AMME10 MATERIALS SCIENCE

UNIT-1 MECHANICAL PROPERTIES

1.1 Introduction to mechanical properties - tensile test
1.2 Plastic deformation mechanisms - slip and twinning
1.3 Role of dislocations in slip - strengthening methods - strain hardening
1.4 Refinement of the grain size - solid solution strengthening - precipitation hardening - creep resistance - creep curves - mechanisms of creep - creep-resistant materials – fracture
1.5 The Griffith criterion - critical stress intensity factor and its determination - fatigue failure - fatigue tests - methods of increasing fatigue life – hardness
1.6 Rockwell and Brinell hardness - Knoop and Vickers microhardness.

UNIT-2 PHASE DIAGRAMS

2.1 Solid solutions- Hume Rothery's rules
2.2 Free energy of solid solution- intermediate phases
2.3 The phase rule- single component system- one-component system of iron
2.4 Binary phase diagrams- isomorphous systems- the tie-line rule- the level rule- application to isomorphous system- eutectic phase diagram- peritectic phase diagram
2.5 Other invariant reactions- microstructural change during cooling.

UNIT-3 FERROUS ALLOYS AND HEAT TREATMENT

3.1 The iron-carbon equilibrium diagram
3.2 Phases, invariant reactions- microstructure of slowly cooled steels - eutectoid steel, hypo and hypereutectoid steels
3.3 Effect of alloying elements on the Fe-C system- diffusion in solids- Fick's law- phase transformations - pearlitic transformations - T-T-T-diagram for eutectoid steel
3.4 Baintic and martensitic transformations- tempering of martensite- heat treatment of steels- annealing - normalizing - quenching and tempering
3.5 Case hardening- induction, flame and laser hardening- carburizing, cyaniding, carbonitriding and nitriding.

UNIT-4 ELECTRONIC MATERIALS

4.1 Classification of solids- energy bands- concept of Fermi level- conductor, semiconductor, insulator- Semiconductors: intrinsic, extrinsic
4.2 Carrier concentration expression (qualitative)- compound semiconductors (qualitative)- dielectric materials- polarization mechanisms- dielectric breakdown
4.3 Magnetic materials- ferromagnetic materials & hysteresis- ferrites- superconducting materials, properties, types and applications.

UNIT-5 NEW MATERIALS AND APPLICATIONS

5.1 Introduction to Ceramics and its applications
5.2 Ceramic Fibres- Fibre reinforced Plastics- Fibre reinforced Metal
5.3 Metallic glasses- Shape memory alloys

5.4 Copper base alloys- Nickel- Titanium alloys
5.5 Relaxor- Ferroelectric materials- Electro and magneto rheological fluids
5.6 Sensors and Actuators – polymer semiconductos – photoconducting polymers – liquid crystals
5.7 Bio- sensors- Scintillation detectors (Position sensitive)-
5.8 Bio materials – hydroxyapatite – PMMA- Silicone.

Reference Books:

1. Calister, W.D., Materials Science and Engineering an Introduction, John Wiley, 2003.
2. Rajendarn V and Marikani A, Materials Science, Tata McGraw Hill, 2006.