

Subject Code:1SC2050404

Subject Title: Crystal Growth and Imperfections in Solids

COURSE OBJECTIVE:

Physics is a science to understand the nature. This course is designed to get basic understanding of the physical world.

LEARNING OUTCOMES:

- Develop understanding of crystal growth and Imperfections in solids

Teaching scheme (hours) per week		Credit		University Examination		Internal Examination		Total
Theory	Practical	Theory	Practical	University Assessment	Practical	Internal Assessment	Practical	
4	--	4	--	60	--	40	--	100

Unit	Content	Lectures	Weight (%)
1	Nucleation, classical theory of nucleation, Gibb's – Thomson equation for vapour, melt and solution, homogeneous and heterogeneous nucleation, Crystal growth techniques – Bridgman- basic process, Crystal pulling method, Vernueil flame fusion process, float zone process, solution growth: slow cooling process at low and high temperature, growth in gels, flux growth, vapour transport.	15	25
2	Lattice vacancies: Schottky and Frenkel, Diffusion, self diffusion in metals, color centers, Dislocations: shear strength of single crystals, slip, dislocations, Burger's vector, stress fields of dislocations, strain energy of a dislocation low angle grain boundaries, dislocation densities, dislocation multiplication and slip, Surface imperfections : grain boundary, tilt and twist boundary, stacking faults: stacking faults in fcc crystals, stacking faults in hcp crystals, strength of alloys, dislocation and crystal growth, whiskers.	15	25
3	Dislocation observation: surface method , decoration method, electron microscopy, X-ray diffraction topography, field ion microscopy, cross-slip, velocity of dislocations, ,forces on dislocation, forces between dislocations, Intersection of dislocations, movement of dislocations containing elementary jogs, composite jogs .Diffusion mechanisms: steady state diffusion and non-steady state diffusion, factors that influence diffusion : diffusing species and temperature, some applications of diffusion : measurement of diffusion coefficient, Carburizing and Decarburizing process in steel, Kirkendall effect, ionic conductivity.	15	25
4	Fracture : ductile and brittle, stress concentration, fracture toughness, design using fracture mechanics, impact fracture testing, crack initiation and propagation, factors that affect fatigue life, Fatigue, cyclic stresses, the S-N curve, Creep- generalized creep behaviour, stress and temperature effects, data extrapolation method, Failure of an automobile rear axle, Hardness, Rockwell hardness tests, Brinell Hardness tests, Knoop and Vicker's micro hardness tests.	15	25

Basic Reference book:

1. Crystal growth processes by J. C. Brice
2. The Physics of engineering solids by T. S. Hutchison and D.C. Baird
3. Crystal growth: Processes and Methods by P. Santana Raghavan and P. Ramasamy
4. Solid State Physics by M.A. Wahab
5. Materials science and Engineering an introduction by William D. Callister. Jr.
6. Introduction to Solid State Physics by Charles Kittel.
7. Principle of Solid State Physics by F. Levy
8. Elements of Solid State physics by J.P. Srivastava
9. The nature and properties of Engineering Materials by Zbigniew. D. Jasterzowski.
10. Introduction to dislocation by D. Hull
11. Elementary Solid State Physics by M.A. Omar