**Course title:** Environmental Engineering  
**Course code:** (GI) ENGI 3001 BRGE  
**Programs offering course:** Global Architecture and Design, Berlin Open Campus Block  
**Open Campus Track:** STEM and Society  
**Language of instruction:** English  
**U.S. semester credits:** 3.00  
**Contact hours:** 45.00  
**Term:** Spring Block III 2021

### 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
By completing this course, students will:

1. Critically explore problems commonly encountered by environmental engineers, analyze common approaches adopted by engineers, and investigate the role of environmental engineers in solving new or emerging environmental problems, particularly ones that are complex or interdisciplinary  
2. 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. Apply material balances and life cycle analyses to engineering problems  
5. Practice professional oral and written communication skills  
6. Apply leadership and teamwork in group projects and assignments.  
7. Enlighten and engage 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>1. Group presentation (oral report)</td>
<td>10%</td>
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<tr>
<td>2. Weekly quizzes (3)</td>
<td>30%</td>
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<tr>
<td>3. Midterm Exam</td>
<td>20%</td>
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<td>4. Final Exam</td>
<td>20%</td>
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<td>5. Participation</td>
<td>20%</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>100%</strong></td>
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### Course Requirements
**Group presentation (oral report)**

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 10-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)**

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**

Students take a midterm exam of multiple choice and short answer questions, calculations, and longer format synthetic questions that build on the major themes of the course so far.

**Final Exam**

Students take a final exam consisting of multiple choice and short answer questions, calculations, and longer format synthetic questions that build on the major themes of the course in total.

**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.

**Attendance**

Regular class attendance is required throughout the program, and all absences will result in a lower participation grade for any affected CIEE course. Due to the intensive schedules for Open Campus and Short Term programs, 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 any required field placement. Students may not miss placement/work hours at an internship or service learning site unless approved in advance by the Academic Director and placement supervisor. All students must complete all of the requisite 100 minimum work hours on site at the internship or service learning placement to be eligible for academic credit.

Students who miss class for personal travel, including unforeseen delays that arise as a result of personal travel, will be marked as absent. 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.

Absences for classes will lead to the following penalties:
N.B. Course schedule is subject to change due to study tours, excursions, and local holidays. Final schedules will be included in the final syllabus provided to students on site.

**Weekly Schedule**

**Week 1**

Class: 1.1 Introduction to Environmental Engineering

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**

Class: 2.1 Engineering for Sustainability: What it is and how to measure it

Sustainable design, engineering and innovation

Students investigate the evolution of environmental protection to sustainability; the imperative for sustainable design, engineering, and innovation. They consider how to operationalize sustainability: life cycle thinking, systems thinking, resilience thinking, and frameworks for sustainable design. They also learn how to measure sustainability in engineered systems. Finally, they discuss current challenges and opportunities for environmental engineers.

Readings:

Textbook, Chapter 1: Sustainable design, engineering, and innovation

Class: 2.2 Engineering for Sustainability: What it is and how to measure it

Students consider standard and advanced environmental measurements useful for engineering decisions, including 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**

**Class: 3.1**  
Topic: Chemistry for engineers.

Environmental Chemistry


Readings:
Textbook, Chapter 3.1 – 3.4: Chemistry.

**Class: 3.2**  
Topic: Chemistry for engineers.

Environmental Chemistry for Engineers


Readings:
Textbook, Chapter 3.5-11: Chemistry.

**Class: 3.3**  
Topic: Chemistry for engineers.

This session includes the Midterm Exam (20%) and an introduction to the second part of the course

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. Students then explore a broad view of how the Environmental Chemistry links to Environmental Physics and engineering.

**Week 4**

**Class: 4.1**  
Physical processes: mass and energy balances, and mass transport

Physics for Environmental Engineering

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

Physics Applied to Environmental Engineering 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%)
Mass Transport and Environmental Engineering


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

Assessment:
Group oral presentation

Week 5

Class:  5.1  Topic: Ecology and Environment meet the Engineer

Modeling Ecosystems


Readings:
Textbook, Chapter 5: Biology

Class:  5.2  Topic: Ecology and Environment meet the Engineer

Water Quality and Quantity


Readings:
Textbook, Chapter 7: Water: Quantity and quality.

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

Class:  5.3  Topic: Ecology and Environment meet the Engineer

Sustainable Water Use

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

Class:  6.1  Solid waste and its management

Readings:

Textbook, Chapter 10: Solid waste management.

Class: 6.2 Solid waste and its management

Solid Waste Management


Readings


Class: 6.3 Final Exam and Final Discussion

Course Materials

Readings

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