Master of Science – Materials Science

(M.Sc.)(Materials Science) Semester –II

Course Code	PS02EMTS51	Title of the Course	Defect Structures and Properties of 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 direction, Seven crystal systems, Miller Indices, Chemical bonding, Bond Energy, Bond length, Types of Bonds	25%
2.	Vacancies and intersitials, Formation of point defects, Schottky and Frenkel defects, Diffusion in solids, Fick's law. Edge , Screw and mixed, Dislocation Forcesbetween dislocation, Forces on dislocation, Origin of Dislocation, Frank Read source, Grain boundaries, Twin boundaries, Observation of dislocation.	25%
3.	**C**lassification of growth processes, Bridgman-Stockbarger technique, Czochralski technique, zone-melting technique, , zone-movement technique, other crucibleless techniques. Growth by vapour – sublimation – condensation, direct and indirect vapour transport , Flame-fusion technique Rotary crystallizer, Holden's rotary crystallizer	25%
4.	Growth of some industrially important crystals, Diamond – HPHT and metastable techniques. Zeolites – Hydrothermal technique, Semiconductors and superconducting materials – Flux growth, and LPE	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 learner will 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/

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