MANGALORE UNIVERSITY

Department of Physics

MSc Physics

PHS 556: CONDENSED MATTER PHYSICS IV

(52 Hrs.)

Course outcome

CO1 The candidate will have through knowledge of crystal defects.

CO2 The candidate will have theoretical and experimental knowledge of thin films.

CO3 Will have good understanding of mechanical properties of thin films.

CO4 Will would have gained knowledge about superconductivity,about polymers & liquid crystals.

Unit I Crystal defects

Imperfections in crystals: classification of defects in crystals - point defects - their energy of formation - diffusion - ionic conductivity in pure and doped halides - colour centers – polorons, excitons. Dislocations - Burger's vector. Observation of dislocation - dislocations and crystal growth. Planar defects.

Luminescence in solids: Thermoluminescence – Electroluminescence. [13 hrs]

Unit II Thin films

Introduction. Physical vapour deposition methods – Evaporation – general considerations. Evaporation methods. Sputtering – Sputtering methods. Chemical vapour deposition (CVD) methods – Typical chemical reactions. Reaction kinetics, Transport phenomena, CVD methods. Atomic Layer Deposition (ALD). Liquid-based growth methods.

Nucleation, growth and structure of thin films: Nucleation- condensation process, theories of nucleation, nucleation modes. Growth Process. Aspects of physical

structure of thin films. Crystallographic structures of thin films. Epiaxial growth of thin films.

A brief review on mechanical properties ofThin Films.

Characterization of Thin Films: Thickness measurement. Structural and morphological characterization, chemical and optical characterization, electrical characterization.

A brief introduction on electron transport phenomena in thin Films. A brief introduction on optical properties of thin films. Reflectance and transmittance of light by thin films. Single layer antireflection coating.

Applications of thin films for: optical components. optical recording, Integrated electronic and optical devices, Band-Gap Engineering and Quantum Devices, Magnetic Recording, Metallurgical and Protective Coatings. [13 hrs]

Unit III Superconductivity

Thermodynamics of superconductivity. Coherence length. A brief overview of BCS theory of superconductivity: Instability of Fermi Sea and Cooper pairs, BCS ground state, Consequences of the BCS theory and comparison with experimental results. Magnetic flux quantization in a superconducting ring.

Single particle and Coper-pair -Josephson tunnelling. AC and DC Josephson effects, Macroscopic Quantum Interference, Superconducting Quantum Interference Devices (SQUIDS). DC and AC SQUIDs. Applications of SQUIDs.

High T_C superconductors: Discovery YBCO, Important families of high temperature superconductors. [13 hrs]

Unit IV Materials II : Polymers & liquid crystals

Polymers : Introduction. Classification. Molecular weight. Configuration. Polymerisation reactions. Polymer processing. Crystallanity. Conducting polymers. Applications.

Liquid crystals : Classification. Structure and texture. Orientational and translational order. Mechanical, optical, magnetic and electrical properties. Liquid crystal displays. [13 hrs]

Reference Books:

1. Kittel C, 'Introduction to Solid State Physics', IV Edn. (Wiley Eastern, 1974), VII Edn. (John-Wiley, 1995)
2. Dekker A J, 'Solid State Physics' (MacMillan, 1971)
3. Ibach H and Luth H 'Solid State Physics', II Edn. (Springer, 2000)
4. Ashcroft N W and Mermin N D, 'Solid State Physics' (Harcourt, 1976)
5. Hass G and Thun R E, 'Physics of Thin Films', Vol. IV (Academic Press, 1967)
6. Chopra K L 'Thin Film Phenomena' (Robert E Kreiger, 1979)
7. Goswami A, 'Thin film fundamentals' (New Age, 1996)
8. Chopra K L and Malhotra L K (Ed) 'Thin film Technology and applications' (Tata McGraw Hill, 1985)
9. M. Ohring: The Materials science of thin films, (Academic Press, 1992, 2nd Ed. 2002).
10. Tinkham M 'Introduction to Superconductivity' II Edn. (McGraw Hill, 1996)
11. Gowarikar V R, Vishwanathan N V and Shridhar J, 'Polymer Science' (Wiley Eastern, 1986)
12. Chandrasekhar S, 'Liquid Crystals', II Edn. (Cambridge, 1992)
13. Chiaken P and Lubensky T C, 'Principles of Condensed Matter Physics' (Cambridge, 1995)
14. Rogalski M S and Palmer S B 'Solid State Physics' (Gordon & Breach, 2000)