



**A) COURSE**

Course Id:	Course
5629	Materials Engineering I

Class Hours per Week	Lab hours per week	Complementary practices	Credits	Total hour course
3	0	0	6	48 Hours

**B) GENERAL COURSE INFORMATION:**

	EE (IEA)	ME (IM)	MME (IMA)	EME (IME)	MTE (IMT)
<b>Level:</b>		III	III		
<b>Course Type (Required/Elective)</b>		Required	Required		
<b>Prerequisite Course:</b>		CHEMISTRY A	CHEMISTRY A		
<b>CACEI Classification:</b>		BS	BS		

**C) COURSE OBJECTIVE**

**At the end of the course, the student will be capable of:**

THE TARGET OF THIS COURSE IS THAT THE STUDENT ACQUIRES THE BASIC KNOWLEDGE OF THE STRUCTURAL LATTICE OF THE DIFFERENT GROUPS OF MATERIALS. IN THIS FIRST COURSE THERE WILL BE CHECKED THE CHEMICAL CHARACTERISTICS THAT DEFINE AND AFFECT THE PROPERTIES OF THE METALLIC, CERAMIC AND POLYMERIC MATERIALS.

THE STRUCTURE OF CRYSTALLINE MATERIALS WILL BE STUDIED IN FOUR DIFFERENT LEVELS: STRUCTURE OF THE ATOM, ATOMIC ARRANGEMENT, GRANULAR STRUCTURE AND MULTI PHASE STRUCTURE. WILL BE ANALYZED ALSO THE RELATIONSHIP AMONG STRUCTURAL LATTICE, PROPERTIES AND PROCESSING OF MANUFACTURE.



#### D) TOPICS (CONTENTS AND METHODOLOGY)

1.- INTRODUCTION.		2 Hours
Specific Objective:	OBJECTIVE: PRESENTATION OF THE COURSE, PROGRAM AND FORM OF WORK. IN ORDER TO AWAKE THE INTEREST OF THE PUPIL IN THE STUDY OF THE MATERIALS, EXAMPLES OF INDUSTRIAL APPLICATIONS WILL BE ANALYZED. DEFINITION AND CLASSIFICATION OF THE MATERIALS.	
1.1. - PRESENTATION OF THE COURSE. 1.2. - REVIEW THE PROGRAM. 1.3. - REMINDER OF CONCEPTS AND DEFINITIONS.		
Readings and other resources	Articles, books, Internet, complementary bibliography.	
Teaching Methodologies	EXPOSURE OF SUBJECTS OF STUDY OF DIAGRAMS, EXPLANATION OF CONCEPTS, MANAGEMENT OF LABORATORY, PROBLEM-SOLVING TECHNIQUES. VISITS TO COMPANIES AND RESEARCH WORK.	
Learning Activities	Dynamics of working in team, assignments, and discussion of these. Studies of reproducibility and repeatability, estimation error, uncertainty, calibration. Analysis of readings and presentations in Powerpoint.	
2.- THE STRUCTURE OF CRYSTALLINE METALS		12 Hours
Specific Objective:	OBJECTIVE: TO UNDERSTAND THE ATOM STRUCTURE DOWN TO THE MOST ELEMENTARY LEVEL, DEFINES THE PHYSICAL AND CHEMICAL CHARACTERISTICS OF EACH OF THE ELEMENTS THAT ARE FOUND IN THE NATURE. CHEMIST, PHYSICS AND MECHANICS ARE IMPORTANT TO UNDERSTAND AND TO ANALYZE ATOMIC LEVEL AND CRYSTAL GROWTH DEPENDING MATERIAL PROPERTIES.	
2.1.- ATOMIC STRUCTURE. 2.2.- THE PERIODIC TABLE, ISOTOPES AND CLASSIFICATION O ELEMENTS. 2.3.- ATOMIC BONDING IN SOLIDS. 2.4.- BRAVAIS LATTICES. 2.5.- POLYMORPHISM AND ALLOTROPY. 2.6.- METALLIC CRYSTAL STRUCTURES. 2.7.- CRYSTALLOGRAPHIC POINTS, DIRECTIONS, AND PLANES. 2.8.- DEPENDENCE OF THE PROPERTIES OF THE MATERIAL WITH THE CRYSTALLOGRAPHIC DIRECTIONS. 2.9.- CRYSTAL STRUCTURES FOR MATERIALS WITH IONIC AND COVALENT BONDING.		
Readings and other resources	Articles, books, Internet, complementary bibliography.	
Teaching Methodologies	EXPOSURE OF SUBJECTS OF STUDY OF DIAGRAMS, EXPLANATION OF CONCEPTS, MANAGEMENT OF LABORATORY, PROBLEM-SOLVING TECHNIQUES. VISITS TO COMPANIES AND RESEARCH WORK.	
Learning Activities	Dynamics of working in team, assignments, and discussion of these. Studies of reproducibility and repeatability, estimation error, uncertainty, calibration. Analysis of readings and presentations in Powerpoint.	
3.- IMPERFECTIONS IN SOLIDS		7 Hours
Specific Objective:	OBJECTIVE: TARGET: TO STUDY THE IMPERFECTION OF THE ATOMIC ARRANGEMENT AND THE SIDE EFFECT OF HARDENING INTO THE MECHANISMS OF PLASTIC DISTORTION, FLAW AND MECHANICAL PROPERTIES OF THE MATERIALS.	



