Course Code	18ME35A	Course Title	Material Science	Semester	III
Credits	3	L – T – P –TL*	3 – 0 – 0 – 3	Teaching Hrs	42
Total Marks	100	CIE*	40	SEE*	60

***NOTE: L – Lecture; T – Tutorial; P – Practical; TL – Total;**
CIE – Continuous Internal Evaluation; SEE – Semester End Examination

	Teaching Hr
Course Learning Objectives: This course will enable students to; • To provide the basic knowledge required to explore the materials science and engineering. • To enhance the knowledge of the structure of materials which includes crystallography, microstructure, defects, and phase diagrams. • To develop the knowledge about the heat treatment process required for the metals. • To incorporate the knowledge in various class of materials and their applications.	
Module-1 **Crystalline Structure, Crystal Defects and Diffusion** Introduction, FCC, BCC, HCP with examples, , classification of engineering materials: single crystal, polycrystalline and amorphous material. Imperfections in solids: point, line, surface and volume defects. Diffusion: diffusion mechanism, steady state. Numerical on crystal structure and diffusion.Plastic deformation of single crystal by slip and twinning,	**08**
Module-2 **Mechanical behavior of Materials** **Creep** – Phenomenon, stages of creep and creep properties. **Fatigue-** Types of fatigue loads, fatigue properties, Fatigue test and S- N curves. **Fracture**: Mechanism of fracture, ductile and brittle fracture, Griffith's theory of fracture (only derivation), ductile to brittle transition.	**08**
Module-3 **Solidification and Phase Diagrams** Mechanism of solidification, homogeneous and heterogeneous solidification, Hume Rothary rules, substitution and interstitial solid solutions. Construction of phase diagram for binary systems, types of phase diagrams, Gibbs phase rule. lever rule. Iron carbon equilibrium diagram and invariant reactions. Numerical on lever rule.	**10**
Module-4 **Heat Treatment of Metals and Alloys** CCT and TTT diagrams, heat treatment of metals: Annealing method and its types. Normalizing, hardening, tempering, mar tempering, austempering. Hardenability-Jominy-end quench test, surface hardening methods:carburizing, cyaniding, nitriding, flame hardening and induction hardening, age hardening of aluminium-copper alloys.	**08**

Module-5	
Composite Materials Composite materials - Definition, classification, types of matrix materials & reinforcements,Metal Matrix Composites (MMCs), Ceramic Matrix Composites (CMCs) and Polymer Matrix Composites (PMCs), Particulate-reinforced and fiber-reinforced composites, Fundamentals of production of composites, Processes for production of composites, hand layup , bag molding and Filament winding, Constitutive relations of composites, Numerical problems on determining properties of composites.	**08**
Course outcomes: By the end of the course student shall be able to CO1: Recognize the classification of materials based on atomic arrangement and behavior of materials. CO2: Enumerate the knowledge on different class of materials and their failures. CO3: Illustrate the mechanism of solidification for various alloys. CO4: Describe various types of heat treatment process require for strengthening of materials	
Question paper pattern: • The question paper will have ten full questions carrying equal marks. • Each full question will be for 20 marks. • There will be two full questions (with a maximum of four sub- questions) from each module. • Each full question will have sub- question covering all the topics under a module. The students will have to answer five full questions, selecting one full question from each module.	
Textbooks: 1. James F Shackleford.& Madanapalli K Muralidhara, **Material science for Engineers,** Sixth edition, Pearson Publications - 2007 2. Smith, **Foundations of Materials Science and Engineering,** 4th Edition McGraw Hill, 2009. **Reference Books:** 1. Alan Cottrell **An Introduction to Metallurgy** Universities Press India Oriental Longman Pvt. Ltd., 1974. 2. W.C.Richards **Engineering Materials Science**, PHI, 1965 3. V.Raghavan **Materials Science and Engineering**, , PHI, 2002 4. William D. Callister Jr., **Materials Science and Engineering**, John Wiley & Sons.Inc, 5th Edition, 2001. 5. Traugott Fischer, **Materials Science for Engineering Studies,** 2009. Elsevier Inc	