BVM ENGINEERING COLLEGE [AN AUTONOMOUS INSTITUTION]

2ME03: MATERIAL SCIENCE AND METALLURGY
CREDITS – 4 (LTP:3,0,1)

Course Objective:

To understand the behavior of materials through structure- property-performance relationships.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				
L	T	P	C	Theory		Practical		Total Marks
				ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Introduction to Materials Science:** Significance of Materials Science, Advanced materials, Engineering needs of modern materials, Levels of internal structure like macro, micro, crystal and atomic and their correlated properties, Methods/Tools to reveal the different levels of structure, Review of service and processing Properties of materials, Criterion for selection of materials for engineering applications through Structure-Properties-Performance co-relationships.	07
2	**Atomic and Crystal Level:** Structure-Property co-relationship at microstructure levels for metals and alloys, Examples from the practice correlating atomic and crystal structure level.	06
3	**Micro Structure Level:** Structure property co-relationship at microstructure levels for metals and alloys, Examples from the practice correlating micro structure level.	05
4	**Iron-Iron-Carbide Equilibrium Diagram:** Allotropy of Iron, Phases of the Iron-Iron Carbide equilibrium diagram and their properties, Reactions of the Iron-Iron Carbide equilibrium system, Alloy groups (Wrought Irons, Steels and cast Irons) of Iron-Iron Carbide equilibrium system and their characteristics in general, Transformation studies of eutectoid, hypo-eutectoid and hypereutectoid steels, their resultant microstructures and hence correlated properties and applications. Classification of Plain Carbon steels IS/ISO Codification, Different specifications and designations of steels. Wrought Irons- microstructures, properties and applications. Cast Irons: Iron-Iron Carbide and Iron-Carbon diagrams, Graphitization, Transformations resulting into White Cast Irons,	08

Unit No.	Topics	Teaching Hours
	Cast Irons, Malleable Cast Irons, S. G. Irons, Alloy Cast Irons. Their microstructures and correlated properties and applications. IS/ISO Codification.	
5	**Heat Treatment of Plain Carbon Steels:** Time-Temperature transformations- isothermal and continuous in plain carbon steels, Annealing: Objectives of different types of annealing like, Full, Process, Stress relief, Spherodizing etc., with Thermal cycle, resultant structure, Applications. Normalizing: Aim, Thermal cycle and Time-temperature transformations, resultant structure and applications. Hardening and Tempering: Aim, features of martensitic transformation, need for tempering, different types of tempering operations, resultant structures and applications, Hardenability, Surface Hardening Methods: Carburizing, Nitriding, Carbo-Nitriding, Cyaniding, Induction, Flame Hardening.	08
6	**Non Destructive Testing Of Materials:** Definition of non-destructive testing, Non-destructive testing methods like Dye Penetrant, Radiography, Magnetic Particle, Ultrasonic, Eddy Current with their Principle of non-destructive testing, Characteristic features, variables of the test, sensitivity, relative merits, demerits and applications.	08
	Total	**42**

List of References:

1. Donald R. Askeland, Donald R, Phule, Pradeep P, "*The Science and Engineering of Materials*", Cengage Learning
2. Avner, Sidney H., "*Introduction to Physical Metallurgy*", 2nd Edition, Tata-McGraw Hill.
3. William D. Callister, Jr., David G. Rethwisch., "*Materials Science and EngineeringAn Introduction*", 8th Edition John Wiley & Sons
4. Yu Lakhtin, "*Engineering Physical Metallurgy*", MIR Publishers.
5. Smith, W. F. "*Principles of Materials Science and Engineering*", McGraw Hill
6. Baldev Raj, T. Jayakumar and M. Thavasimuthu: "*Practical Non-Destructive Testing*", Narosa Pub. House.
7. George F. Vander Voort (editor): ASM Handbook Vol. 9: "*Metallography and Microstructure,*" ASM International 2004.
8. Robert E.Reed-Hill: "*Physical Metallurgy Principles*", Affiliated East West Press New Delhi.

Course Outcomes (COs):

At the end of this course students will be able to …

1. Select engineering materials on the basis of structure-property-performance relationship.
2. Correlate behavior of materials at atomic and crystal level.
3. Correlate behavior of materials at microstructure level.
4. Interpret iron-iron carbon diagram.
5. Apply the knowledge of heat treatment of plain carbon steels to get the desired properties for given applications.
6. Illustrate characteristics, capabilities and applications of NDT methods like liquid penetrant test, ultrasonic testing, radiography, eddy current testing, and magnetic particle inspection.