3.1.- CRYSTALLIZATION MECHANISM 3.2.- CRYSTAL IMPERFECTIONS. 3.3.- DIFFUSION MECHANISMS AND LAWS. 3.4.- GRAIN SIZE 3.5.- GRAIN BOUNDARIES 3.6.- TWIN BOUNDARIES 3.7.- FRACTURE.	
<b>Readings and other resources</b>	Articles, books, Internet, complementary bibliography.
<b>Teaching Methodologies</b>	EXPOSURE OF SUBJECTS OF STUDY OF DIAGRAMS, EXPLANATION OF CONCEPTS, MANAGEMENT OF LABORATORY, PROBLEM-SOLVING TECHNIQUES. VISITS TO COMPANIES AND RESEARCH WORK.
<b>Learning Activities</b>	Dynamics of working in team, assignments, and discussion of these. Studies of reproducibility and repeatability, estimation error, uncertainty, calibration. Analysis of readings and presentations in Powerpoint.

4.- TEST AND MECHANICAL PROPERTIES OF METALS. <span style="float: right;"><b>7 Hours</b></span>	
<b>Specific Objective:</b>	OBJECTIVE: TO STUDY THE DIFFERENT METHODS OF ESSAY THAT ARE USED TO EVALUATE THE MOST COMMON MECHANICAL PROPERTIES FOR DIVERSE APPLICATIONS.
4.1.- TENSILE TEST. 4.2.- HARDNESS TEST. 4.3.- IMPACT TEST. 4.4.- FATIGUE TEST 4.5.- STRESS AND TEMPERATURE EFFECTS	
<b>Readings and other resources</b>	Articles, books, Internet, complementary bibliography.
<b>Teaching Methodologies</b>	EXPOSURE OF SUBJECTS OF STUDY OF DIAGRAMS, EXPLANATION OF CONCEPTS, MANAGEMENT OF LABORATORY, PROBLEM-SOLVING TECHNIQUES. VISITS TO COMPANIES AND RESEARCH WORK.
<b>Learning Activities</b>	Dynamics of working in team, assignments, and discussion of these. Studies of reproducibility and repeatability, estimation error, uncertainty, calibration. Analysis of readings and presentations in Powerpoint.

5.- STRAIN HARDENING AND ANNEALING. <span style="float: right;"><b>7 Hours</b></span>	
<b>Specific Objective:</b>	OBJECTIVE: TO STUDY THE EFFECT OF HARDENING AS A RESULT OF COLD WORKING AND THE WAY TEMPERATURE MODIFY PROPERTIES AS IN ANNEALING THERMAL TREATMENT. TO STUDY THE SIDE EFFECTS ON METALS AS A RESULT OF THE MANUFACTURING PROCESSES AS STRAIN HARDENING AND ANNEALING AND USE OF ALLOYS.
5.1.- RECRYSTALLIZATION TEMPERATURA. 5.2 – EFFECT OF COLD WORK ON THE MECHANICAL PROPERTIES. 5.3. - RECOVERY, RECRYSTALLIZATION, AND GRAIN GROWTH. 5.4. - HOT WORKING.	
<b>Readings and other resources</b>	Articles, books, Internet, complementary bibliography.
<b>Teaching Methodologies</b>	EXPOSURE OF SUBJECTS OF STUDY OF DIAGRAMS, EXPLANATION OF CONCEPTS, MANAGEMENT OF LABORATORY, PROBLEM-SOLVING TECHNIQUES. VISITS TO COMPANIES AND RESEARCH WORK.
<b>Learning Activities</b>	Dynamics of working in team, assignments, and discussion of these. Studies of reproducibility and repeatability, estimation error, uncertainty, calibration. Analysis of readings and presentations in Powerpoint.

6.- PRINCIPLES OF PROCESSING SOLIDIFICATION AND HARDENING <span style="float: right;"><b>3 Hours</b></span>	
<b>Specific Objective:</b>	OBJECTIVE: TO STUDY SOLIDIFICATION PROCESSES OF MATERIALS.



6.1- NUCLEATION. 6.2.- GROWTH MECHANISMS. 6.3.- TIME OF SOLIDIFICATION AND DENDRITE SIZE. 6.4.- COOLING CURVES. 6.5.- CASTING PROCESSES 6.6.- MELTING AND CASTING STRUCTURE. 6.7.- SOLIDIFICATION	
<b>Readings and other resources</b>	Articles, books, Internet, complementary bibliography.
<b>Teaching Methodologies</b>	EXPOSURE OF SUBJECTS OF STUDY OF DIAGRAMS, EXPLANATION OF CONCEPTS, MANAGEMENT OF LABORATORY, PROBLEM-SOLVING TECHNIQUES. VISITS TO COMPANIES AND RESEARCH WORK.
<b>Learning Activities</b>	Dynamics of working in team, assignments, and discussion of these. Studies of reproducibility and repeatability, estimation error, uncertainty, calibration. Analysis of readings and presentations in Powerpoint.

