MATERIAL SCIENCE AND ENGINEERING

Course Code	19ME3303	Year	II	Semester	I
Course Category	Program Core	Branch	ME	Course Type	Theory
Credits	3	L – T – P	3 – 0 – 0	Prerequisites	Applied Physics, Chemistry of Materials
Continuous Internal Evaluation	30	Semester End Evaluation	70	Total Marks	100

Course Outcomes		Levels
After successful completion of the course, the student will be able to		
CO1	Identify the properties of metals with respect to crystal structure and grain size	L2
CO2	Interpret the phase diagrams of materials and describe the concept of Strengthening Mechanisms	L2
CO3	Describe the concept of heat treatment and Case hardening of steels	L2
CO4	Distinguish different types of steels, Tool and cast irons	L4
CO5	Explain Properties and Applications of Nonferrous alloys and composite materials	L1

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1		2					2			3	
CO2	3	3	1		2					2			3	2
CO3	3	2	2	1	2					2			2	2
CO4	3	2	2	1	2		2			2			2	2
CO5	2	2	2	1	2		2			2			1	2

Syllabus

Unit No.	Contents	Mapped COs
I	**MATERIALS SCIENCE AND ENGINEERING**: Introduction, Classification of Materials, Mechanical Properties of Materials, Case Study: Delhi Iron Pillar and Wootz Steel. **CRYSTALLOGRAPHY:** Unit cell, Classification, Bravais Lattices, Packing factor and coordination number in cubic systems, Miller Indices for Cubic systems, imperfections in solids: Point, Line and Volume, Slip and Twinning. Determination of grain size.	CO1
II	**MECHANISM OF CRYSTALLIZATION:** Nuclei Formation, crystal growth **CONSTITUTION OF ALLOYS:** Types of solid solution- substitutional and interstitial solid solutions, Hume Rothery rules for solid solution. **PHASE DIAGRAMS:** Phase, Phase equilibrium, Gibbs Phase rule –	CO2

	one component system, two component system, Construction of binary phase diagram, Isomorphous, eutectic, eutectoid, peritectic and peritectoid systems, Fe-Fe_3C equilibrium diagram, Lever rule: Isomorphous. **STRENGTHENING MECHANISMS:** Grain Refinement, Strain hardening, solid solution strengthening, Dispersion strengthening	
III	**HEAT TREATMENT PROCESSES:** stages of heat treatment, TTT and CCT diagram of eutectoid steel, Annealing: Full Annealing, Spherodizing, Stress Relief Annealing, Process Annealing, Normalizing, Hardening, Tempering, Aus-tempering, Mar-tempering. **CASE HARDENING:** Flame hardening, Induction hardening, Carburizing, Cyaniding, Nitriding.	CO3
IV	**STEELS: STAINLESS STEELS**: Ferritic, Martensitic, Austenitic, **Tool steels:** Water Hardened, Shock Resistance, Cold-Work, Hot-Work Tool Steels, Applications and Properties. **CAST IRONS:** Structure, Properties and Applications of White Cast iron, Malleable Cast iron, Grey cast iron, Spheroidal graphite cast iron.	CO4
V	**NON-FERROUS METALS AND ALLOYS:** Properties and Applications of Copper and its alloys: Cartridge Brass, Cupronickel, Gun Metal, Naval Brass, Bell Metal, Speculum metal, Phosphor Bronze, **ALUMINIUM AND ITS ALLOYS:** Duralumin, Hindalium, Magnalium, Aluminium–Scandium, **TITANIUM AND ITS ALLOYS:** α and Nearα, β Alloys, α-β Alloys. **COMPOSITE MATERIALS:** Classification of composites, particle reinforced materials, fiber reinforced composite materials and metal matrix composites.	CO5

Learning Recourse(s)

Text Book(s)

1. R. Balasubramaniam, Callister's, Material Science and Engineering, 2/e, Wiley India,2014.
2. S.H. Avner, Introduction to Physical Metallurgy, 2/e, Tata McGrawHill,1997.

Reference Book(s)

1. Donald R. Askeland, "Essential of Materials Science and Engineering", Thomson Learning, 5th Edition – 2006
2. V.D. Kodgire, "Material Science and Metallurgy", Everest Publishing House - 25th Edition – 2009.
3. B.K.Agarwal, "Introduction to Engineering Materials", Tata McGraw Hill-1stEdition.
4. V. Raghavan, "Material Science and Engineering",-PHI Learning - 5th Edition.

e-Resources & other digital material

1. http://materials.iisc.ernet.in/~wootz/heritage/WOOTZ.htm
2. http://met.iisc.ernet.in/~rangu/text.pdf
3. https://nptel.ac.in/courses/113106032/
4. https://nptel.ac.in/courses/113107078/
5. http://vvm.org.in/study_material/ENG%20-%20Indian%20Contributions%20to%20Science.pdf