



CERTIFICACIÓN NÚMERO 23-06

La que suscribe, Secretaria del Senado Académico del Recinto Universitario de Mayagüez de la Universidad de Puerto Rico, **CERTIFICA** que, en la reunión ordinaria celebrada el martes, 17 de enero de 2023, este organismo **APROBÓ** la **CREACIÓN DE LA SECUENCIA CURRICULAR EN INGENIERÍA COSTERA Y OCEÁNICA**.

Esta secuencia curricular en Ingeniería Costera y Oceánica tiene las siguientes metas:

1. Proporcionar a estudiantes de ingeniería y de ciencias una introducción al área de la ingeniería costera y oceánica y proporcionarles los conocimientos fundamentales de la dinámica de las costas y el medio ambiente oceánicos para permitirles resolver problemas de ingeniería relacionados con la costa y el océano.
2. Preparar a los estudiantes para estudios de posgrado en el campo de la ingeniería costera y oceánica o campos relacionados.
3. Desarrollar una masa crítica de personas capacitadas con al menos un conocimiento práctico de los procesos costeros y oceánicos que los ayudará a tomar decisiones informadas y sostenibles con respecto a nuestras costas y océanos.

La propuesta se hace formar parte de esta certificación.

Y para que así conste expido y remito la presente certificación a las autoridades universitarias correspondientes, bajo el Sello de la Universidad de Puerto Rico a los dieciocho días del mes de enero del año dos mil veintitrés, en Mayagüez, Puerto Rico.

Carmen A. Negrón Moure
Carmen A. Negrón Moure
Secretaria



nav

Anejo



21 de diciembre de 2022

Miembros del Senado Académico
Recinto Universitario de Mayagüez

SECUENCIA CURRICULAR EN INGENIERÍA COSTERA Y OCEÁNICA

El Comité de Asuntos Curriculares recibió ante su consideración la propuesta para crear la secuencia curricular en Ingeniería Costera y Oceánica. Una secuencia curricular en Ingeniería Costera y Oceánica es un primer paso hacia el objetivo final de desarrollando un programa dedicado con este enfoque en el RUM. Además, de los bien documentados problemas de erosión costera en Puerto Rico (Morelock y Barreto, 2002), se necesita con urgencia esta secuencia curricular en el RUM por las siguientes razones:

- Existe un interés creciente entre los estudiantes por esta disciplina.
- El reciente aumento de colaboraciones interdisciplinarias en el RUM que involucran a las comunidades costeras y los proyectos de investigación en ingeniería oceánica requieren una masa crítica de estudiantes capacitados.
- Varias agencias y empresas necesitan urgentemente mano de obra capacitada en esta área.
- Según el Consorcio para el Liderazgo Oceánico, solo el 4% de los graduados en ciencias oceánicas de la población estudiantil es hispana o latina (McDuff, 2014).
- La apuesta por las energías renovables y otras fuentes de combustible como el gas natural licuado (GNL) y la generación de energía eólica marina deben traer importantes proyectos a nuestra isla.

Metas y objetivos

El objetivo de la Secuencia Curricular en Ingeniería Oceánica y Costera (CSCOPE) es proporcionar estudiantes de ingeniería y de ciencias una introducción al área de la ingeniería costera y oceánica y proporcionarles los conocimientos fundamentales de la dinámica de las costas y el medio ambiente oceánico para permitirles resolver problemas de ingeniería relacionados con la costa y el océano. Un objetivo secundario, pero igualmente importante es preparar a los estudiantes para estudios de posgrado en el campo de la ingeniería costera y oceánica o campos relacionados. En última instancia, la secuencia busca desarrollar una masa crítica de personas capacitadas con al menos un conocimiento práctico de los procesos costeros y oceánicos que los ayudará a tomar decisiones informadas y sostenibles con respecto a nuestras costas y océanos.



El CSCOE consta de un total de 12 créditos, 9 créditos de cursos básicos requeridos (ver TABLA 1), y 3 créditos de la lista de optativas aprobadas (ver TABLA 2).