<b>7.- PHASE EQUILIBRIA AND SOLID SOLUTION HARDENING.</b>		<b>10 Hours</b>
<b>Specific Objective:</b>	OBJETIVE.: THERE WILL BE ANALYZED THE INFORMATION THAT THERE PROVIDE THE CURVES OF COOLING OF PURE METALS AND OF HIS ALLOYS FOR THE CONSTRUCTION OF PHASE DIAGRAMS. THERE WILL BE CHECKED THE TRANSFORMATIONS THAT INVOLVE THREE PHASES IN BINARY SYSTEMS. THERE WILL BE ANALYZED THE INFORMATION THAT IT IS POSSIBLE TO OBTAIN OF THE PHASE DIAGRAMS AND THE FORM IN WHICH THIS ONE CAN BE USED TO IMPROVE THE MECHANICAL PROPERTIES OF A MATERIAL ACROSS HARDENING FOR DISPERSION OF THE MATERIAL. SIMULTANEOUSLY THERE WILL BE STUDIED THE EFFECT THAT PROVOKES THE PRESENCE OF ELEMENTS OF ALLOY IN THE NETWORK OF A PURE METAL PRODUCING A HARDENING FOR SOLID SOLUTION. THERE WILL BE ANALYZED THE CASES OF SOLUBILITY THAT WILL INFLUENCE THE FORMATION OF DIFFERENT SOLID PHASES THAT APPEAR IN THE ALLOYS.	
7.1.- PHASES AND PHASE DIAGRAMS. 7.2.- SOLUTIONS AND SOLUBILITY. 7.3.- SOLID SOLUTION HARDENING. 7.4.- RELATIONSHIP BETWEEN THE PROPERTIES DIAGRAM. 7.5.- MICROCONSTITUENTS FORMATION. 7.6.- HARDENING SOLID STATE DISPERSION. 7.7.- SOLID SOLUTION HARDENING. 7.8.- CONDITIONS FOR A LIMITED SOLID SOLUTION.		
<b>Readings and other resources</b>	Articles, books, Internet, complementary bibliography.	
<b>Teaching Methodologies</b>	EXPOSURE OF SUBJECTS OF STUDY OF DIAGRAMS, EXPLANATION OF CONCEPTS, MANAGEMENT OF LABORATORY, PROBLEM-SOLVING TECHNIQUES. VISITS TO COMPANIES AND RESEARCH WORK.	
<b>Learning Activities</b>	Dynamics of working in team, assignments, and discussion of these. Studies of reproducibility and repeatability, estimation error, uncertainty, calibration. Analysis of readings and presentations in Powerpoint.	

**E) TEACHING AND LEARNING METHODOLOGIES**

**F) EVALUATION CRITERIA:**

Evaluation:	Schedule	Suggested Form of Evaluation and weighing	Topics
1er. Partial Evaluation	Session	Exam, Assignment, Presence	
2º Partial Evaluation	Session	Exam, Assignment, Presence	



3er. Partial Evaluation	Session	Exam, Assignment, Presence	
Final Evaluation Ordinary		100% (average partial evaluations)	
Other Activity:			
Special Exam:	Week 17 of the Semester	100% Exam	100% topics
Special Exam	According to schedule school secretary	100% Exam	100% topics
Regularization Exam	According to schedule school secretary	100% Exam	100% topics

#### **G) BIBLIOGRAPHY AND ELECTRONIC RESOURCES**

##### **Main Books**

- [1] WILLIAM F. SMITH, CIENCIA E INGENIERÍA DE MATERIALES. 3A. EDICIÓN. MCGRAW-HILL (2004)
- [2] DONALD R. ASKELAND, CIENCIA E INGENIERÍA DE MATERIALES. 4A. EDICIÓN. CENGAGE LEARNING (2003)
- [3] SHACKELFORD, JAMES F. INTRODUCCIÓN A LA CIENCIA DE MATERIALES PARA INGENIEROS. 6A. EDICIÓN, PRENTICE HALL (2005).
- [4] S. KALPAKJIAN, S. SCHMID. MANUFACTURA, INGENIERÍA Y TECNOLOGÍA 4a. EDICIÓN. PRENTICE HALL (2001)

##### **Complementary Books**

- [5] CALLISTER, W. D. JR. MATERIALS SCIENCE AND ENGINEERING. AN INTRODUCTION. JOHN WILEY & SONS, INC. 5TH. EDITION (2000).
- [6] MANGONON, P. L. THE PRINCIPLES OF MATERIALS SELECTION FOR ENGINEERING DESIGN. PRENTICE HALL (1999).
- [7] RICHARD A. FLINN/PAUL K. TROJAN, ENGINEERING MATERIAL AND THEIR APPLICATIONS, MCGRAW-HILL. 4TH EDITION (1995).

##### **Internet Links**