EASTERN MEDITERRANEAN UNIVERSITY
FACULTY OF ENGINEERING
Department of Industrial Engineering
IENG263
Materials and Manufacturing Processes
Spring 2019 – 2020

Course Syllabus

Course Code : IENG263 **Course Title :** Materials and Manufacturing Processes **Course Type :** Core Course
Semester: Spring 2019-20 **Credit Value :** (4,1,0) 4 **ECTS Value :** 6
Pre-requisites : CHEM101 **Co-requisites :** None **Course Coordinator :** Sen. Inst. Emir Taşcıoğlu

Instructor : Emir Taşcıoğlu **e-mail :** emir.tascioglu@emu.edu.tr
Office : IE-B211 **Tel. :** 2806 **Teaching Assistants:** None **Office Hours:** Thursday 13:30-14:20

CATALOGUE DESCRIPTION

This course is designed to give students knowledge regarding classification of materials through their properties and structures, mechanical behaviour of materials based on their structures and properties, phase diagrams of metal alloys, thermal processing of metallic materials and performance of materials in service. It also familiarize students with production engineering, including casting, bulk forming (rolling, extrusion, forging), sheet metal forming, machining processes (turning, drilling and milling), welding, abrasive and grinding processes.

COURSE OBJECTIVES

The main objectives of this course are:

1. Classification of materials (Metals, ceramics, polymers, composites), Relationship among the four components of materials (processing-structure-properties-performance), Advanced Materials (shape memory alloys, semi-conductors) (Contributing to Student Outcome 1)
2. Crystalline and Crystal Structures, Face-Centered Cubic Structure (FCC), Body-Centered Cubic (BCC), (Contributing to Student Outcomes 1, 6)
3. Atomic Packing Factor, Density Computations, Crystalline and Non Crystalline Materials, Anisotropy and Isotropy (Contributing to Student Outcome 1)
4. Concept of Stress and Strain, Types of Stresses (Contributing to Student Outcomes 1, 2, 6)
5. Tensile Test, Stress-Strain Relationship, True Stress and Strain (Contributing to Student Outcomes 1, 6)
6. Concept of Toughness, Impact test, Comparison between toughness, strength and ductility, effect of temp. on mechanical properties (toughness, strength and ductility) (Contributing to Student Outcomes 1, 6)
7. Fracture Concept (Ductile vs. Brittle Fracture, Transgranular vs. Intergranular Fracture, Stress concentration, Stress Intensity Factor, Design against Fracture) (Contributing to Student Outcomes 1, 6)
8. Phase/Equilibrium Diagrams, Binary Eutectic Phase Diagrams, Iron-Iron carbide Phase Diagram (Contributing to Student Outcomes 1, 6)
9. Casting procedure, Sand Casting, Sand Casting Defects (Contributing to Student Outcome 1)
10. Other Types of Casting Processes, Expandable Mold and Permanent Mold Castings (Contributing to Student Outcome 1)
11. Principles of Major Manufacturing Processes, Bulk Deformation Processes, Stresses in Metal Forming, Sheet Metal Working Processes (Contributing to Student Outcome 1)
12. Preparing a Term Project (Working effectively in teams, making an independent research, and writing and presenting a technical report) (Contributing to Student Outcomes 3, 7)

TEXTBOOK/S & REFERENCES

William D. Callister, "Materials Science and Engineering: an Introduction 9th Ed." John Wiley & Sons, 2015.
Mikell P. Groover, "Principals of Modern Manufacturing 4rd Ed.", John Wiley & Sons, Inc., 2007.
Lab Outline and Lab Manual: Uploaded to the Course Web Page, staff.emu.edu.tr/emirtascioglu/en

COURSE LEARNING OUTCOMES

On successful completion of this course, students are expected to develop **knowledge** and **understanding** of:

- Classification of solid materials.

- Atomic bonding in solids.
- Calculating the density of materials from the knowledge of their crystal structure.
- Drawing the cubic crystal structures unit cell such as; Face-centred cubic, body-centre cubic and Hexagonal close-packed.
- Mechanical properties of materials, the Hooke's law, the stress and strain relations, Poisson's ratio, ductility, hardness.
- Phase diagrams for alloy systems, learning to make a correlation between microstructure and mechanical properties by carefully control of the heat treatment processes.
- The importance of a heat treatment, and the effects on the microstructure of the iron-carbon alloys. To design a heat treatment process that will produce the desired microstructure.

On successful completion of this course, students are expected to develop **skills in:**

- Conducting experiment to determine properties of material such as module of elasticity, ultimate strength, ductility, hardness and toughness.
- Designing and conducting a heat treatment process that will produce the desired microstructure.
- Experiment with design and performance of a variety of manufacturing processes in which performance characteristics are measured, analyzed and interpreted, and communicated through written reports.
- Selecting manufacturing process for different products' requirements and design.
- Analysing the manufacturing processes quantitatively and qualitatively.

On successful completion of this course, students are expected to develop their **appreciation** of, and respect for **values and attitudes** to:

- Group dynamics, working in teams, respecting team work ethics and contributing to team work.
- Build team skills through group activities in laboratory settings.
- Understand the impact of engineering solutions in global, environment and societal context.

