

Academic
year
2025/2026

Course Guide:

MATERIALS FOR INDUSTRY



FACULTAD DE
CIENCIAS QUÍMICAS



1. COURSE CHARACTERISTICS

Degree	Master in Chemical Engineering: Process Engineering			Code	
Course Title	Materials for Industry			ECTS	6
Matter	Application Areas of Chemical Engineering				
Module	Process and product engineering				
Type	Elective	Year	First	Semester	First
Department	Chemical and Materials Engineering				

Professor/s in charge

Activity	Professor	Email	Office
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2. OBJECTIVES

General Objectives

The Course Objective is to provide students with scientific and technological basis of materials used in Chemical Engineering in order for them to be able to apply the acquired knowledge to selection of materials and materials performance in service.

Specific Objectives

- To acquire knowledge of materials used in Chemical Industry.
- To acquire knowledge of in-service performance of materials used in chemical processing plants and installations, their inspection and maintenance, and reliability, effectiveness and remaining field life analysis.
- To acquire knowledge of materials selection criteria in industrial chemical engineering processes.
- To develop capability to apply the acquired knowledge to forensic failure case analysis in industrial chemical processing installations.

3. KNOWLEDGE REREQUISITES

Not required.

4. COURSE CONTENT

Brief description of content

Properties and applications of materials. Ferrous alloys. Non-ferrous alloys. Polymeric materials. Composite materials. Materials performance in service. Corrosion mechanisms. Protection methods. Materials selection. Case studies.



Programme

Unit I. MATERIALS: TYPES, PROPERTIES & APPLICATIONS

- Topic 1. Physical and mechanical properties.
- Topic 2. Toughness, fracture, fatigue, creep, fire resistance.
- Topic 3. Carbon steels and cast irons.
- Topic 4. Alloyed and stainless steels.
- Topic 5. Non-ferrous alloys of interest in chemical technology.
- Topic 6. Polymeric materials of interest in chemical technology.
- Topic 7. Composite materials. Nanomaterials.

Unit II. MATERIALS PERFORMANCE IN SERVICE.

- Topic 8. Structural integrity and deterioration of materials.
- Topic 9. Oxidation and corrosion.
- Topic 10. Corrosion inhibitors.
- Topic 11. Cathodic and anodic protection.
- Topic 12. Metallic coatings. Paints.
- Topic 13. Surface modification techniques.
- Topic 14. Risk based inspection.
- Topic 15. Maintenance of equipment and installations.

Unit III. MATERIALS SELECTION IN CHEMICAL TECHNOLOGY.

- Topic 16. Design parameters in selection of materials.
- Topic 17. Failure analysis. Remaining life.
- Topic 18. Case studies.



5. SKILLS

General skills

CG1	Be able to apply a scientific method and engineering and economy principles to resolution of complex problems in processes, equipment, installations and operations where matter undergoes changes in composition, state, and energetic level, typical in chemical industry and other related sectors such as pharmaceutical, biotechnology, materials, energy, food processing and environmental.
CG2	Comprehend and be able to design and develop processes, equipment, installations and operations in the area of chemical engineering and related industrial sectors, in terms of quality, safety, economics, and rational and efficient use of natural resources and conservation of the environment.
CG10	Be able to adapt to changes and other relevant progress and apply advanced and new technologies with initiative and enterprise.
CG11	Be capable of self-teaching in order to maintain and improve the skills pertinent to chemical engineering that would enable a continuous development of the profession

Specific skills

CE1	Be able to apply the knowledge of mathematics, physics, chemistry, biology and other sciences.
CE2	Design new products, processes, systems and operations of chemical industry and optimize the existing ones, based on different areas of chemical engineering, including transport phenomena and processes, separation operations and engineering principles of chemical, nuclear, electrochemical and biochemical reactions.
CE10	Be able to adapt to structural societal changes induced by economic, energy or natural factors and phenomena, in order to solve problems derived from those and provide highly sustainable technological solutions.

Transverse skills

CT1	Application of the knowledge of mathematics, physics, chemistry, biology and other sciences..
CT2	Team working and development of social skill.
CT3	Develop awareness and responsibility in regards to energy, environmental and ethical issues.
CT4	Be able to apply criticism and self-criticism in search of scientific quality and rigor.
CT5	Report writing and other scientific and technical document writing skills.
CT7	Processing and management of scientific data, bibliographic reference, specialized databases and other resources available via internet.
CT9	Communication of scientific concepts using typical audio-visual media and development of oral communication skills.



