	1
	Total Credit Hours	30

Direct B.S. to Ph.D. Pathway - Fall Admission

Year One		
Fall		**Credit Hours**
CAE 630	Water Resources Engineering II	3
CAE 640	Environmental Chemistry	3
CAE 735	Water and Wastewater Engineering: Treatment and Reuse	3
	Credit Hours	9
Spring		
CAE 642	Solid and Hazardous Waste Engineering	3
CAE 743	Risk Analysis	3
Elective (700 level)		3
	Credit Hours	9
Summer		
Comprehensive Examination (August)		
	Credit Hours	0
Year Two		
Fall		
CAE 633	Water-Quality Control in Natural Systems	3
CAE 641	Engineering Systems for Disease Control and Bioremediation	3
CAE 830	Pre-Candidacy Doctoral Dissertation	1
	Credit Hours	7
Spring		
CAE 730	Environmental Hydrology	3
CAE 830	Pre-Candidacy Doctoral Dissertation	4
	Credit Hours	7
Summer		
Research		
	Credit Hours	0
Year Three		
Fall		
CAE 730	Environmental Hydrology	3
CAE 830	Pre-Candidacy Doctoral Dissertation	4
Dissertation Proposal (Admission to Candidacy)		
	Credit Hours	7
Spring		
CAE 840	Post-Candidacy Doctoral Dissertation	7
	Credit Hours	7

Summer		
Research		
	Credit Hours	0
Year Four		
Fall		
CAE 840	Post-Candidacy Doctoral Dissertation	7
	Credit Hours	7
Spring		
CAE 840	Post-Candidacy Doctoral Dissertation	7
Dissertation Defense		
	Credit Hours	7
	Total Credit Hours	60

Admission Requirements

Admission Requirements

All applicants to the graduate program are required to submit official academic transcripts, GRE scores (optional for some MS programs), and a minimum of three letters of reference. Specific admission criteria are described in this Bulletin under Engineering (https://bulletin.miami.edu/graduate-academic-programs/engineering/) - General Admission Requirements.

Applicants who hold a bachelor's degree in a field other than chemical, environmental or materials engineering may be admitted to the graduate program (and to candidacy, if applicable) upon completion of (a) the regular graduate degree requirements, and (b) 31 undergraduate deficiency credits, which include:

1. Calculus (6 credits)
2. Advanced Mathematics
   - Differential Equations, or other mathematics similar in rigor (3 credits)
   - Probability and Statistics (3 credits)
3. General Chemistry (3 credits)
4. Calculus-based Physics (7 credits)
5. Statics (3 credits)
6. Engineering Science related to area of study (3 credits)
   - Examples of Engineering Science courses include Mechanics of Materials, Fluid Mechanics, Dynamics, and Thermodynamics
7. Engineering Design related to area of study (3 credits)
   - Examples of Engineering Design courses include Water-Resources Engineering I and Water Quality Control Systems

The deficiency courses listed above apply to students without an earned undergraduate degree in engineering, while the Engineering Science and Engineering Design courses apply to students with an earned undergraduate degree in engineering, but not necessarily in chemical, environmental, and materials engineering.

The list represents the minimum number of required deficiency credits for each subject area. Additional deficiency credits may also be warranted based upon the recommendations of a student's advisor and/or Supervisory Committee. Students should be cognizant that the deficiency course list is not exhaustive and may not necessarily include all pre-requisite courses needed to enroll in their desired graduate-level coursework. A student must still satisfy the pre-requisites of graduate-level courses prior to enrollment. Therefore, ample care should be taken when planning a Program of Study upon matriculation.

Prior Coursework Evaluation: Students may be exempt from individual deficiency courses if they have already completed these deficiency credits at another institution. A student's prior coursework can be evaluated and shall be based upon a student's official transcript. A delegated CEM Faculty member in the student's primary area of study shall determine which, if any, deficiency credits have already been satisfied. Questions regarding the equivalency of coursework (completed at another institution) to its counterpart here at the University of Miami shall be addressed by the relevant department and instructor at the University of Miami.

Prior Work Experience: In rare cases, students may be able to satisfy specific deficiency credits if they can demonstrate a substantive knowledge of the subject area through examination using written/oral assessment and supportive evidence such as peer-reviewed journal articles authored by the student, professional licenses, or other quantifiable experience. An examination of all evidence of experience shall be vetted by the relevant instructor at the University of Miami prior to making a recommendation to the CAE Graduate Program to either waive or require deficiency credits for a specific subject area.

