COURSE DATA

Data Subject	
Code	33092
Name	Foundations of environmental engineering
Cycle	Grade
ECTS Credits	4.5
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
1104 - Degree in Environmental Sciences	Faculty of Biological Sciences	2	Second term

Subject-matter

Degree	Subject-matter	Character
1104 - Degree in Environmental Sciences	145 - Foundations of environmental engineering	Obligatory

Coordination

Name	Department
PEÑARROCHA OLTRA, JOSEP MANUEL	245 - Chemical Engineering

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

OUTCOMES

1104 - Degree in Environmental Sciences

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

LEARNING OUTCOMES

- Mass and energy balance calculations focused on environmental problems
- Fundamentals of Environmental reaction engineering calculations
- Application of transport phenomena to environmental systems
- Understanding of sources of key pollutants
- Interpret and use information to solve practical cases
- Develop skills to handle specialized bibliographic sources for finding, selecting and understanding the information
- Critically analyze the results of practical applications

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

ACTIVITY	Hours	% To be attended
Theory classes	27,00	100
Classroom practices	12,00	100
Computer classroom practice	4,00	100
Tutorials	2,00	100
Development of group work	10,00	0
Development of individual work	7,00	0
Study and independent work	22,50	0
Preparing lectures	12,00	0
Preparation of practical classes and problem	16,00	0
TOTAL	**112,50**	

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 in:

1. Continuous assessment and practical activities (30% of grade): Based on written work given to the professors (reports, problems solved, etc) and/or individual specific tests. Regular course attendance and classroom activities will be taken into account.
2. Objective test (70% of grade): Based on a written test with theoretical and practical questions.

The course will be over passed when the weighted average grade is equal to or greater than 5 (out of 10), being mandatory to obtain in the objective test a grade equal or greater than 4.5 (out of 10). In case that the grade of the objective test were lower than 4.5, this grade of the objective test will be the global grad of the course.

In any case, the student may choose if the objective test sholud account for the 100% of the grade.

REFERENCES

Basic

- Bases dEnginyeria 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)

Additional

- Ingeniería Ambiental. G. Kiely (McGraw-Hill)
  - Introduction to chemical transport in the environment. J.S. Gulliver (Cambridge University Press)
  - Introducció a lenginyeria química. A. Aucejo, D. Benaiges, A. Berna, M. Sanchotello, C. Solà (Biblioteca Universitària)
  - Introducción a la ingeniería química. G. Calleja y otros (Síntesis)