

# BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani, Pilani Campus

**First Semester 2015-2016.**

**Instruction Division**

**Course Handout (Part II)**

In addition, to Part I (General Handout for all courses appended to the Time Table), this portion gives further specific details regarding the course.

- 1. Course No.** : ME F213& MF F213  
**2. Course Title** : Materials Science and Engineering.  
**3. Instructor In-charge** : Sachin U Belgamwar

## **4. Course Description**

Lattice structure and dislocations, binary phase diagrams, iron-iron carbide phase diagram, heat treatment of steel, Phase transformation in Metals, Metallurgical techniques for property enhancement, Mechanical and thermal properties of Metals, and polymers, powder metallurgy.

## **5. Scope and Objectives**

This course aims to provide the relation between structure and properties of metallic materials. Concept of phase transformation, phase diagrams and its influence on properties of metals. Methods for improving properties by thermal and mechanical treatment. Powder metallurgical techniques and the standards of materials. Importance of non metallic materials like polymers, ceramics and composites and their applications.

## **6. Prescribed Text Book**

- T1. Callister William D & R. Balasubramaniam, Materials Science and Engineering, Wiley Student Edition, 7th Edition, 2007.

## **7. Reference Books**

- R1. William F Smith, Javad Hashmi and Ravi Prakash, Materials Science and Engineering, Fourth Edition, Tata Mcgraw Hill Education Private Limited, New Delhi.  
R2. George E. Dieter, Mechanical Metallurgy, SI Metric Edition, McGraw Hill Book Company, London.  
R3. R.A.Higgins, Applied Physical Metallurgy, Sixth edition, Viva Low priced students edition, New Delhi.  
R4. Thomas.H. Courtney, "Mechanical Behaviour of Materials" McGrawhill Publication company, Materials Science series, II Edition, 2000.  
R5. Martin. J.W, "Structure of Engineering Materials. Woodhead Publishing, Third edition. (24x7 e book)\*.  
R6. Pual Holloway and Vaidyanathan.P.N, Characterization of Metals and alloys, Momentum Press 2010. (24x7 e book)\*.

\*These books and other books on Materials science are available online 24x7 in the library web site may be referred to get more knowledge in the specific area of the course.

## **8. Course Plan**

Lecture No.	Topics	Learning Objective	Reference to text book	For self study
1	Introduction to Engineering Materials and Applications	Metals, Ceramics, Polymers and Composites. Properties of these materials, selection, and applications.	T1:1.1-1.6	R1 1.1 to R1.6
2	The Structure of Crystalline Solids	Application of miller indices for planes and directions and its influence on properties of materials.	T1:3.1-3.10 T1:4.1-4.9	R1:3.1-3.10
3	Crystal Imperfections-I	Vacancies and interstitials, dislocations.	T1: 5.1-5.4,5.6	R2:5.1-5.6
4	Dislocations	Types and influence on Mechanical properties of materials.	T1: 10.1-10.14.	R4:3.1-3.6
5-6	Imperfections in Solids-II	Planer defects, grain, grain boundaries, grain size determination. Metallographic examinations and specimen preparation.	T1: 5.7-5.8 T1: 5.11-5.13	R3:10.1-10.40

Lecture No.	Topics	Learning Objective	Reference to text book	For self study
7	Phase diagrams (Isomorphous system)	Phases, microstructure, phase equilibria, Isomorphous system, Gibb's Phase rule, lever rule. prediction of Microstructure.	T1 :7.1-7.10	R3 :9.1-9.44
8-9	Iron-Iron Carbide phase diagram-I	Fe-Fe <sub>3</sub> C Phase diagram, Transformation in steel region, Microstructure and influence on properties.	T1:7.18-7.20	R3:11.10-11.36
10	Iron-Iron carbide Phase diagram-II	Alloy steel, types, applications and selections.	T1:9.1-9.2	R3:13.1-13.130
11	Iron-Iron carbide Phase diagram-III	Cast iron, Phase transformation, microstructure. Types of cast iron, properties and applications.	T1:pp284-290.	R3;15.10-15.86
12	Non ferrous metals and alloys	Copper, Aluminium, Magnesium, Titanium and alloys	T1:9.3	R3:Ch16,17&18.(Elementary treatment only)
13	Non equilibrium phase transformation.	Phase transformation kinetics and influence on phase distribution and properties of materials.	T1:8.1-8.4	R3:11.1-11.8
14-15	Isothermal transformation diagram.	TTT diagram, cooling rate, selection of heat treatment process. CCT Diagram.	T1: 8.4-8.7	R3:12.50-12.52.
16	Mechanical testing of materials.	Tensile testing and influence of structure, elastic, plastic deformation and instability.	T1: 9.5-9.10	R2Ch 8,9,&10
17	Failure of metals	Ductile and brittle fracture, DBTT& Fractography.	T1:11.2-11.4	R4:9.1-9.4.
18-19	Fatigue and Failure of materials.	S-N Curve, Fatigue life methods of improving fatigue failure	T1:11.8-11.11.	R2:12.1-12.21. (Elementary treatment only).
20-21	Creep and failure of materials.	Creep curve, factors influencing creep life, creep failure.	T1:11.12-11.15.	R2:13.1-13.5.
22	Polymers and applications.	Types of polymers, structure and applications.	T1: Ch13&14	R1 C10
23	Ceramic materials and applications	Types of ceramics , structure and applications.	T1: Ch 4 &12	R1 Ch11
24	Composites	FRP,MMC,PMC and other types and applications.	T1: Ch15	R1 Ch12.
25	Selection of Materials	Various factors influencing the materials selection and application.	Class notes.	Class notes

#### 9. Evaluation scheme

Evaluation component no.	Evaluation component	Duration	Weightage	Date and Time	Nature of component
1	Mid semester	60 min	30	9/10 2:00 - 3:30 PM	CB
2	Assignment and/or Quiz (online) (five component)	45 min each	20		OB
3	Comprehensive Examination	180 min	50	11/12 FN	CB

**Mid-semester grading:** It will be announced normally in the month of October. It is done in the same manner as that of the final grading

**Chamber Consultation Hours:** Room No.: 2202-D. Time: To be announced in the class.

**Notices:** All notices related to this course will be put on the **Nalanda / Mech.Engineering notice board** only.

**Make-up Policy:** Make-up will be given only in exceptional circumstances like hospitalization.

*Instructor-in-charge MEF214/MFF214/MEC211*