## M. Tech (Material Science and Technology)

### FIRST SEMESTER

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Subject Code</th>
<th>Subject Name</th>
<th>L-T-P</th>
<th>Contact hrs/week</th>
<th>Credits</th>
<th>Marks</th>
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<tbody>
<tr>
<td>1</td>
<td>MST-101</td>
<td>Materials and their properties</td>
<td>4-0-3</td>
<td>7</td>
<td>4+2</td>
<td>50</td>
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<tr>
<td>2</td>
<td>MST-102</td>
<td>Material Characterization</td>
<td>4-0-0</td>
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<td>3</td>
<td>MST-103</td>
<td>Physics of Nano-materials</td>
<td>4-0-3</td>
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<tr>
<td>4</td>
<td>MST-104</td>
<td>Thermodynamics</td>
<td>4-0-0</td>
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<td>5</td>
<td>MST-105</td>
<td>Research Methodology</td>
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<tr>
<th>Internal Assessment</th>
<th>University Exam</th>
<th>Practical*</th>
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<tbody>
<tr>
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**Total Marks :600**  
**Total Credits: 23**

*Practical marks are for continuous and end semester evaluation

### SECOND SEMESTER

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<tr>
<th>S. No.</th>
<th>Subject Code</th>
<th>Subject Name</th>
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<tr>
<td>1</td>
<td>MST-201</td>
<td>Advanced Material Characterization</td>
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<td>MST-202</td>
<td>Ceramics and Biomaterials</td>
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<td>MST-203</td>
<td>Solid State Phase Transformations</td>
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<td>4</td>
<td>MST-204</td>
<td>Semiconductors and Optoelectronics</td>
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**Total Marks :600**  
**Total Credits: 22**
### THIRD SEMESTER

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<td>1</td>
<td>MST-301</td>
<td>Magnetism and Superconductivity</td>
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<td>2</td>
<td>MST-302</td>
<td>Nanomaterials</td>
<td>4-0-0</td>
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<td>3</td>
<td>MST-303</td>
<td>Preliminary Thesis Work</td>
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<tr>
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Total Marks : 300
Total Credits: 18
# FOURTH SEMESTER

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**Total Marks: 100**  
**Total Credits: 15**

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<tr>
<td>1</td>
<td>A+</td>
<td>Publication in SCI/SCIE Indexed Journal</td>
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<tr>
<td>2</td>
<td>A</td>
<td>Scopus/ESCI Indexed Journal</td>
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<tr>
<td>3</td>
<td>B+</td>
<td>Paper presented in International/National conference</td>
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FIRST SEMESTER

MST-101: Materials and their Properties

Max (Univ. Exam) Marks: 50      Time of examination: 3hrs.
Internal Assessment: 50      Total Credits: 4

Course Duration: 45 lectures of one hour each with 4 lectures per week.

Note for the paper setter: Total of 7 questions will be set with first question compulsory, three questions from part A and three questions from part B. Candidate will be required to attempt 5 questions in all, with first question compulsory and selecting two from each of the part A and part B.

Part- A

Crystal Structure:

Bonding forces and energies, Primary and Secondary bonds.
Space Lattices, Symmetries in a cubic lattice, close packed morphology (Hexagonal and cubic close packing), interstitial spaces (trigonal, tetrahedral and octahedral voids in closest and other close packings)
Assignment of coordinates, directions and planes in crystals, Linear, Planar and Space densities in crystals,
Single and polycrystalline structures, structure of ceramics (NaCl, Zinc blende, silica and silicates, diamond crystal, Graphite, Fullerenes and carbon nanotubes)
Structure of polymers, crystallinity of long chain polymers
Crystal Defects (Point, line, surface and volume imperfections)

Diffusion: Diffusion mechanisms, steady state diffusion, non-steady state diffusion, factors affecting diffusion, applications based on diffusion (corrosion resistance of Duralumin, carburization of steel, decarburization of steel, doping of semiconductors)

Elastic, Anelastic and Viscoelastic Behaviour: Elastic behaviour and its atomic model, rubber like elasticity, anelastic behaviour, relaxation processes, viscoelastic behaviour, spring-dashpot model.
Part- B

**Plastic Deformations and Strengthening Mechanisms:** Tensile properties (Yield strength, Tensile Strength, Ductility, Resilience, Toughness), dislocations and plastic deformation, characteristics of dislocations, slip systems, slip in single crystals, plastic deformation of polycrystalline materials, mechanisms of strengthening in metals (grain size reduction, solid-solution strengthening, strain hardening), recovery, recrystallization and grain growth.

