Material Science and Engineering

Semester No	Code	Credit Hours
2	MECH-204	2-0

Course Description

The course is designed to develop fundamentals of both conventional and advanced materials being used in engineering applications with emphases on Aerospace applications. Course contents include fundamental concepts of material science and engineering with focus on internal atomic structure, crystal structures,crystal systems in metals, crystal imperfections, and diffusion in materials. Understand concepts of origin of mechanical properties and structure-property relationship. Concepts of phase diagrams and TTT diagrams are explained, subsequently ferrous and non-ferrous alloys, their manufacturing processes, heat treatments and surface treatments are explained. Students are also introduced to polymeric, ceramic andcomposite materials, as well as advanced materials (shape Memory Alloys, rapidly solidified alloys).

Text Book (S):

1. Callister, William D., and David G. Rethwisch. Materials science and engineering.NY: John Wiley & Sons, 2019 (10^{th} Edition).
2. Askeland, Donald, Pradeep Fulay, and Wendelin Wright. The science andengineering of materials. Nelson Education, 2016 (7^{th} Edition).

Reference Material:

1. Van Vlack, Lawrence H. Elements of materials science and engineering. Addison-Wesley, 1989.
2. Pollack, Herman W. "Materials Science and Metallurgy." Prentice Hall USA,1988. (1988).

Course Learning Outcome

No	CLO	PLO	Level of Learning
1	**Comprehend** the fundamental concepts of material science and engineering with focus on Internal atomic structure, crystal structures, crystal systems in metals, crystal imperfections, diffusion. **Explain** concepts of origin of mechanical properties and structure-property relationship.	1	C2
2	**Concept** and **application** of phase diagrams and TTT diagrams. **Understand** ferrous and non-ferrous alloys, their manufacturing processes, Heat treatments and surface treatments. Knowledge of polymeric, ceramic and composite materials, along with advanced materials (shape Memory Alloys, rapidly solidified alloys).	1	C3

ASSESSMENT SYSTEM:

Quizzes	10%
Assignments	10%
OHTs	30%
ESE	50%

Teaching Plan

Lec No	Description	Reference	Quizzes	Assignment	CLO No
1	Introduction to Materials Science & Engineering, History, Conventional and advance materials	Text 1: Ch1 Text 2: Ch1	3	2	1
2-7	Atomic bonding, Crystal Structures and Crystal Geometry, (planes, direction concepts, respective densities)	Text 1: Ch1 Text 2: Ch 2, 3			
8-12	Intro to 0,1,2 D Crystalline Imperfections,Intro to Diffusion and Fick's laws	Text 1: Ch4, Ch5 Text 2: Ch4, 9			
13	**ONE HOUR TEST NO 1**				
14-16	Concepts of hardness, TS, YS, Toughness, Moduli Resilience, poisons ratio, ductility, hardness, True and engineering stress strain, plasticity, Strengthening Mechanisms and Mechanical Properties of Metals (In context of structure property relationship)	Text 1: Ch6,7,8 Text 2: Ch6,7,8	2	1	2
17-19	Phase Diagrams, Iron-carbon Phase diagram	Text 1: Ch9 , Text 2: Ch10			
20-22	Intro to solidification, TTT diagrams	Text 1: Ch 10 Text 2: Ch 9			

23	**ONE HOUR TEST NO 2**				
Lec No	**Description**	**Reference**	**Quizze**	**Assignme**	**CLO**
24-26	Aerospace Engineering Alloys - Ferrous	Text1: Ch11 Text 2: Ch 13	1	1	2
27-28	Heat Treatments and surface Treatments	Text 1: Ch11, Text2: Ch 13			
28-29	Nonferrous Engineering Alloys –(Aerospace alloys Al, Ti, Cu, Mg, Ni)	Text1: Ch11 Text 2: Ch 14			
30	Concept of manufacturing processes	Text1: Ch11			
31	Introduction of Metal, Polymeric, Ceramics, Composite (MMC, PMC, CMC), and advanced Materials (intermetallic compounds, shape memory alloys) Powder metallurgy	T1: Ch12 ,14, 16			
32	Intro to conductors and Magnetic Materials	T1: Ch 18 ,20			
END SEMESTER EXAM					