

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. in Mechanical Engineering
Course Code:	2ME101
Course Title:	Material Science and Engineering
Course Type:	Core
Year of introduction:	2023-24

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Course Learning Outcomes (CLOs):

After successful completion of the course, student will be able to –

- 1 explain the relationship between structure of materials and mechanical properties, (BL2)
- 2 recommend the heat treatment process for ferrous materials using phase diagrams, (BL5)
- 3 analyse the microstructure of ferrous and non-ferrous materials, (BL4)
- 4 select the material for engineering applications. (BL3)

Syllabus:

Total Teaching Hours: 30

Unit	Syllabus	Teaching Hours
Unit I	Crystal structure and mechanical properties Various crystal structures and their characteristics, imperfection in solids, plastic deformation by slip, stress-strain curve, generalized Hooke's law, yield strength, resilience, toughness and elastic recovery, impact test, hardness measurement.	09
Unit II	Phase diagram and heat treatment Phase rule, cooling curves, construction and applications of phase diagrams, lever rule, important binary phase diagrams, isomorphous system, eutectic system, peritectic system, iron-iron carbide (Fe-Fe ₃ C) equilibrium diagram. Purpose of heat treatment, TTT diagram, study of heat treatment processes such as annealing, normalizing, hardening, tempering, carburizing, nitriding, cyaniding, martempering, austempering,	09

induction hardening and flame hardening, hardenability and its determination.

Unit III Ferrous materials 05

Classification of steel, effect of alloying elements on the properties of steels, properties and applications of alloy steels, exposure to national & various international standards such as AISI, SAE, IS etc., classification of cast iron, properties and applications of different cast irons.

Unit IV Non-ferrous materials 07

Composition, properties & uses of important aluminium alloys & copper alloys. Properties and applications of Ceramics, Composite materials and Polymers. Non-destructive testing using dye penetrant, radiography, Magnetic particle testing and ultrasonic, their applications and limitations.

Self – Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work: Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated

Suggested Readings/References:

1. Callister W.D., Materials Science and Engineering, Wiley India (P)Ltd.
2. Avener S.H., Physical Metallurgy, Tata Mc Graw Hill publication
3. Raghavan V., Materials Science and Engineering- A first Course, PHI publication
4. Askeland D.R., The Science and Engineering of Materials, Cengage Publication

Suggested list of experiments: (not restricted to the following)

Sr. No.	Title	Hours
1.	Non-Destructive Testing using dye-penetrant test	2
2.	Detection of defects using ultrasonic flaw detector	2
3.	Study of optical and electron beam microscopes	2
4.	Preparation of specimen for microscopic examination	2
5.	Examination of microstructures of different ferrous metals	2
6.	Examination of microstructures of different non-ferrous metals	2
7.	Study of iron-iron carbide phase diagram	2
8.	Analysis of the effect of quenching media on hardness of steel	2

Sr. No.	Title	Hours
9.	Determination of hardenability of steel	2
10.	Determination of effect of section size on hardness of the metal during the hardening process	2
11.	Study of grain size and its measurement	2
12.	Microhardness measurement of a specimen	2