CIEE Global Institute – Madrid

Course name: Environmental Engineering
Course number: (GI) ENGI 3001 MASP
Programs offering course: Madrid Open Campus Block
Open Campus track: STEM and Society
Language of instruction: English
U.S. semester credits: 3
Contact hours: 45
Term: Spring 2020

Course Description

This introductory course to environmental engineering emphasizes the protection of air, water, and land resources through engineered solutions that impact human society via energy, water, climate and nutrient cycles. Topics covered include water quality engineering, solid waste management, fate and transport of contaminants in the environment, and energy production. The course emphasizes material and energy balance, and life-cycle thinking as conceptual tools.

Learning Objectives

Completing this course, students will:
1. learn what types of problems are commonly encountered by environmental engineers, become familiar with common approaches adopted by engineers, and have enhanced understanding of the role of environmental engineers in solving new or emerging environmental problems, particularly ones that are complex or interdisciplinary.
2. possess the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context;
3. demonstrate knowledge and skilled use of mathematics, science, and engineering in the identification, formulation, and solving of engineering problems;
4. become adept at applying material balances and life cycle analysis to engineering problems
5. practice and expand oral communication skills
6. practice leadership and teamwork in group projects and assignments.
7. become enlightened and engaged stakeholders regarding the appropriate use of engineered solutions for environmental challenges, at home and abroad.
Course Prerequisites
Two (2) semesters of university-level courses in engineering, chemistry, or physics.

Methods of Instruction
This course is taught through the use of lectures, discussions, and readings, and assigned problem sets. The problem sets are not graded, but prepare students for weekly quizzes. Also, students investigate, and report to their peers, on real-life applications of engineering tools (analytical/quantitative).

Assessment and Final Grade

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Attendance and Participation</td>
<td>20%</td>
</tr>
<tr>
<td>Group presentation (oral report)</td>
<td>10%</td>
</tr>
<tr>
<td>Weekly quizzes (3)</td>
<td>30%</td>
</tr>
<tr>
<td>Midterm exam</td>
<td>20%</td>
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<tr>
<td>Final exam</td>
<td>20%</td>
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Course Requirements

Attendance and Class participation (20%)

Participation
Participation is valued as meaningful contribution in the digital and tangible classroom, utilizing the resources and materials presented to students as part of the course. Meaningful contribution requires students to be prepared in advance of each class session and to have regular attendance. Students must clearly demonstrate they have engaged with the materials as directed, for example, through classroom discussions, online discussion boards, peer-to-peer feedback (after presentations), interaction with guest speakers, and attentiveness on co-curricular and outside-of-classroom activities.

Class Attendance
Regular class attendance is required throughout the program, and all unexcused absences will result in a lower participation grade for any affected CIEE course. Due to the intensive schedules for Open Campus programs, unexcused absences that constitute more than 10% of the total course will result in a written warning.

Students who transfer from one CIEE class to another during the add/drop period will not be considered absent from the first session(s) of their new class, provided they were marked present for the first session(s) of their original class. Otherwise, the absence(s) from the original class carry over to the new class and count against the grade in that class.

For CIEE classes, excessively tardy (over 15 minutes late) students must be marked absent. Attendance policies also apply to any required co-curricular class excursion or event, as well as
to Internship, Service Learning, or required field placement. Students who miss class for personal travel, including unforeseen delays that arise as a result of personal travel, will be marked as absent and unexcused. No make-up or re-sit opportunity will be provided.

Attendance policies also apply to any required class excursion, with the exception that some class excursions cannot accommodate any tardiness, and students risk being marked as absent if they fail to be present at the appointed time.

Unexcused absences will lead to the following penalties:

<table>
<thead>
<tr>
<th>Percentage of Total Course Hours Missed</th>
<th>Equivalent Number of Open Campus Semester classes</th>
<th>Minimum Penalty</th>
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<tbody>
<tr>
<td>Up to 10%</td>
<td>1 content classes, or up to 2 language classes</td>
<td>Participation graded as per class requirements</td>
</tr>
<tr>
<td>10 – 20%</td>
<td>2 content classes, or 3-4 language classes</td>
<td>Participation graded as per class requirements; <strong>written warning</strong></td>
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<tr>
<td>More than 20%</td>
<td>3 content classes, or 5 language classes</td>
<td>Automatic <strong>course failure</strong>, and possible expulsion</td>
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**Group presentation (10%)**

Students work in groups of 2 or more to select a methodology presented in Chapter 2. They investigate (using online sources) real-life applications of the methods and make an oral presentation to the class. The format is a 20-minute Powerpoint presentation. Students provide the justification for the use of the methodology, explain the analytical tool, and interpret the results of its application.

**Weekly quizzes (3; 30% total).** Weekly quizzes draw from the problem sets at the end of each assigned chapter of the textbook. To prepare for the quizzes, students are encouraged strongly to practice solving the problems.