**Fracture, Fatigue and Creep:** Fracture (Ductile and brittle fractures), principles of fracture mechanics, fracture toughness, ductile to brittle transitions cyclic stresses, S-N curve, crack initiation and propagation, factors that affect fatigue life, environmental effects, generalized creep behavior, stress and temperature effects.

**Thermal Properties:** Lattice vibrations, vibrations of simple lattice, optical and acoustic phonons, heat capacity, thermal expansion, thermal conductivity, thermal stresses in materials.

**Optical Properties:** Interaction of radiation with matter (metals and non-metals), Refraction, reflection, absorption, transmission, color, opacity and translucency in insulators, phosphorescence, luminescence, photoconductivity.

**Reference Books**

1. Lawrence H.Van Vlack, Elements of material Science & Engg., Addison Wesley
PART A

Vacuum Technology and Materials Deposition
Basics of vacuum technology, Rotary Pump, Diffusion pump, Turbo Molecular Pump, Cryopumps and ionization pumps Gauges for measuring high vacuum (pirani, penning and ionization gauge).
Physical vapor deposition, sputtering, chemical vapour deposition, molecular beam epitaxy


PART B

Optical and X-Ray Spectroscopy
Overview of electron and photon sources, Electron and Photon interactions with matter,

**Principles, methods and applications of particle analysis**: Basic measurements (grain size, particle morphology, particle size, and size distribution) and applications.  
**X-ray Fluorescence**: X-ray absorption in materials, Basic principles, Instrumentation, elemental identification and quantification.

**Reference Books**
6. John P. Sibilia, A guide to material characterization and chemical analysis, VCH Publishers Inc. NY, 1988
MST-103: Physics of Nanomaterials

Max (Univ. Exam) Marks: 50  Time of examination: 3hrs.
Internal Assessment: 50  Total Credits: 4

Course Duration: 45 lectures of one hour each with 4 lectures per week.

Note for the paper setter: Total of 7 questions will be set with first question compulsory, three questions from part A and three questions from part B. Candidate will be required to attempt 5 questions in all, with first question compulsory and selecting two from each of the part A and part B.

PART A

Quantum Physics of Nano-Scale Materials

Foundations of Quantum Physics: Transition from classical to quantum realm (Black Body Radiation, Compton Scattering, Photoelectric Effect), idea of wave matter duality and Davison-Germer experiment, uncertainty principle and correspondence principle, Ehrenferst theorem.

Schrodinger’s Equation: Time dependent and steady state form, wave function-interpretation and its properties, operators formalism, commutator relations.

Application of Schrodinger’s Equation: Infinitely deep one-, two- and three-dimensional potential well (idea of nano-wires, nano-sheets and nano-dots), excitons and quantum confinement, finite potential barrier and well, harmonic oscillator, tunneling effect.

Statistical Physics: Maxwell-Boltzmann statistics, Bose-Einstein statistics and Fermi-Dirac Statistics, Fermi energy, specific heat of crystalline solids, photon gas

PART B

Theory of Solids: free electron gas, density of states, Kronig Penny model, zone theory, effective mass.
Overview of Density Functional Theory (DFT).
**Introduction to Nanomaterials:** Features of nanosystems: characteristic length scales of materials and their properties; fundamental behaviour of 0-D(nanoclusters, Quantum dots), 1-D(nanowires), 2-D(thin film multilayers), and 3-D(bulk nanostructures) materials, Conduction electrons and dimensionality, density of states, properties dependent on density of states, top down and bottom up approaches of generation nanoparticles

**Properties of Nanomaterials:** Size and shape dependent properties, color, melting point, magnetism, conductivity and band gap, Mechanical properties of nano-materials; Magnetic and electronic transport properties of nano-structured materials.

**Reference Books**

1. A. K. Bandopadhyay, Nano-materials, New Age International
2. Paul Harrison, Quantum Wells, Wires & Dots: Theoretical & Computational Physics of Semiconductors Nanostuructures, Wiley International
3. Cao Guozhong, Nanostructures and Nanomaterials - Synthesis, Properties and Applications
MST-104: Thermodynamics

Max (Univ. Exam) Marks: 50      Time of examination: 3hrs.
Internal Assessment: 50       Total Credits: 4

Course Duration: 45 lectures of one hour each with 4 lectures per week.

Note for the paper setter: Total of 7 questions will be set with first question compulsory, three questions from part A and three questions from part B. Candidate will be required to attempt 5 questions in all, with first question compulsory and selecting two from each of the part A and part B.

PART A


Thermodynamics of Solutions: Partial molar quantities, Gibbs-Duhem equation, ideal and regular solutions, partial and excess properties, quasi-chemical model, polynomial expressions for excess Gibbs energy of mixing for binary and higher order solutions. multi-component dilute solutions and interaction parameters.

