Indian Institute of Technology Kanpur

COURSES OF STUDY

2024

Indian Institute of Technology Kanpur
KANPUR-208016

MATERIAL SCIENCE

DEPARTMENT OF MS			
Course ID	**Course Title**	**Credits L-T-P-D-[C]**	**Content**
MS601	STRUCTURAL & MAGNETIC PROPERTIES OF MATERIALS	3-0-0-0-9	Crystal structure, Bonding of atoms, Crystal chemistry, Equilibrium thermodynamics, Phase equilibria, Phase transformations, Dia, Para, Ferro, Ferri and Antiferromagnetism, Magnetic domains, Anisotropy effects, Magnetostriction, Measurement of magnetic properties, Soft and hard magnetic materials and their technology.
MS602	ELECTRICAL AND DIELECTRIC MATERIALS	3-0-0-0-9	Metallic conduction, Energy bands, Brillouin zones, Temperature dependence of metallic conductivity, Impurity contributions, Semiconductor materials, Doping effects, Law of mass action, Electrical resistivity and Hall effect measurements, Recombination Processes, pn junctions, MOS field effect transistors, Semiconductor technology, Point defects, Diffusion phenomenon, Ionic conduction, Temperature and (aliovalent) impurity effects, Superionic conductors and devices, Di, piezo and ferroelectric materials, Mechanisms of polarization, Dielectric parameters and their measurements.
MS603	MECHANICAL PROPERTIES OF MATERIALS	3-0-0-0-9	Stress and strain tensors, Elastic constants, Effect of structure on elastic behaviour, Elastic stress distributions, Viscosity and viscoelasticity in polymers, Yielding criteria, Dislocations and plastic deformation of metals and ceramics, Strengthening mechanisms, Creep, Brittle fracture in ceramics and glasses, Toughening of ceramics and composites, Fatigue, Mechanical testing, Strength and engineering design with brittle solids, Heat treatment, Powder processing.
MS604	CHARACTERIZATION OF MATERIALS	3-0-1-0-10	Crystallography, Reciprocal lattice, Diffraction methods, Electron microscopy, Metallography, Thermal analysis, Chemical analysis, Spectroscopic techniques, Laboratory sessions.
MS605	MATERIALS ENGINEERING	3-0-0-0-9	Solidification, Powder processing, Crystal growth, Heat treatment and microstructures, Nondestructive evaluation, Processing of glasses and polymers, Novel processing methods, Thin films, Surface phenomena and corrosion.
MS606	ELECTRONIC MATERIALS		Classification, Crystal growth techniques, Wafer processing, Doping methods, Formation of oxide layer, CVD, MOCVD and MBE, Metallic contacts and interconnects, Lithography, Processing integration. Photonic materials solar cells, photodetectors, light emitting diodes, Superlattice structures, Materials for high frequency and high temperature devices, Application of linear and nonlinear dielectric materials, Electrooptic ceramics, Materials for signal processing, transducers and digital data storage, Superconducting materials and

			applications.
MS608	NANOSTRUCTURED MATERIALS: SCIENCE & APPLICATIONS		To be procured
MS611	MATERIALS FOR ENERGY CONVERSION & STORAGE	3-0-0-0-9	Characteristics of solar radiation, Basic features of solar cells, Various junction configurations, pn homojunction, Schottky barrier, Heterojunction, Photo electrochemical cells, Desired material properties, Promising semiconductor materials, Various fabrication techniques, Solid state diffusion, Vacuum evaporation, Sputtering, Thermal oxidation, Chemical displacement, Plasma deposition, Energy storage devices.
MS614	ENGINEERING POLYMERS	3-0-0-0-9	Classification and structure of polymers, Glass transition, Linear viscoelasticity, Stress relaxation and dynamic experiments, Mechanical models, Superposition principles, Effect of structure on mechanical properties, Rubber elasticity, Yield and fracture.
MS616	HIGH PERFORMANCE POLYMERS AND COMPOSITES		To be procured
MS617	INTRODUCTION TO NANOMATERIALS AND NANOTECHNOLOGY	3-0-0-0-9	Effects of confinement and finite size zero, one and two dimensional nanostructures(concepts of surface and interfacial energies), Intermolecular and interfacial forces in organic, polymeric, biological and aqueous systems Van der Waals, electrostatic, double layer, acid base, depletion interactions, hydrophobic force, layering, mesoscale thermodynamics, Gibbs treatment of interfaces, mesoscale fluid dynamics, thin soft films, mesoscale phenomena in soft matter and applications: adhesion, wetting, nucleation, Nanofabrication: patterning of soft materials by self organisation and other techniques, chemical self assembly,artificial multilayers, cluster fabrication, Langmuir Blodget growth, Nanolithography, Scanning probe lithography, Micro contact printing, Synthesis of nanoparticles and films: solgel, hydrothermal, freeze drying, intercalation, attrition, ionimplantation, Gas phase condensation, Chemical vapour deposition, Nanosuspensions ferrofluids, Compaction of nanocrystlline materials, Carbon nanotubes, short and long term applications and perspectives, Demonstration of some techniques in preparation and characterization of nanomaterials.
MS888	INTRODUCTION TO PROFESSION AND COMMUNICATION SKILLS FOR MATERIAL SCIENTISTS	3-0-0-0-3	Interdisciplinary nature of material science, design and technologies; Current themes in materials education and research; Elements of scientific oral and written communication, Scientific ethics and norms.
MS698	GRADUATE SEMINAR	0-0-0-0-0	Graduate Seminar
MS699	M TECH THESIS	----	M. Tech. Thesis
MS799	PHD THESIS	----	Ph. D. Thesis