Course Selection and Enrollment: Undergraduate-level deficiency courses at the University of Miami typically range between the 100 and 400 levels. The student shall enroll in the corresponding courses identified in the undergraduate CEM curriculums to satisfy the deficiency credits for Calculus, Advanced Mathematics, Chemistry, Physics, and Statics. To satisfy the deficiency credits for Engineering Science and Engineering Design, the student's advisor and/or Supervisory Committee will select courses on an individual bases. If a student has not yet selected an advisor nor established a Supervisory Committee, the Graduate Program Director shall serve as the student's advisor in the interim. The Graduate Program Director will identify coursework in consultation with a delegated faculty member in the student's area of study.

In accordance with Graduate School Policy, a student in deficiency status may not enroll in supervised research, but is permitted to enroll in graduate-level courses as long as the student has satisfied the course pre-requisites.

Rationale

Rationale

The College of Engineering is currently proposing (under a separate proposal) to create a new academic department, Department of Chemical, Environmental and Materials Engineering (CEM). Environmental Engineering currently exists within the Department of Civil, Architectural and Environmental Engineering (CAE). An additional separate proposal has been submitted to change the name of CAE to Civil and Architectural Engineering (CAE). CAE currently offers a Ph.D. program in Civil Engineering in which students can choose an emphasis in Environmental Engineering. This proposal is to create a new doctoral program in the new department utilizing the existing courses that form the Environmental Engineering component of the Ph.D. in Civil Engineering. The proposed Ph.D. in Chemical, Environmental and Materials Engineering will require 30 credit hours for students who enter with a relevant master's degree and 60 credit hours for students entering a relevant bachelor's degree.

Chemical Engineering programs are present in most engineering schools but not at UM. Chemical engineering is a discipline influencing numerous areas of science and technology. In broad terms, chemical engineers conceive and design processes to produce, transform, and transport materials — beginning with experimentation in the laboratory followed by the implementation of the technology in full-scale production. The absence hampers visibility and recognition as a holistic College of Engineering, recruiting, rankings, and more. The proposed program will provide an opportunity to consolidate synergistic areas of Environmental Engineering and provide a base for Materials efforts. Environmental engineering currently relies on multiscale studies ranging from molecular to the field scale, a disciplinary aspect covered well in chemical engineering. A similar approach is relevant for advanced materials synthesis – a current gap in CoE.

Market Demand

The Ph.D. program will graduate engineers who will cover the disciplinary areas of chemical engineering, environmental engineering and materials science and engineering. These are conventional disciplines and there are a variety of sectors that employ such graduates. The new program will have the added advantage of providing a holistic and multifaceted education in these sectors, making our graduates more desirable to industry and other sources. The vision is for the Department is a focus on first principles in the development of new chemical, environmental and materials engineering approaches. For example, many traditional chemical engineering programs focus on petroleum. The program at the University of Miami will not focus on this traditional area in terms of petroleum exploitation but rather identifying potential alternatives (based upon new chemical, environmental and materials approaches) to petroleum-based energy sources. We see ourselves as filling a unique niche in developing new approaches to meet today's societal needs by synergizing and converging expertise with the three disciplines.

We provide a summary of the recent demand and job prospects for these disciplines. As per the US Bureau of Labor Statistics (https://www.bls.gov/ooh/architecture-and-engineering/chemical-engineers.htm), employment of chemical engineers is projected to grow 4 percent from 2019 to 2029, about as fast as the average for all occupations. Demand for chemical engineers' services depends largely on demand for the products of various manufacturing industries. Employment of environmental engineers (https://www.bls.gov/ooh/architecture-and-engineering/environmental-engineers.htm) is projected to grow 3 percent from 2019 to 2029, about as fast as the average for all occupations. State and local governments' concerns regarding water availability and quality should lead to efforts to increase the efficiency of water use. Finally, for materials scientists and engineers (https://www.bls.gov/ooh/life-physical-and-social-science/chemists-and-materials-scientists.htm), employment is projected to grow 5 percent from 2019 to 2029, faster than the average for all occupations. Engineers and materials scientists who have an advanced degree, particularly a Ph.D., are expected to have the best opportunities.

Relationship to Other Programs

The CEM PhD program will be synergistic with programs in other College of Engineering Departments and with programs in other units of the University outside of Engineering. For example, other units within the College (e.g., BME and MAE) have a medical focus in transport as applied to tissue systems and in biomaterials. Similarly, ECE has expertise in nanomaterials and CAE in materials used for infrastructure again providing synergy to the CEM PhD program and vice versa. For units outside of the College of Engineering, considerable synergy is envisioned with the Department of Atmospheric Sciences at RSMAS given the focus area on aerosol science and technology within CEM. Other units with potential synergies include the Department of Chemistry, and with the Department of Biology, Physics, and Marine and Atmospheric Sciences, and the School of Medicine. Finally, the Frost Institute of Chemistry and Molecular Science is highly relevant to this PhD program as PhD students would have access to equipment housed in this facility.