Curso	Pre-requisitos	Créditos
INGE 5185: Introducción a la Ingeniería Costera	INGE 4015	3
CMOF5015: Oceanografía física para las Ciencias Atmosféricas o CMOF 6617: Oceanografía física	MATE 4009, FISI 3171 o FISI3162 Autorización del director	3
INGE 5027: Mecánica de ondas de agua para ingenieros	INGE4015	3

Tabla 1: Cursos requeridos

Curso	Pre-requisitos	Créditos
INCI 6305: Ingeniería Eólica	INGE 4015	3
CIMA 5007: Introducción a la observación del océano	Ninguno	3
CMOG 5001: Introducción al cambio climático	Autorización del director	3
CMOF 6631: Dinámica de fluidos geofísicos	Autorización del director	3
CMOB 6618: Oceanografía Biológica	Ninguno	3
CMOG 6616: Oceanografía Geológica	Ninguno	3
CMOQ 6615: Oceanografía Química	Ninguno	3
METE 4061: Meteorología Dinámica I	FISI 3171 o FISI3162 y METE 4006 y MATE 3063	3
METE 5065: Meteorología Dinámica Avanzada	METE 4061 y MATE 4009 o autorización del director	3

Tabla 2: Cursos electivos u optativos



El Comité de Asuntos Curriculares recomienda al Senado Académico aprobar esta propuesta ya que puede resultar de gran interés para los estudiantes y por ser una secuencia interdisciplinaria. Para el éxito de esta es importante la colaboración entre los departamentos de Ciencias de Ingeniería y Materiales, Física y Ciencias Marinas. Se incluyen anejados todos los documentos considerados por el comité relacionados con la misma

Cordialmente,

Prof. Jaime Sepúlveda Rivera
Co-Presidente Comité Asuntos Curriculares

Dr. Omell Pagán Parés
Co-Presidente del Comité de Asuntos Curriculares



Proposal for the Establishment of a Curricular Sequence in Coastal & Ocean Engineering

1. BACKGROUND AND JUSTIFICATION

Despite being an island with a coastline-to-land area ratio of twenty-five times that of the US (CIA, 2016), Puerto Rico does not have any formal ocean or coastal engineering education program. The precarious state of our coasts is partly due to the fact that a very large percentage of our engineers do not have any knowledge about ocean and coastal processes, and the scarce ocean literacy level of the general Puerto Rican population. Moreover, given the observed trends and future projections of sea levels rise, tropical cyclone activity, and ocean acidification (PRCCC, 2013), it is the University's responsibility to educate our engineers, scientists and citizens on the importance and responsible management of our ocean and coastal environments.

The disciplines of coastal and ocean engineering are multidisciplinary in nature and combine the classical disciplines of civil, mechanical and electrical engineering with oceanography and fluid dynamics. According to ABET, an academic program in coastal & ocean engineering:

“... must demonstrate that graduates have: knowledge and the skills to apply the principles of fluid and solid mechanics, dynamics, hydrostatics, probability and applied statistics, oceanography, water waves, and underwater acoustics to engineering problems; the ability to work in groups to perform engineering design at the system level, integrating multiple technical areas and addressing design optimization.”

A curricular sequence in coastal and ocean engineering is a first step towards the ultimate goal of developing a dedicated program with this focus at UPRM. Besides the island's well documented coastal erosion problems (Morelock and Barreto, 2002), this curricular sequence is urgently needed at UPRM due to the following reasons:

- There is a growing interest among students in this discipline, but there is no formal educational strategy at UPRM to satisfy these students' needs.
- The recent increase in cross-disciplinary collaborations at UPRM involving coastal and ocean engineering research projects require a critical mass of trained graduate students.
- Several agencies (e.g. US Army Corps of Engineers -USACE, Office of Naval Research - ONR, National Oceanographic and Atmospheric Administration - NOAA) and companies are in urgent need of a trained workforce in this area.
- According to the Consortium for Ocean Leadership, only 4% of the ocean science graduate student population is Hispanic or Latino (McDuff, 2014). A curricular sequence at UPRM will improve this number by increasing the number of potential recruits in coastal and ocean engineering graduate degrees.
- The move towards renewable energy and other fuel sources such as liquefied natural gas (LNG) and offshore wind energy will undoubtedly involve significant projects in our island's ports and coasts and will demand significant local expertise in this discipline.

2. GOALS & OBJECTIVES

The goal of the Curricular Sequence in Ocean and Coastal Engineering (CSCOE) is to provide engineering and science students (and other STEM fields) with an introduction to the field of coastal and ocean engineering and provide them with fundamental knowledge of the dynamics of the coastal and ocean environment to allow them to solve engineering problems involving coastal and ocean processes. A secondary but equally important goal is to prepare students for graduate studies in the field of coastal and ocean engineering or related fields. Ultimately, the sequence seeks to develop a critical mass of trained individuals with at least a working knowledge of coastal and ocean processes that will help them make informed and sustainable decisions concerning our coastal and ocean environment and infrastructure.