6. CONTRIBUTION OF ACTIVITIES TO COURSE CREDITS

Activity	Attendance (hours)	Independent work (hours)	Credits
Theory classes	38	57	3,8
Seminars	5	7,5	0,5
Tutorials	2	3	0,2
Laboratory practice	9	6,75	0,63
Examinations and Supervised Coursework	3	18,75	0,87
Total	57	93	6

7. METHODOLOGY

The subject will be taught in English language.

Face-to-face teaching and learning activities will include theory classes and seminars.

In theory classes, a lecturer shall present to the students the contents of the subject. These shall include theoretical concepts and some experimental data that will give the students a global and comprehensive view of the subject. Each Topic shall disclose its contents and main objectives. Course materials of the theory classes and seminars (in PowerPoint presentations, scientific publications, text, standards) shall be made available to the students via UCM's online portal "Campus Virtual" (CV).

Seminars and tutorials shall be dedicated to application of the acquired theoretical knowledge to resolution of problems and exercises. Coursework topics shall be proposed by the lecturer; coursework will be presented by the students orally and/or as a written report.

During laboratory work students shall carry out in practice the experiments and observations applying the acquired theoretical knowledge.

8. BIBLIOGRAPHY

- W. Smith. "Structure and Properties of Engineering alloys". 2^a Ed. McGraw-Hill. 1993.
- K.G. Budinsky. "Engineering Materials: Properties and Selection." 5^a Ed. Prentice Hall. 1996.
- S. Kalpakjian y S.R. Schmid. "Manufacturing Engineering and Technology". Prentice Hill. 5^a Ed. 2006.
- E. Otero. "Corrosión y Degradación de Materiales". 2^a Ed. Síntesis. 2013.
- D.A. Jones. "Principles and Prevention of Corrosion". 2^a Ed. Prentice Hall. 1996.
- M.G. Fontana. "Corrosion Engineering". 3^a Ed. New Delhi: Tata McGraw-Hill, 2005.
- Z. Ahmad. "Corrosion Engineering". Butterworth-Heinemann. 2006.
- M.F. Ashby. "Materials Selection in Mechanical Design". 3rd Ed. BH. 2005.



9. EVALUATION

Attendance to programmed tutorials and laboratory practices is compulsory, as is completion of the assigned coursework. In order to be eligible for the final evaluation, students must have participated in at least 70% of the face-to-face activities (theory classes and seminars).

Final grade for the subject will be calculated as weighted average in accordance with the following percent contributions, which will be maintained for all Calls:

❖ **WRITTEN EXAMINATIONS: 70%**

Two mid-term exams shall be administered in accordance with the Subject Content Units. The average obtained exam grade shall contribute 70% towards the final grade in the Subject. Students who have achieved a minimum average grade of 5 on the scale of 10 in mid-term exams and whose final grade in the Subject (taking into account the grade for individual work) is a minimum 5, are not obligated to sit the final exam.

The final exam (either end-of-term or additional call) in the entire content of the Subject shall contribute 70% towards the final grade. Students must achieve a minimum grade of 5 in order to pass the exam and in order to qualify for a final grade in the Subject.

❖ **INDIVIDUAL COURSEWORK AND SUPERVISED ACTIVITIES: 30%**

The evaluation of the independent learning activities and supervised activities will take into account the following:

- Submitted solutions (individually or as a group) to the problems and exercises proposed by the supervisor during tutorials and seminars.
- Submitted coursework (individually or as a group) on the topics proposed by the supervisor and related with the Topics of the Units and related case studies.
- Compulsory laboratory practices work, including an elaborated Report on the practical activities carried out in the laboratory.

CHRONOGRAMME OF THE PLANNED ACTIVITIES

The activities programme will be implemented in a chronological order of the Unit Topics in the time allotted as follows:

TOPIC UNITS	ACTIVITY	HOURS
Unit I. MATERIALS: TYPES, PROPERTIES & APPLICATIONS	Theory	15
	Seminar	1
	Tutorials	1
Unit II. MATERIALS PERFORMANCE IN SERVICE	Theory	16
	Seminar	2
	Tutorials	1
Unit III. MATERIALS SELECTION IN CHEMICAL TECHNOLOGY	Theory	7
	Seminar	2