

DEPARTMENT OF BIOELECTRONICS AND BIOSENSORS

Ph.D. ENTRANCE – SYLLABUS (2023 Onwards)

Discipline: Materials Science

Paper –II MATERIALS SCIENCE

UNIT I: TYPES OF MATERIALS

Metals, Ceramics, Polymers, Advanced Materials – composites, nanomaterials, biomaterials, smart materials, selection of materials, alloys, applications.

UNIT II: MATERIAL PROPERTIES

Mechanical, Hardness, Thermal – heat capacity, thermal conductivity, thermal stresses, electrical & electronic conductivity, band structures and atomic bonding models, semi-conductivity, optical, magnetic-dia, para, ferro, ferri, anti-ferro; domains & hysteresis. Optical properties-interaction of matter with electromagnetic waves – luminescence and photoconductivity.

UNIT III: METHODS OF PREPARATION

Bottom-up and Top-down approaches; Co-precipitation, Ultrasonication, Mechanical milling, Colloidal routes, Self-assembly, Physical and chemical Vapour Deposition; Crystal growth; Nucleation concept, nucleation rate – induction period, solution growth, gel growth, melt growth methods.

UNIT IV: CHARACTERISATION TECHNIQUES

Powder X-ray diffraction technique, Fourier transform infrared spectroscopy, Raman spectroscopy, Ultraviolet spectroscopy, scanning electron microscopy, transmission electron microscopy including high resolution imaging, Surface analysis techniques, AFM, ESCA, SIMS, Nanoindentation.

UNIT V: APPLICATIONS

Nanotechnology, Quantum dots – Applications, Sensor- definition- Sensor characteristics; Calibration, Dynamic Range, Signal to noise, Sensitivity, Selectivity, Interference; Biosensors-Historical perspective-Types of biosensors-Medical applications.

References:

1. Pradeep, T. (2007). *NANO: The Essentials: Understanding Nanoscience and Nanotechnology*. 1st ed. NEW DELHI McGraw-Hill Offices: Tata McGraw-Hill Publishing Company Limited.
2. Akhlesh Lakhtakia. (2007). *The Hand Book of Nanotechnology, Nanometer Structure, Theory, Modelling and Simulations*. Prentice-Hall of India (P) Ltd, New Delhi.
3. Bhat H.L. (2019). *Introduction to crystal growth*. Tailor and Francis.
4. Kumar, A., Li, L., Zhang, S. (2008). *Materials Characterization Techniques*. United Kingdom: CRC Press.
5. Malhotra B.D. Turner A.P.F. (2003). *Advances in Biosensors*. Elsevier JAI.