3. CLASSIFICATION AND STUDENT PROFILE

The CSCOE proposes to establish itself as an “undergraduate sub-specialty sequence” (per Category IV, Certification 15-07). It therefore seeks to attract undergraduate students from engineering, physics, chemistry, geology, computer science or mathematics programs. This is because the core courses of these disciplines align well with the requirements for the Sequence, and therefore students in these fields with a particular interest in Coastal and Ocean Engineering will have strong incentive and preparation. These students will then be able to use this knowledge in their practice as engineers or scientists after finishing their undergraduate degree, or use their knowledge to pursue graduate studies in ocean and coastal engineering, the ocean sciences, or related fields. Potential employers of CSCOE graduates include private companies such as Tetra Tech, Moffat & Nichol, Taylor Engineering, and Arcadis as well as federal and state agencies such as USACE, US Coast Guard, the PR Department of Natural and Environmental Resources, among others.

Based on our experience over the last 10 years in teaching coastal and ocean engineering courses at UPRM, we expect that 5-10 students will participate in the CSCOE each academic year.

4. ADMISSION REQUIREMENTS

Before admission into the sequence each student must:

1. Be an active student in an undergraduate program at UPRM leading to a bachelor’s degree in engineering, physics, chemistry, geology, computer science or mathematics. Students from other majors may be considered by the program coordinator if they satisfy the prerequisites (see below) and take the required courses.
2. Have a minimum general GPA of 2.5 and a minimum point average of 2.5 in science, engineering and math courses.
3. Complete an application form and obtain the approval of the CIIM Department Director.
4. Have passed the following courses (or similar with approval from the CIIM Department Director) with C or better:

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Course Code	Minimum Required Credit hours
INGE 3016 (Algorithms and Computer Programming) or CIIC 3015 (Introduction to Computer Programming I) or COMP 3010 (Introduction to Computer Programming I) or similar	3
INGE 4015 (Introduction to Fluid Mechanics) or INQU 4010 (Momentum Transfer Operations) or METE 4061 (Dynamical Meteorology I) or FISI 5045 (Physics of Fluids) or similar	3

TABLE 1 – Program admission required courses

Courses equivalent to the list provided above will be approved once reviewed by the Sequence Coordinator.

4. COURSES

The CSCOE consists of a total of 12 credits, 9 credits from required core courses (see TABLE 2), and 3 credits from the list of approved electives (see TABLE 3). The course sequence is highly focused on ocean-related courses as no ocean related courses currently form part of any undergraduate curriculum. After admission into the program, students must take the following core courses to complete the CSCOE, in any order:

Course	Prerequisites	Credits
INGE 5185 (Introduction to Coastal Engineering)	INGE 4015	3
CMOF 5015 (Physical Oceanography for Atmospheric Sciences) or CMOF 6617 (Physical Oceanography)	MATE 4009, FISI 3172/3162 or Authorization from Director	3
INGE 5027 (Water Wave Mechanics for Engineers)	INGE 4015	3

TABLE 2 – Program required courses

In addition, students must choose **one course** from the following elective courses:

Course	Prerequisites	Credits
INCI 6305 (Wind Engineering)	INGE 4015	3
CIMA 5007 (Introduction to Ocean Observation)	none	3
CMOG 5001 (Introduction to Climate Change)	Authorization of the Director of the	3

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	Department	
CMOF 6631 (Geophysical Fluid Dynamics)	Authorization of the Director of the Department	3
CMOB 6618 (Biological Oceanography)	none	3
CMOG 6616 (Geological Oceanography)	none	3
CMOQ 6615 (Chemical Oceanography)	none	3
METE 4061 (Dynamic Meteorology I)	FISI 3162 or FISI 3172, and METE 4006 and MATE 3063.	3
METE 5065 (Advanced Dynamic Meteorology)	(METE 4061 and MATE 4009) or authorization of the Director of the Department.	3

TABLE 3 – Program elective courses

The list provided above is not exclusive and other ocean-related courses can be considered to meet the requirements with approval from the program coordinator. A 3-credit undergraduate research course on an ocean related topic may satisfy the requirements for the fourth course after review by the program coordinator. Courses at the 6000 level can be attended by undergraduate students after approval of the Director of the Department at which the course is taught. An additional advantage of the Sequence is that some of the CSCOE courses may be counted as elective courses for students pursuing a graduate degree at UPRM.

The syllabi for each of the core courses are included as attachments to this document. We also include as attachments to this document the planned course offerings from the CIIM and CIMA departments which include the CSCOE core courses. See the CIIM Department Director’s support letter for a history of the offering of INGE 5027 and INGE 5185. CMOF 6617 is offered once every year since it is a core course of all graduate programs offered by the Department of Marine Sciences.

