BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani
Pilani Campus
Instruction Division

First Semester 2015-16

Course Handout Part II Date: 03/08/2015

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.: PHY F414
Course Title: Physics of Advanced Materials
Instructor-in-charge: **Subhashish Gangopadhyay**

Course Description:
The course emphasizes the Physics aspect of structure-property relationship of advanced materials used for modern technology which involves fundamentals of semiconductors, carbon-based nanomaterials, metals and ceramics, their growth/synthesis, characterization and technological applications.

Scope and objective of the course:
The objective of the course is to develop an understanding of Physics behind the various preparation techniques of advanced materials, their structural, chemical and electronic characterization, correlation between the structures and properties, as well as recent trend in applications. Each student has to do one Project/assignment using the existing experimental facility/data of the Physics department and submit a report followed by presentation, at the end of the course. The topics of the projects/assignments will be floated in the lecture class.

Text Book:

Lecture notes and research articles to be distributed in the class

Reference Books

1. MATERIALS SCIENCE AND ENGINEERING-AN INTRODUCTION by WILLIAM D.CALLISTER, JR. Seventh Edition, John Wiley (2007)
2. INTRODUCTION TO SOLID STATE PHYSICS by CHARLES KITTEL, Eighth Edition, John Wiley (2012).
3. MATERIAL SCIENCE AND ENGINEERING by V. RAGHAVAN, Second Edition, Prentice-Hall of India private Limited (1979).
4. VACUUM SCIENCE AND TECHNOLOGY by RAO, GHOSH and CHOPRA, 3rd reprint, Allied Publishers Pvt. Ltd. (2008).
5. THE SCIENCE AND ENGINEERING OF MATERIALS by DONALD R. ASKELAND, PRADEEP P. PHULE, Fifth editions, Thomson, (2006)

Course Plan:

L.No.	Learning Objectives	Topics to be covered	Chap./ Sec. No. (Book)
1	Introduction	Basics of materials and their classification	GENERAL
2-4	Crystallography	Primitive lattice, Unit cell, Bravais lattices, Crystal planes and directions, Simple crystal structures	CALLISTER, KITTEL

5-8	Structural properties of crystalline solid	Packing, Linear and planar densities, close-packed crystal structures, defects and dislocations, grain boundaries, reciprocal lattice.	CALLISTER, KITTEL
9-10	Structural characterization	X-ray diffraction (XRD) and Electron diffractions (LEED, RHEED)	LECTURE NOTES
11-12	Phenomena of diffusion	Diffusion mechanism, steady and non-steady state of diffusion, factors	CALLISTER
13-15	Phase diagrams	Different phase diagrams for materials preparation especially Fe-C.	CALLISTER
16-19	Electrical properties of materials	Electrical conductivity, classification of meterials, energy band structures, Hall effect, magneto resistance and superconductivity	CALLISTER, RAGHVAN
20-25	Advanced Materials	Materials for semiconductor industry; Carbon based nano-materials; Materials for energy industry	LECTURE NOTES
26-31	Vacuum science & technology	Basics, measurement gauges, pumps, thin film deposition	RAO, LECTURE NOTES
28-32	Growth techniques	Epitaxial growth, Molecular beam epitaxy (MBE), Chemical vapour deposition (CVD), doping process, growth modes	LECTURE NOTES
32-33	Surface and interfaces	Surface reconstruction, diffusion, domain boundary and phase separation	LECTURE NOTES
34-40	Advanced characterization techniques	Electron microscopy (SEM, TEM), Photoelectron spectroscopy (XPS, UPS), Scanning probe microscopy (STM & AFM).	LECTURE NOTES

Evaluation Scheme:

Component	Duration	Weightage(%)	Date & Time	Remarks
Mid-semester Exam	90 Min	30%	5/10 8:00 - 9:30 AM	Open & Closed Book
Tutorial test		25%	Pre-announced	Closed Book
Project/lab components		5%		
Comprehensive Exam	3 Hours	40 %	1/12 FN	Open & closed book

Chamber Consultation Hours: To be announced in class

Notices: Will be displayed on Nalanda or Physics department notice board.

Make-up Policy: Make-up will be given only in genuine cases, that is, illness leading to hospitalization or for going out of station with prior permission.

Instructor-in-charge