SECOND SEMESTER 2014-15
Course Handout (Part-II)

Date: 07/01/2016

In addition to part-I (General Handout for all courses append to the timetable), this portion gives further specific details regarding the course.

Course No:	CHE F243
Course Title:	Materials Science and Engineering
Instructor in Charge:	Banasri Roy
Instructor (Tutorial):	Sonal Mazumder, Utkarsh Maheshwari
Lectures:	M W F, 3 hr (10 am); NAB 6105
Tutorials:	T, 1h (8 am), NAB 6106 & 6105, respectively

Course Description: Introduction on materials for engineering structures of metals, ceramics and polymers; crystalline structure imperfections; amorphous and semi crystalline materials (includes glasses, introduction to polymers); Correlation of structure to properties and engineering functions (mechanical, chemical, electrical, magnetic and optical); phase diagrams; Improving properties by controlled solidification, diffusion or heat treatment; Failure analysis and non-destructive testing; Types of materials (includes synthesis, Fabrication and processing of materials): Polymers and composites, Environmental degradation of materials (corrosion); Evolution of materials (functional materials, Biomimetic materials, energy saving materials etc); Criteria for material selection

Objectives: This course will be focused on the necessity of the chemical engineering students to know and understand about the materials used in industrial applications and develop a background in the general area of materials. Systematic review of the basic structures of inorganic solids (metallic, ceramics, and polymers) and techniques to determine basic microstructures and phases will be done. Emphasis will be given on structures-properties correlations, processing, and applications in chemical industries. Advance materials and their applications will be covered.

Text Book:

T1. Callister's Materials Sc & Engg, W.D. Callister & R. Balasubramaniam (Adapted), Wiley India, 7th Rev. ed., 2010 ISBN 9788126521432.

Reference Books:

R1. Materials science and engineering by V. Raghavan, 5th edition, Prentice Hall of India, ISBN: 978-81-203-2455-8

R2. Materials science and engineering by Smith, Hashemi, and Prakash, 4th edition (2008), Tata McGraw Hill education pvt. Limited, ISBN 10: 0-07-066717-9 or ISBN 13: 978-0-07-066717-4.

R3. The Science and Engineering of Materials by Askeland and Fulay, 6th Ed. Cengage Learning, Indian reprint 2012, ISBN 9788131516416.

R4. Essentials to Materials Science and Engineering by Askeland and Phule, 2nd Ed. Cengage Engineering, Indian reprint 2013, ISBN: 9788131520703.

Course Plan:

Lec. Num.	Learning Objectives	Topics to be covered	Chapter in book (T1)
1	Introduction	Introduction	1
2-3	Crystallography	Unit cell, Crystallographic directions and planes	3.1-3.10 +note
4-7	Structures of materials (Metallic, ceramic and polymer). Deformation in polymers	Linear and planner densities, close-packed crystal structures. Crystal structures of ceramics. Molecular weight, molecular configurations of polymers. Mechanisms of deformation and strengthening in polymers, glass transitions	4.1-4.15, 4.17, 13.1-13.10, 4.18-4.20 +note
8	X-ray diffraction	Determination of crystal structure, Bragg's Law, diffraction technique	4.20+note
9	Microscopic techniques	Optical and electron microscopy, grain size determination	5.11-5.13+note
10-11	Defects and dislocations	Vacancies and interstitials, dislocations and grain boundaries	5.1-5.9+note
12-13	Diffusion	Steady and non-steady diffusion	6.1-6.6+note
14-16	Mechanical properties of the materials and deformation mechanism	Stress-strain, elastic and plastic deformations. Slip systems, plastic deformation, strengthening mechanisms	9.5-9.7 10.1-10.10+note
17-19	Phase diagrams. Iron-carbon system	Phases, microstructures, phase equilibrium. Fe-Fe_3C phase diagram, development of microstructure in Fe-C alloys	7.1-7.17 7.18-7.20+note
20	Kinetics of phase transformations	Avrami rate equations	8.1-8.4+note
21-23	Correlation of properties to microstructures Mechanical behavior of Fe-C alloys	Isothermal transformation diagrams, continuous cooling transformations Mechanical behavior of Fe-C alloys, tempered martensite	8.5-8.9+note
Midsem 14-19th March			
24-27	Electrical properties of materials	Electrical conduction, semiconductivity, electrical conduction in ionic ceramics and in polymers, dielectric behavior	17.2-17.25+note
28-31	Magnetic Properties of Materials	Magnetism types, Structure and characterization, mechanism, materials and types.	18.1-18.12 +note
32-35	Nano technology	Introduction, applications (solar cell, fuel cell, Catalysts)	notes
36-37	Biomaterials	Introduction, Processing, applications	Notes

38-40	Materials Selection and Design	Materials selection for automotive, biomedical , chemical protective clothing, and semiconductor applications	21.1-21.20 +note

Calculation of the course grade: A weighted average grade will be calculated as follows:

COMPONENETS	**DURATION**	**WEIGHTAGE (300 marks/100%)**	**Date & Session**	**REMARKS**
Mid Sem. Exam.	90 min	75 (25%)	18/3 2:00 - 3:30 PM	Closed and/or open book
Group Problems/Class problem		30 (10%)	Surprise	Closed and/or open book
Tutorials (10 best out of 13)	-------	60 (20%)	Tutorial Class	Closed and/or open book
Comprehensive Exam.	3h	135 (45%)	13/5 FN	Closed and/or open book

Note:

- **Chamber consultation hour** will be announced in the class.
- The **notices** will be displayed on the Nalanda only.
- **Make-up** will be granted for genuine cases only. Certificate from authenticated doctor from the Medical Center must accompany make-up application (*only prescription or vouchers for medicines will not be sufficient*). Prior permission of IC is compulsory.
- No make up for tutorial tests or class problems.
- No exchange of calculator or other materials will be allowed during tests/quizzes.

Instructor in Charge
CHE F243