5. STUDY PROGRAM

To maintain good standing in the Sequence and to ultimately be awarded the program certificate, each student must fulfill the following requirements:

- Satisfactorily complete the graduation requirements of their major.
- Maintain a minimum general GPA of 2.50 (out of a scale of 4.00)
- Maintain a minimum point average of 2.50 (out of a scale of 4.00) in the CSCOE specialty courses
- Earn a C or better in each of the required courses.

6. EDUCATIONAL APPROACH

Although it is not necessary for the Sequence to satisfy all accreditation criteria, the required and recommended courses of the Sequence generally attend to ABET Outcomes 1, 6, and 7. In addition, the course INGE 5185 Introduction to Coastal Engineering attends to Outcomes 2 and 4 through assignments and projects that embed problems within a meaningful ethical or social context, and which will require students to formulate solutions beyond technical specifications or calculations. For reference, the 7 ABET Outcomes are listed below.

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

7. ASSESSMENT PLAN

In order to assess the effectiveness and impact of the curricular sequence, an assessment approach will be established and executed. This will include the following:

- Interviews and surveys to alumni immediately after completing the CSCOE and after one year of graduation in order to obtain employment profiles
- Self assessment by students toward the end of the CSCOE regarding course effectiveness
- Annual statistical evaluation of: incoming students applying for and accepted in the CSCOE, students enrolled in the CSCOE, and students completing the CSCOE.

8. RESOURCES:

The curricular sequence will reside in the Department of Engineering Sciences and Materials and will take advantage of the facilities of the UPRM Center for Applied Ocean Science and Engineering (CAOSE / Stefani 111). CAOSE is an interdisciplinary effort that brings together students and faculty

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from several departments from both the Colleges of Engineering and Arts and Sciences. CAOSE seeks to develop and maintain a state of the art, externally funded **research, service and education program in applied coastal/ocean science and engineering**. CAOSE brings together the disciplines of oceanography, fluid dynamics, renewable ocean energy, and ocean and coastal engineering in an effort to improve understanding of ocean processes and ways that society can live in harmony with our coastal environment, while driving economic growth and improving our quality of life.

The Department of Engineering Sciences and Materials will provide administrative support to aid the CSCOE program coordinator. The Department of Engineering Sciences and Materials already successfully operates a curricular sequence in Engineering Sciences and Materials and the CSCOE will follow the same administrative structure. See the attached letter of support from the Department Director for further details.

Each course's minimum number of students will be in accord with the Regulations and Policies set forth by UPRM and will be offered at least once a year. The core courses in this curricular sequence will be offered by professors from the departments of Engineering Sciences and Materials and Marine Sciences. The following faculty members offer the core courses:

- Dr. Miguel Canals (CIIM 75%) holds a joint appointment (25%) at the Department of Marine Sciences and teaches one INGE 5027 (as well as elective course CMOF 6631) and can teach CMOF 6617 is necessary
- Dr. Sylvia Rodriguez (CIIM) teaches INGE 5185
- Dr. Wilford Schmidt teaches (CIMA) CMOF 6617

The syllabi for each of the core courses are included as attachments to this document. We also include as attachments to this document the planned course offerings from the CIIM and CIMA departments which include the CSCOE core courses.

In addition, personnel from various institutions, including the USACE Coastal Hydraulics Laboratory, University of New Hampshire, and Oregon State University, among others, will assist UPRM in the CSCOE by offering short courses, lectures, and providing summer internship opportunities for CSCOE students. Moreover, the CSCOE will highly benefit from the educational opportunities provided by the CARICOOS and Puerto Rico Sea Grant College Programs, both of which reside at UPRM.

REFERENCES:

- CIA-Central Intelligence Agency (2016), *The World Factbook 2016-17*, Washington, DC:
<https://www.cia.gov/library/publications/the-world-factbook/index.html>, last checked 07/17/16.
- McDuff, R. (2014), *Demographics of Ocean Science Graduate Programs: Some Long Term Perspectives*, <http://oceanleadership.org/wp-content/uploads/Demographics-of-Ocean-Science-Graduate-Programs.pdf>, last checked 07/17/16.

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University of Puerto Rico at Mayagüez

Morelock J. and Barreto, M. (2002), *An Update of Coastal Erosion in Puerto Rico*,
http://geology.uprm.edu/Morelock/GEOLOCN_/pdfdoc/PRerosupD.pdf, last checked
04/03/17.

PRCCC-Puerto Rico Climate Change Council (2013), *Puerto Rico's State of the Climate 2010-2013: Geophysical and Chemical Scientific Knowledge: Observed Trends and Future Projections*, Puerto Rico Coastal Zone Management Program, San Juan, PR.