GRADING CRITERIA

Exams: All examinations will be based on lectures, tutorials, labs experiments, workshop experiences, homeworks, assignements and projects. To pass these exams students will need to have studied the material well in advance in order to understand the concepts, procedures and techniques. Descriptions of these examinations are as follows:

Class Quizzes: It is planned to make 4 or 5 class quizzes that will be announced in advance. They will be of closed-book/closed-notes type unless otherwise is mentioned.

Midterm Exam: There will be one midterm examination that covers all the material up to the date of the examination. The midterm exam may consists of three types of questions: Numarical problems, Definitions and Multiple-choice. The midterm exam will take place during the mid-term exams week which is organized centrally by the University.

Final Exam: The final examination will not cover the midterm exam materials and has the same structure as the midterm examination. The final exam will take place during the final exams period which is organized centrally by the University.

Make-up Exam: No make-up examination will be given to students missing any of the quizzes. Make-up examination will only be offered (at the end of the semester) to those students who missed the final or midterm exam and provided valid documentation for their absence within three working days at the latest after the examination date. Any medical report should be approved by EMU Health Center, otherwise will not be accepted. University regulations apply for graduation make-up exams.

Term Project: Students should form groups of maximum 4 students. A penalty (at least 50% reduction in the grade) for late submissions will be applied if the project report is not submitted on the due date. As the project, the students will work on topics in more details based on general subjects which they have been familiarized in the class. The project topics are subject to approval of the instructor.

LEARNING/TEACHING METHOD

The function of teaching is to enable students to learn. To realize this course will be organized into three modules: Lectures, Laboratories and workshops sessions. Sometimes four hours of class in a week will be used for lectures or laboratories or workshops according to the perceived need. The laboratories and workshops date and place of this course will be announced on the cuorse website and teach group is expected to provide a copy of the lab/workshop sheet from the website if it is mentioned in the announcement. For the lectures students are expected to read the related materials before coming to lectures and try to participate the discussions. The instructor will lecture in class

by using the slides with the overhead projector. The instructor will do his best to invite various experts on the field to give seminar to the students.

GRADING POLICY

Class Attendance & Homeworks	5%
Quizes (4 or 5)	10%
Lab work	10%
Project (with presentation)	10%
Midterm Examination	25%
Final Examination	40%

Hint: The project grading is based on the quality of related report and power point presentation in the class.

NG (Nil-grade): Conditions that might lead to NG (Nil-grade):

1. Not attending the Final Exam or its Make-up Exam.
2. Not attending the Mid-term Exam without a valid excuse.
3. Attendance to lectures/labs/workshops less than 50%.

RELATIONSHIP WITH OTHER COURSES

This course is composed of two main topics; material science and manufacturing technology. Chemistry (CHEM101) is a pre-requisite for this course.

COURSE CONTENT AND SCHEDULE

WEEK	TOPIC
1	**Introduction:** structure and methodology of the course; materials and engineering, major classes of materials **Structure of materials:** Unit Cells, metallic crystal structures, crystallographic planes & directions, single crystals, polycrystalline materials.
2-3	**Properties of Engineering Materials:** Strength of materials, Hooke's Law, Youngs Modulus, Elasticity, Plasticity, Hardness, Toughness.
4	**Workshop experiments**
5-6	**Phase/Equilibrium Diagrams:** including Iron - Iron Carbide Diagrams
7	**Heat treatments**
8-9	**Midterm Exam Week**
10-11	**Metal Casting:** Sand Casting, Metal die casting, Invetment casting, Centrifugal Casting.
12	**Bulk Forming:** Rolling, Extrusion, Drawing, Forging
13	**Sheet Metal Forming:** Bending, Cutting, Deep Drawing, others
14	**Machining:** Turning, Milling, Drilling, Planing and shaping, Boaring, Broaching and gear manufacturing.
15	**Casting Demonstration and Project Presentation**

CONTRIBUTION OF COURSE TO MEETING THE REQUIREMENTS OF CRITERION 5

Mathematics and Basic Sciences	0%
Engineering Science	50%
Engineering Design	50%
General Education	0%

RELATIONSHIP OF THE COURSE TO STUDENT OUTCOMES

	Level of Contribution		
Student Outcomes	**No**	**Moderate**	**High**
(1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	☐	☐	☑
(2) an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	☐	☑	☐
(3) an ability to communicate effectively with a range of audiences	☐	☑	☐
(4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	☑	☐	☐
(5) an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	☑	☐	☐
(6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	☐	☐	☑
(7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies	☐	☑	☐

ACADEMIC HONESTY - PLAGIARISM

Cheating is copying from others or providing information, written or oral, to others. Plagiarism is copying without acknowledgement from other people's work. According to university by laws cheating and plagiarism are serious offences punishable with disciplinary action ranging from simple failure from the exam or project, to more serious action (letter of official warning suspension from the university for up to one semester). During the penalty period the student is not allowed to enter the University campus which means the student will not be able to listen the lectures, joining any kind of exams/presentations, submitting homeworks/projects etc. Practically it will cost the student to receive an **NG grade**. Disciplinary action is written in student records and may appear in student transcripts.

PLEASE KEEP THIS COURSE OUTLINE FOR FUTURE REFERENCE AS IT CONTAINS IMPORTANT INFORMATION