Relationship to Undergraduate and Professional Programs

As part of the separate proposals to create the new CEM department and change the name of the existing CAE department, the undergraduate programs in Environmental Engineering will be moving into the CEM department. Student in these programs as well as other engineering and in chemistry and materials sciences should be able to apply for PhD-level graduate studies within CEM. Students in these undergraduate programs would also benefit from the research opportunities available through CEM.

Library Resources Available and Needed to Support the Program

The University of Miami Libraries prepared an Library Holdings and Expenditures Report for the proposed program. The full report is attached. The College of Engineering endorses the highly recommended list of acquisitions (p. 29) at a cost of $22,446:

- Inorganic Crystal Structure Database (ICSC): $3775
- Journals: $18,671

- Journal of Nanoscience and Nanotechnology
- Journal of Toxicology and Environmental Health - Part A - Current Issues
- Nanotoxicology
- Urban Water Journal

Laboratory Facilities, Equipment, and Space Available and Needed to Support the Program

Space has been allocated for research related to areas covered by faculty of CEM. Space available for the CEM Department include the existing laboratory space currently allocated to Environmental Engineering in the McArthur Engineering Building. Additional space is available as follows:

- For aerosol and air quality research, we will have access to shared space with RSMAS faculty. The space of about 2500 square feet is being remodeled for use. This corresponds to enough space for the research activities of two faculty.
- About 10,000 square feet of shared space has been allocated in the new Frost Institute for Chemical and Molecular Sciences. In addition, there will be shared facilities relevant to Chemical, Environmental and Materials research on the first two floors of the building. This corresponds to enough space for the research activities of 6 faculty.
- Finally, there is a campus master plan for a new building in the future, and this will be provide additional laboratory space for relevant research.

Other Resources Available or Needed to Support the Program

N/A

Curriculum

Program Curriculum

This program will use existing courses from the CAE program. In addition, new courses will be developed in the future to enhance the program and support future concentrations in Chemical Engineering and Materials Engineering. Potential new courses could include the following:

- Transport Phenomena
- Chemical Engineering Thermodynamics
- Kinetics and Reaction Engineering
- Aerosol Science and Technology

Proposed Schedule of Course Offerings for the First Three Years

N/A. This program will be using existing courses. (The course numbers will be changed to align with the new department once it has been approved.)

Faculty

Program Directors

Dr. James Englehardt will be serving as the interim PhD Program Director. Dr. Pratim Biswas will be providing oversight of the new PhD program. Dr. James Englehardt has considerable experience leading PhD program as he has served the CAE Department in the past as the Graduate Program Director.

Dr. Englehardt, P.E., is Professor of Environmental Engineering at the University of Miami, appointed 1992. Before receiving his Ph.D. in Civil Engineering from the University of California, Davis, Dr. Englehardt led filtration research projects for Johns Manville Corporation (1983-1987), and supervised water treatment laboratory development and field service for the Western Filter Company (now GE Water) (1978-1980). He currently directs the Water Quality Engineering Laboratory. Developments include net-zero water treatment, that is the first energy-positive treatment system for management of municipal water and wastewater; a patented low-energy chemical-free electrochemical process for recovering nutrients as fertilizer from sewage; the first inferential models for tracking of relatively slow-moving pollutant masses; and the first machine learning/evidence fusion algorithms for sensor-based detection of health risk in drinking water in near-real time, under support of the National Science Foundation (NSF), the U.S. Environmental Protection Agency (EPA), the Gulf of Mexico Research Initiative (GoMRI), and the Electric Power Research Institute (EPRI). Discoveries in the field of risk analysis include the first general explanation of $1/f$ noise (a signature of complex system data); derivation of probability distributions for complex system outcomes including illness severities and microbial concentrations; and derivation of the first general dose-response function for mixtures of chemical toxicants.

Dr. Englehardt serves on the EPA Science Advisory Board (SAB), Drinking Water Advisory Committee, and as Associate Editor for PLoS ONE, and for ASCE-ASME Risk and Uncertainty in Engineering Systems, Parts A Civil Engineering and ASCE-ASME Risk and Uncertainty in Engineering Systems, Part B Mechanical Engineering B. Awards include the WaterReuse Association 2018 Award for Excellence in Transformation Innovation, two Johnson A. Edosomwan Outstanding Publication Awards, University of Miami; the Science Advisor's Award, EPA National Center for Environmental Assessment; the Robert C. Barnard Environmental Science & Engineering Award for Advances in Risk Assessment, American Association for the Advancement of Science and EPA; and two University of Miami Eliahu I. Jury Awards for excellence in research.

