Course Code	Course Name	Credits
MTC303	**Engineering Materials and Metallurgy**	**03**

Prerequisite :FEC103 Engineering Chemistry-I, FEC203 Engineering Chemistry-II

Objectives

1. To prepare the students understand basic engineering materials, their properties & selection and applications.
2. To familiarize the students with various types and causes of failure of components in different engineering applications.
3. To acquaint the students with the new concepts of Nano Science and Technology.
4. To prepare the students acquire basic understanding of advanced materials, their functions and properties for technological applications.

Outcomes: Learner will be able to...

1. Distinguish different types of materials and composites used in manufacturing.
2. Select a material for specific applications
3. Read and interpret Iron-Iron Carbide phase diagram, TTT diagram and CCT diagram.
4. Demonstrate a deeper understanding of materials in engineering applications.

Module	Detailed Contents	Hrs.
01	**1.1 Introduction:** Classification of materials, functional classification and classification based on structure. **1.2 Solidification of Metals:** Formation of solids from liquids of pure metals and alloys. Single crystal and polycrystalline structure. **1.3 Crystal Imperfection:** Definition, classification, Point defects: their formation and effects. Dislocations: Edge and screw dislocations, their significance. Surface defects: Grain boundary, sub-angle grain boundary, stacking fault, and their significance.	**5**
02	**2.1 Ferrous Metals and Alloys:** Classification of Alloys based on phases and phase diagram- Binary alloy phase diagram – Isomorphous, Eutectics type I and II, Peritectic. The Iron-Iron Carbide Phase Diagram. Classification of Plain Carbon Steels and Cast Irons. Effect of alloying elements in steels. TTT diagram & CCT diagram. Annealing, normalizing, tempering, hardening and surface hardening processes. **2.2 Nonferrous Metals and Alloys:** Basics only. Important nonferrous materials like aluminium, copper, nickel, tin, zinc and their alloys, properties and applications. **2.3 Powder Metallurgy:** Powder manufacturing methods; Powder Metallurgy Process. Applications such as oil impregnated Bearings and Cemented Carbides. Limitations of Powder Metallurgy.	**10**
03	**3.1 Ceramics:** Definition, comparative study of structure and properties of Engineering Ceramics with reference to metallic materials. Toughening mechanisms in ceramics. Engineering application of Ceramics. **3.2 Polymers:** Classification of polymers. Thermoplastics, effect of temperature on thermoplastics, mechanical properties of thermoplastics. Thermosetting polymers and elastomers. **3.3Composites**: Definition; Classification; Particle-reinforced composites and fibre-reinforced composites. Rule of mixtures; Sandwich structures. Classification of composites on basis of matrix materials.	**9**

04	**4.1 Fracture:** Definition and types of facture. Brittle fracture and Ductile fracture. Ductility transition. **4.2 Fatigue Failure:** Definition of fatigue and significance of cyclic stress. Mechanism of fatigue. Fatigue testing. Test data presentation. S.N. Curve and its interpretation. Influence of important factors on fatigue. **4.3 Creep:** Definition and significance of creep. Effect of temperature and creep on mechanical behaviour of materials. Creep testing.	**5**
05	**5.1 Electronic Materials:** Band structure of solids. Conductivity of metals and alloys. Semiconductors and superconducting materials. Insulators and dielectric properties. Electrostriction, piezoelectricity and ferroelectricity. **5.2 Photonic Materials:** Refraction, reflection, absorption and transmission. Luminescence, Photoconductivity, Lasers, optical fibres in communications. **5.3 Magnetic Materials:** classification of magnetic materials, Diamagnetic, paramagnetic, ferromagnetic, ferromagnetic and super paramagnetic materials. Metallic and ceramic magnetic materials. Applications of magnetic materials.	**6**
06	**6.1 Nano-structured Materials:** Definition and Introduction to nanotechnology. Unique features of nano-structured materials. Typical applications. **6.2 Modern Engineering Materials**: Smart materials, Shape memory alloys, Chromic materials (Thermo, Photo and Electro), Rheological fluids, Metallic glasses.	**4**

Assessment:

Internal Assessment for 20 marks: Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying20marks.
2. Total 04 questions need tobe solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub- questions of 2 to 5 marks willbe asked.
4. Remaining questions will be mixed in nature.(e.g. Suppose Q.2 has part (a) from module3 then part (b) will be from any module other than module3)
5. In question paper weightage of each module will be proportional to number of respective lecture hrs as mentioned inthe syllabus.

Text Books:

1. Callister's Materials Science and Engineering, 2nd edition by R. Balasubramanium, Wiley India Pvt. Ltd

References:

1. The Science and Engineering of Materials (6 th Edition), by Donald R. Askeland, Pradeep P. Fulay, Wendelin J. Wright, Cengage Learning, Inc., Stanford, USA., (2010)
2. Materials Science and Engineering: An Introduction (8th Edition), by William D. Callister, Jr.Adapted by R. Balasubramaniam. Wiley India (P) Ltd., (2010).
3. Introduction to Physical Metallurgy (2nd Edition), by S H Avner, Tata McGraw Hill (1997).
4. A Text Book of Nanoscience and Nanotechnology, by Pradeep.T, Tata McGraw Hill, New Delhi, (2012).
5. Material Science, by S.L. Kakani, New Age International, (2006).
6. Electronic Properties of Materials (4th Edition), by Rolf.E. Hummel, Springer, New York,(2011).
7. Photonic Crystals: Theory, Applications, and Fabrication, by Dennis W Prather, John Wiley &Sons, Hoboken, (2009).