Master of Science – Nano Science & Nano Technology

(M.Sc.) (Nano Science & Nano Technology) Semester –II

Course Code	PS02ENST51	Title of the Course	Selected topics in Nano-Materials
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	1.Concepts of crystal in terms of lattice structure, chemical bonding, types of defect in crystals 2. Different types of growth process used to grow crystals 3. Specific techniques used for diamond, zeolites, semiconductor and super conducting material

Course Content		
Unit	Description	Weightage* (%)
1.	Fundamental concepts, Crystal lattice, Unit cell, Bravais lattice, Lattice planes and directions.Seven crystal systems, Miller Indices, Chemical bonding, Bond energy, Bond length, Types of bond.	25%
2.	Vacancies and interstitials, Formation of point defect. Schottkyand Frenkel defects, Diffusion in solid, Fick's laws. Dislocations, Edge, Screw and Mixed, Stress field energy, Force between dislocations, Forces on dislocations, Origin of dislocation, Frank read source, Grain boundaries, Twin boundaries, Observation of dislocation. Homogenous and heterogeneous nucleation, MBE, LPE, Crystal growth technique of Industrially important crystals.	25%
3.	Methods of preparation of nano material, Physical techniques , Thermal techniques, Physical vapour deposition, Plasma techniques, Template method, Lithography Sol-gel, CVD, Emulsion, chemical radiation etc.	25%
4.	Hall- Petch equation, Dependence of mechanical properties on microstructure and grain size.	25%

Teaching-Learning Methodology	Group discussion/ Panel/Presentation

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learnerwill be able to	
1.	Learn about different crystal structures and crystal growth techniques.
2.	knowledge of their properties and processing behaviours
3.	Identification methods used for above materials. Knowledge of all these will be helpful in industries and research.

Suggested References:	
Sr. No.	References
1.	Van Vlack, L. H. (1970). *Materials Science for Engineers*. Addison-Wesley.
2.	Brice, J. C., Brice, J. C. (1986). *Crystal Growth Processes*. Blackie.
3.	Bacon, D. J., Hull, D. (2001). *Introduction to Dislocations.* Elsevier Science.
4.	Saxena, B. S., Gupta, R. C., & Saxena, P. N. (1993). *Fundamentals of solid state physics*. Pragati Prakashan.
5.	Chanda, M. (1981). *Science of Engineering Materials: Volume 2 Materials.* Macmillan International Higher Education.
6.	Askeland, D.R., Fulay P. R. & Wright W. J. (2010). *The Science and Engineering of Materials.* Cengage Learning, Stamford, CT, USA.

On-line resources to be used if available as reference material
On-line Resources
Defects in Crystalline Solids (Part-I & II), Prof. Shashank Shekhar, IIT Kanpur

https://nptel.ac.in/courses/113/104/113104081/
https://nptel.ac.in/courses/113/104/113104085/

*****