Upload CV(s)

3_Englehardt_biosketch-DrEnglehardt r1.pdf

Program Faculty

Biswas, Pratim. Professor Biswas's research and educational interests include aerosol science and engineering; nanoparticle technology; air quality engineering; environmentally benign energy production; combustion; materials processing for environmental technologies, environmentally benign processing, environmental nanotechnology, public health, and the thermal sciences.

Chin, David. Dr. David Chin's area of expertise is in water systems focused on water quality, watershed management, flood modeling, coastal systems and water security.

Englehardt, James. Dr James Englehardt's effort focus on developing energy-positive systems to manage municipal water and wastewater systems.

Solo-Gabriele, Helena. Dr. Solo-Gabriele's research has focused on evaluating the relationship between the environment and human health. Her research has spanned diverse areas including evaluating the impacts of chemicals in the environment and evaluating the impacts of microbial contaminants in coastal zones.

Additional faculty may be hired in the future to support the new department and its programs.

Upload CV(s) Grad

Biosketches_Combined.pdf

Students

Applicant Pool

This program will recruit from University of Miami undergraduate students, undergraduate and graduate students from the U.S., undergraduate and graduate students from international Universities. Students who would be interested in this program are those interested in interdisciplinary study that combines the life and physical sciences with engineering in areas.

Enrollment Projections

	FY22	FY23	FY24	FY25	FY26
New PhD Students	4	4	6	8	10
Total PhD Student Enrollment	8	12	18	26	36

Teaching or Research Assistants

This program will support both teaching and research assistants (12-month). Stipend is to be consistent with cost of living estimates which for FY21 was at $31,000 per year including an 80% health insurance credit worth $2800 per year. Below is a five-year projection of TA's and RA's in the program:

	FY22	FY23	FY24	FY25	FY26
First year PhD Students (TAs)	4	4	6	8	10
Non-first year PhD Students (RAs)	4	8	12	18	26

Administration

Program Administration

The program will be administered through the College of Engineering. The Department will have a Department Chair and a shared administrative staff with the Department of Industrial Engineering during year 1.

Budget

Program Budget

See "Documents: Budget" for Budget in tabular format. Below is a summary of the items included in the budget estimation.

Chair Salary - $300 K (includes fringe benefits)
Regular Faculty Salary – average to be hired is $ 200 K per faculty (includes fringe benefits)
Startups – average is $ 350,000

Remodeling set up (beyond the startup) - $ 250,000
PhD Student - $ 32,000 per year plus health insurance at $3,000 per year.

Office Staff - $80,000 per year (includes fringe benefits)

Department Chair, Regular Faculty and Office Staff are expected to support both the undergraduate programs in environmental engineering and the PhD program in CEM.

See library resources section for endorsement of library resources budget.

Comparison

Peer Comparisons

At our 7 peer and aspirational universities (Table 1 - please see attached file to view tables), the programs vary in name but provide combinations most frequently between Chemical and Environmental Engineering. One also integrates Materials Engineering as an area of emphasis. A unique aspect of the proposed CEM program will be the integration of the three areas of focus. The program lengths in credit hours range from 20 to 120 (Table 2) and the proposed CEM program (30 for MS admits and 60 for BS admits) fits within that range. Admissions requirements are similar among all programs (including the proposed program at U.Miami) with the exception that some have waived the GRE exam. Qualifying exam requirements are similar among Universities. Some require comprehensive written exams. All require a proposal defense. All require a written and oral defense of a PhD dissertation at the completion of the program. Sources of the comparison data are given in Table 3. Please see attachment to view Tables.

Documents

Attach Supporting Documentation

CEM Supporting Documents.pdf

For Administrative Use Only

Administrative Notes

Note from Patty: A new department is being created that will house this program, Department of Chemical, Environmental and Materials Engineering. Once it is approved, you can change the name of the department on this form. 3/2021

Reviewer Comments

Patty Murphy (pxm491) (Fri, 05 Mar 2021 15:55:12 GMT): Although this is a new program, it will be using existing courses (although when the new department is created these courses may move over to the new department or be crosslisted with the new department courses). Therefore this does not represent a significant departure from what we are currently approved to offer at the University. Consequently, notification to or approval from SACSCOC is not required.

Tiffany Plantan (tplantan) (Fri, 19 Mar 2021 14:10:29 GMT): Proposal was discussed at the March 16, 2021 meeting of the Graduate Council and approved by those present (10 approved, 1 abstention). As a note, it is likely that the proposal will not receive full governance approval by Fall 2021, so the proposed start date may need to be pushed to Spring 2022 or later.

Robyn Hardeman (rhardeman) (Fri, 26 Mar 2021 23:05:47 GMT): This proposal will be added to the Wednesday, April 7, 2021 GWC agenda. Supplemental documents include letters of support that the School faculty, College Council and department faculties approve the new department and synergies it will create; a detailed list of the library holding, purchases and budget, and college strategic plan.

Key: 615