**Fw: Ingeniería Oceánica**

1 message

Monserrate Casiano <monserrate.casiano@upr.edu>
To: "academicos.ingenieria@upr.edu" <academicos.ingenieria@upr.edu>

Tue, Jan 1

Monserrate Casiano, (Taty)
Asistente Administrativa
Asuntos Académicos y Estudiantiles
Departamento de Ciencias Marinas
Número directo: 787-265-3838, ext. 3447
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From: Ernesto F Weil Machado <ernesto.weil@upr.edu>
Sent: Friday, January 13, 2023 3:55 PM
To: Miguel Canals <miguelf.canals@gmail.com>
Subject: Re: Ingeniería Oceánica

Estimado Dr. Canals,

Habiendo revisado el documento con los detalles de la secuencia curricular en Ingeniería Oceanica, como director del Departamento de Ciencias Marinas certifico que el DCM apoya esta iniciativa.

Atentamente,

EW

Dr. Ernesto Weil
Director/Professor
Department of Marine Sciences
UPRM

Estimado Dr. Canals,

Habiendo revisado el documento enviado, el Departamento de Ciencias MARinas

From: Miguel Canals <miguelf.canals@gmail.com>
Sent: Thursday, January 12, 2023 9:39 AM
To: Ernesto F Weil Machado <ernesto.weil@upr.edu>
Subject: Re: Ingeniería Oceánica

Saludos, avisame si puedo llamarte para explicarte mejor

adjunto el documento

On Jan 10, 2023, at 4:27 PM, Ernesto F Weil Machado <ernesto.weil@upr.edu> wrote:

Seguro, pero necesito me informes de que se trata con mas detalles.

EW

Dr. Ernesto Weil
Director/Professor

Department of Marine Sciences
UPRM

From: Miguel Canals <miguelf.canals@gmail.com>
Sent: Tuesday, January 10, 2023 4:00 PM
To: Ernesto F Weil Machado <ernesto.weil@upr.edu>; Monserrate Casiano <taty@cima.uprm.edu>; Monserrate Casiano <monserrate.casiano@upr.edu>
Subject: Fwd: Ingeniería Oceánica

Saludos! Podrían ayudarnos con esta carta de apoyo?

M

Sent from my iPhone

Sent from my iPhone

Begin forwarded message:

From: Omell Pagán Parés <omell.pagan@upr.edu>
Date: December 21, 2022 at 1:53:38 PM AST
To: Ivan Baiges Valentin <ivan.baiges@upr.edu>, Cristina D Pomales <crisrina.pomales@upr.edu>
Cc: Aidsa Santiago <aidsa.santiago@upr.edu>, Miguel F Canals Silander <miguelf.canals@upr.edu>, "Sylvia B. Rodriguez Abudo" <rodriguez.abudo@upr.edu>
Subject: Re: Ingeniería Oceánica

Saludos

Falta la carta de endoso o apoyo del Departamento de Ciencias Marinas.

Omell Pagán Parés

From: Ivan Baiges Valentin <ivan.baiges@upr.edu>
Sent: Tuesday, December 13, 2022 2:32 PM
To: Omell Pagán Parés <omell.pagan@upr.edu>; Cristina D Pomales <crisrina.pomales@upr.edu>
Cc: Aidsa Santiago <aidsa.santiago@upr.edu>; Miguel F Canals Silander <miguelf.canals@upr.edu>; Sylvia B. Rodriguez Abudo <rodriguez.abudo@upr.edu>
Subject: Re: Ingeniería Oceánica

Saludos

adjunto esta la propuesta con los cambios solicitados

From: Omell Pagán Parés <omell.pagan@upr.edu>
Sent: Tuesday, December 13, 2022 11:40 AM
To: Ivan Baiges Valentin <ivan.baiges@upr.edu>; Cristina D Pomales <crisrina.pomales@upr.edu>
Cc: Aidsa Santiago <aidsa.santiago@upr.edu>
Subject: Ingeniería Oceánica

Saludos

La propuesta de Secuencia Curricular en Ingeniería Oceánica fue evaluada por Comité de Asuntos Curriculares y se piden las siguientes correcciones:

1. Eliminar el curso de MATE 4009 de los requisitos
2. Poner los cursos equivalentes en los prerrequisitos para entrar a la secuencia
3. Poner los prerrequisitos de todos los cursos en la secuencia
4. Incluir carta de apoyo del Departamento de Ciencias Marinas

Me parece que hay varias propuestas y no son iguales a la que vimos hoy en la reunión .
Respetuosamente,

Omell Pagán Parés