**Midterm exam (20%)**

Students take a 60-point exam consisting of questions in the format of multiple choice, short answer questions, and calculations on lecture and reading materials.

**Final Exam (20%)**

Students take a 80-point exam consisting of questions of multiple choice and short answer questions, and calculations.
Weekly Schedule
NOTE: this schedule is subject to change at the discretion of the instructor to take advantage of dynamic experiential learning opportunities.

Week 1 Introduction

Class 1:1 Topic: Introduction to this course.

We will review the syllabus, learning objectives, and assessment methods, including aspects of participation and engagement in class. The introduction will cover the scope of the course, a conceptual framework, plus fundamental concepts and definitions.

Readings:


Week 2 Topic: Engineering for sustainability: what it is and how to measure it

Class 2.1 This session includes a lecture and discussion of the assigned articles.

Lecture. Sustainable design, engineering, and innovation. The evolution of environmental protection to sustainability; the imperative for sustainable design, engineering, and innovation. How to operationalize sustainability: life cycle thinking, systems thinking, resilience thinking, and frameworks for sustainable design. How to measure sustainability in engineered systems. Great challenges and opportunities for environmental engineers.

Readings:
Textbook, Chapter 1: Sustainable design, engineering, and innovation
Class 2.2  This session includes a lecture and Quiz 1

Lecture. Environmental measurements. Mass concentration units; volume/volume and mole/mole units; partial-pressure units; mole-volume units; normality; concentrations of greenhouse gases

Readings:
Textbook, Chapter 2: Environmental measurements.

Assessment:
Quiz 1 (drawn from problem sets in Chapters 1; 10%)

Week 3  Topic: Chemistry for engineers.

Class 3.1  This session has a lecture and an assigned reading.


Readings:
Textbook, Chapter 3.1 – 3.4: Chemistry.

Class 3.2  This session has a lecture and an assigned reading.


Readings:
Textbook, Chapter 3.5-11: Chemistry.

Class 3.3  This session is devoted entirely to the Midterm Exam (25%).
Students take a 60-point exam consisting of questions in the format of multiple choice, short answer questions, and calculations on lecture and reading materials to date.

**Week 4**

Topic: Physical processes: mass and energy balances, and mass transport

**Class 4.1** This session includes a lecture and required readings.
Lecture. Physical processes for the environmental engineer, Part 1. Mass balances: mass balance equation for the completely mixed flow reactor (CMFR); batch and plug-flow reactor; retention time; materials flow analysis and urban metabolism.

Readings:
Textbook, Chapter 4.1 Physical Processes (Mass balances)

**Class 4.2** This session includes a lecture, required readings, and Quiz 2

Lecture. Physical processes for the environmental engineer, Part 2. Energy balances: forms of energy; conducting an energy balance; the greenhouse effect and impacts of GHG emissions on Earth energy balance; energy efficiency in buildings; urban heat islands.

Readings:
Textbook, Chapter 4.2-4.3: Physical Process (Energy balances)

Assessment:
**Quiz 2** (drawn from problem sets in Chapters 5 and 7; 10%)

**Class 4.3** This session includes a lecture and group oral presentations


Readings:
Textbook, Chapter 4.4. Physical Processes (Mass transport)
Assessment:

**Group oral presentation**

**Week 5**

Topic: Ecology and Environment meet the Engineer

**Class 5.1**

This session consists of a lecture and assigned readings


Readings:

Textbook, Chapter 5: Biology

**Class 5.2**

This session consists of a lecture, assigned readings and Quiz 3.


Readings:

Textbook, Chapter 7: Water: Quantity and quality.

Assessment

**Quiz 3 (10%), drawn from problem sets in Chapter 5.**

**Class 5.3**

This session consists of a lecture, assigned readings, and group oral presentations

Lecture. Treat water respectfully. Life cycle analysis of wastewater streams; global and local trends in waste water production; primary and secondary waste water management; facility design and function; facility levelized costs; compare and contrast water treatment plant with water cycles in nature. The role of the environmental engineering in mitigating
environmental and social issues associated with waste water management practices.

Readings:
Textbook, Chapter 9: Wastewater and Stormwater: Collection, Treatment, and Resource Recovery.

Assessments:
Group oral presentations

Week 6

Topic: Solid waste and its management

Class 6.1
This session consists of a lecture and required readings


Readings:
Textbook, Chapter 10: Solid waste management.

Class 6.2
This session consists of a lecture and required readings


Readings


**Course Materials**

**Course Textbooks**

**Readings**


**Online Resources**
https://works.bepress.com/lvanasup/
https://www.epa.gov/eco-research
https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid
https://www.epa.gov/ghgreporting
https://www.epa.gov/heat-islands
https://www.esrl.noaa.gov/
https://ghgprotocol.org/
https://www.oercommons.org/authoring/1660-the-sustainability-learning-suites/view
http://www.sustainablemeasures.com/
https://toxics.usgs.gov/