COURSE DATA

DATA SUBJECT

Code: 33092
Name: Foundations of environmental engineering
Cycle: Undergraduate Studies
ECTS Credits: 4.5
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1104 - Degree in Environmental Sciences	Facultat de Ciències Biològiques	2	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1104 - Degree in Environmental Sciences	Foundations of environmental engineering	COMPULSORY

COORDINATION

PEÑARROCHA OLTRA JOSEP MANUEL

SUMMARY

The course "Fundamentals of Environmental Engineering" is a mandatory course in the fall semester of the second degree course in Environmental Sciences. This course consists of 4.5 ECTS.

The course, based on previously developed skills in basic courses, introduces the conceptual tools to define and manage environmental problems from a quantitative point of view. To achieve this goal, the course is based on the following contents:

- Materials Balance
- Energy Balance
- Introduction to reaction engineering
- Introduction to transport phenomena

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

COMPETENCES / LEARNING OUTCOMES

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Capacidad de realizar y aplicar balances de materia y energía a todo tipo de procesos e instalaciones.

DESCRIPTION OF CONTENTS

1. Introduction

1.Role of Environmental Engineering
2.Sources of pollutants
3.Unit operations and Processes in Environmental Engineering: Definitions and classification of Unit or Basic operations. Momentum transfer unit operations. Energy transfer unit operations. Mass transfer unit operations
4.Batch and Continuous operations: steady state and non-steady state regimes. advantages and disadvantages of intermittent of Batch and Continuous systems
5.General approach to analysis and design of systems: Required Information: conservation laws, kinetic laws, and constraints of the system

2. Mass balances

1. General property balance: Formulation of balances. Generation term: balances and conservation principles
2. Total material balance: Total mass balance. Total quantity of substance balance
3. Material balance for a component
4. Practical use of material balances
4.1. Steady state systems without chemical reaction: Single unit systems. Systems with multiple units. Process with a bypass stream. Processes with a recycle stream and purge.
4.2.Non-steady state systems without chemical reaction
4.3.Systems with chemical reaction
4.4.Chemical element mass balances

3. Energy Balances

1. Total energy balance: Determination of inputs and outputs associated with material flow: enthalpy, potential energy and kinetic energy. Inputs and outputs non associated with material flow. Accumulation term and specific internal energy determination. Practical use of total energy balance at steady state
2. Enthalpy balance
2.1. Practical use of enthalpy balance for systems without chemical reaction: Steady state systems. Non-steady state systems. Practical use of enthalpy balance for systems with chemical reaction at steady state
3. Mechanical energy balance: Formulation of mechanical energy balance. Pressure. Generation: head loss

4. Reactors

1. Chemical reaction engineering in environmental engineering: Transformation processes in environmental engineering. Characteristic examples
2. Reactor classification: Mode of operation. Flow pattern of reacting materials. Form of heat Exchange. Nature of the phases
3. Reactor design: Reaction rate and mass balance. Reactor sizing
4. Ideal reactors: Ideal reactors description. Batch reactor (BR). Continuous stirred-tank reactor (CSTR). Plug flow reactor (PFR). Analysis and/or design of ideal reactors.

5. Transport phenomena introduction

1. Transport mechanisms: molecular and turbulent transport
2. Molecular transport equation: Fourier Law. Newton Law. Fick Law
3. Turbulent transport (transport coefficients): Individual transport coefficients. Transport between phases: global transport coefficients
4. Practical applications (Example for simple systems): Steady state. Planar and cylindrical geometry
5. Fundamentals of pollutant transport

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	2,00
Theory	27,00
Computer classroom practice	4,00

Classroom practices	12,00
Total hours	**45,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	17,00
Independent study and work	22,50
Preparation of lessons	28,00
Preparation for assessment activities	0,00
Resolution of case studies	0,00
Total hours	**67,50**

TEACHING METHODOLOGY

The methodology used in the course will consider the following aspects:

Lecture sessions: Single group to introduce the theoretical and practical principles of the course.

Practical questions lessons: Practical questions will be solved in groups of 40 students in a regular classroom and in groups of 30 students in a computer classroom.

Tutorials: Students will be divided into small groups and participate in mandatory sessions.

EVALUATION

The evaluation of the course is based on the following aspects:

1. Continuous evaluation and practical activities (30% of the grade), which will include:

a. Attendance and participation in class (5%)

b. Submission of practical exercises (10%)

c. Evaluation of work done with computer applications (5%)

d. Objective tests on the contents through individual questionnaires to be completed periodically (10%)

2. Exam (70% of the grade): There will be a written exam consisting of both theoretical-practical questions and problems.

The course will be considered passed when the weighted average grade is equal to or higher than 5 (out of 10), provided that the grade obtained on the exam is equal to or higher than 4.5 (out of 10). If the exam grade is lower than 4.5, the weighted average with the continuous evaluation and practical activities will not be calculated. In this case, the exam will account for 100% of the course evaluation.

In any case, each student can choose to have the exam account for 100% of the course evaluation.

REFERENCES

- Bases d¿Enginyeria ambiental. A. Bouzas, J.A. González, V. Martínez-Soria, J.M. Penya-roja (PUV)
- Introduction to environmental engineering and science. G.M. Masters (Prentice-Hall International)
- Fundamentos de Ingeniería ambiental. J.R. Mihelcic y otros (Limusa-Wiley)
- Introduction to environmental engineering. M.L. Davis, D. A. Cornwell (McGraw-Hill)
- Ingeniería Ambiental. G. Kiely (McGraw-Hill)
- Introduction to chemical transport in the environment. J.S. Gulliver (Cambridge University Press)
- Introducció a l¿enginyeria química. A. Aucejo, D. Benaiges, A. Berna, M. Sanchotello, C. Solà (Biblioteca Universitària)
- Introducción a la ingeniería química. G. Calleja y otros (Síntesis)