**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI**

**HYDERABAD CAMPUS**

**SECOND SEMESTER 2019-20**

**Course Handout (Part II)**

Date:06/01/2020

In addition to part ‑I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

***Course No.* : CHE F243**

***Course Title* : Materials Science and Engineering**

***Instructor‑in‑charge* : Nandini Bhandaru**

**Scope and Objective of the Course:**

The objective of the course is to introduce the fundamentals of materials science to Chemical Engineering undergraduate students. It gives a basic understanding of the structure (crystalline and amorphous) and properties (thermal, mechanical and electrical) of different types of materials such as metals, ceramics and polymers. The course also deals how the type of bonding, crystal structure, formation of structure (defects, diffusion, phase diagrams and phase transformation) and dynamics influence the properties of these materials. The course will include case studies and examples to expose students to recent developments in materials science & engineering research and applications.

**Learning Outcomes:**

On completing this course the student should be able to:

1. Classify the materials, describe the basic structure of materials at the molecular, microscopic, and macroscopic scales and understand structure-property correlation.
2. Understand the type of force/environments that a material should withstand for different applications, select appropriate type of material for specific application and offer different approaches to modify structure/microstructure in order to get desired properties.
3. Suggest best methods of characterizing different categories of materials.

**Text Book:**

**T1.** MATERIALS SCIENCE AND ENGINEERING-AN INTRODUCTION by WILLIAM D. CALLISTER, JR. Ninth Edition, John Wiley (2013)

**Reference Books:**

R1. MATERIAL SCIENCE AND ENGINEERING by V. RAGHAVAN, Sixth Edition, Prentice-Hall of India private Limited (2018)

**Course Plan:**

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| --- | --- | --- | --- |
| **Lect. No.** | **Learning Objectives** | **Topics to be covered** | **Chapter in the Text Book** |
| 1 | Introduction | Classification of Materials | Ch. 1 (T1) |
| 2 | Atomic structure and Bonding in materials | Bonding forces & Energies; Primary and Secondary bonds | Ch. 2 (T1) |
| 3-5 | Crystallography | Unit cell; Crystallographic points, directions and planes; Crystalline and Noncrystalline materials | Ch. 3 (T1) |
| 6-8 | Metallic structures | FCC, BCC, Linear and planar densities; close-packed crystal structures | Ch. 3 (T1) |
| 9-10 | X-ray diffraction | Determination of crystal structure; Bragg’s Law; Diffraction technique | Ch. 3 (T1) |
| 11-13 | Imperfections in solids | Vacancies and interstitials; dislocations and grain boundaries | Ch. 4 (T1) |
| 14-16 | Diffusion | Diffusion mechanisms | Ch. 5 (T1) |
| 17-20 | Phase diagrams | Phases; Microstructure; Phase equilibrium; Iron-Carbon system; Development of microstructure in Fe-C alloys | Ch. 9 (T1) |
| 21-23 | Phase Transformations | Avrami rate equations; Isothermal transformation; Continuous cooling transformation diagrams | Ch. 10 (T1) |
| 24-26 | Mechanical Properties of materials and characterization | Stress-Strain; Elastic and plastic deformations; Mechanical properties and behavior of Fe-C alloys. | Ch. 6 (T1) |
| 27-28 | Dislocations and strengthening mechanisms | Fractography; Slip systems; plastic deformation; strengthening mechanisms; Recovery, recrystallization and grain growth | Ch. 7 (T1) |
| 29 | Ceramic structures | Crystal structures of ceramics | Ch. 12 (T1) |
| 30-31 | Polymer structures | Molecular weight; Molecular configurations of polymers; and Polymer crystallinity | Ch. 14 & 15 (T1) |
| 32-34 | Thermal properties of materials and characterization | Glass Transition; Crystallization and Melting Phenomenon; calorimetry; thermal conductivity | Ch. 19 (T1) |
| 35-37 | Electrical Properties of Materials and characterization | Electrical characteristics of Metals; Ceramics and Polymers; dielectric spectroscopy; piezoelectrics | Ch. 18 (T1) |
| 38-39 | Magnetic Properties of materials and characterization | Diamagnetism; Para magnetism; Ferromagnetism, Hysteresis; Superconductivity | Ch. 20 (T1) |
| 40-41 | Composite materials | Fiber phase; Matrix phase; PMC (polymer matrix composite; interfaces and characterization | Ch. 16 (T1) |

**6. Evaluation Scheme:**

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| --- | --- | --- | --- | --- |
| **Component** | **Duration** | **Weightage** | **Date & Time** | **Nature of Component** |
| Quiz (min 2) | TBA | 15% |  | Open book |
| Assignments (min 2) | TBA | 10% |  | Open book |
| Presentation | TBA | 10% |  | Open book |
| Mid-Term Exam | 90 min | 25 % | 7/3 9.00 - 10.30AM | Closed book |
| Comprehensive Exam. | 3 hours | 40 % | 14/05 FN | Closed book |

**Chamber Consultation Hour:** To be announced in the first class.

**Notices:** All notices related to the course will be uploaded in CMS.

**Make-up Policy:** Make-up will be granted for genuine cases with prior approval of IC.

**Note:** A student will be likely to get “NC”, if he / she doesn’t appear / appear for the sake of appearing for the evaluation components / scoring zero in pre-comprehensive total.

**Academic Honesty and Integrity Policy:** Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

***Nandini Bhandaru***

**INSTRUCTOR-IN-CHARGE**