Chemical Equilibrium: Direction of spontaneous change in a chemical reaction, extent of reaction, stoichiometric coefficients, equilibrium constant in terms of G. Temperature and pressure dependence of equilibrium constant, homogeneous and heterogeneous equilibria.

PART B

**Phase Equilibria**: Phase rule and binary phase diagrams. Free energy composition diagrams. Phase equilibrium calculations. Introduction to ternary phase diagrams, chemical reactions involving gases and solids- Ellingham diagrams, eutectics, freezing mixture, zone refining.

**Reference Books**

MST-105: Research Methodology

Max (Univ. Exam) Marks: 50                       Time of examination: 3hrs.
Internal Assessment: 50                             Total Credits: 4

Course Duration: 45 lectures of one hour each with 4 lectures per week.

Note for the paper setter: Total of 7 questions will be set with first question compulsory, three questions from part A and three questions from part B. Candidate will be required to attempt 5 questions in all, with first question compulsory and selecting two from each of the part A and part B.

PART A

Introduction Research Methodology: Definition of Research, Need of Research, Concept and steps of Research Methodology, Uses of Research Methodology, Research Techniques.

Reviewing Literature: Need, Sources—Primary and Secondary, Purposes of Review, Scope of Review, Steps in conducting review.


Method of Research: Descriptive research design—survey, case study, content analysis, Ex-post Facto Research, Correlation and Experimental Research.

Sampling Techniques: Concept of population and sample’ sampling techniques—simple random sampling, stratified random sampling, systematic sampling and cluster sampling, quota sampling techniques determining size of sample.

Procedure of Data Collection: Aspects of data collection, Techniques of data Collection.
PART B

Statistical Methods of Analysis: Descriptive statistics: Meaning, graphical representations, mean, range and standard deviation, characteristics and uses of normal curve.

Inferential Statistics: t-test, Chi-square tests, Correlation (rank difference and product moment), ANOVA (one way).

Procedure for Writing a Research Proposal and Report: Purpose, types and components of research proposal, Audiences and types of research reports, Format of Research report and journal

Reference Books

4. N.K. Malhotra, Marketing Research- An Applied Orientation, Pearson Education
MST-101: Materials and their properties

Max (Univ. Exam) Marks: 25                   Time of examination: 3hrs.
Internal Assessment: 25                      Total Credits: 2

Course Duration: There will one laboratory session of 3 hours per week.

1. To measure the resistivity of a semiconductor using four probe method.
2. To measure the magneto-resistance of a semiconductor specimen.
3. To measure the g-factor of electron using ESR spectrometer.
4. To study the dependence of the Hall Coefficient on temperature.
5. To determine dielectric constant of a material as a function of temperature and measure the Curie temperature of material.
6. To measure the susceptibility of paramagnetic solids by Gouy’s method.
7. To determine the thermionic work-function of tungsten using a directly heated diode.
MST-103: Physics of Nanomaterials (Practical)

Max (Univ. Exam) Marks: 25
Internal Assessment: 25

Time of examination:
Total Credits: 2

Course Duration: There will one laboratory session of 3 hours per week.

1. To synthesize metal nanoparticles by chemical route.
2. Synthesis of nanoparticles of different sizes using sol-gel technique.
4. To deposit a thin film of metal using thermal evaporation technique and measure its thickness.
5. To deposit a thin film of metal using electron beam gun and determine its thickness.
6. To synthesize semiconductor nanoparticles by chemical route.
7. To synthesize a polymer material.
8. To prepare and isolate and characterize of a biomaterial.
SECOND SEMESTER

MST-201: Advanced Materials Characterization

Max (Univ. Exam) Marks: 50
Internal Assessment: 50
Total Credits: 4

Time of examination: 3hrs.

Course Duration: 45 lectures of one hour each with 4 lectures per week.

Note for the paper setter: Total of 7 questions will be set with first question compulsory, three questions from part A and three questions from part B. Candidate will be required to attempt 5 questions in all, with first question compulsory and selecting two from each of the part A and part B.

PART A


Surface Structure and Surface Structure Analysis: Introduction to surface studies, Surface chemical composition: The extension of bulk techniques to surface studies - Unit meshes of five types of surface nets, surface reconstructions - diffraction from di-periodic structures. Surface methods using electron, low energy electron diffraction (LEED), reflection high energy electron diffraction (RHEED), Ellipsometry.

PART B

Determination of Surface Properties:

Scanning Tunneling Microscopy: Basic principle of tunneling spectroscopy, instrumentation and applications, Atomic Force Microscopy, tip-surface interaction, contact and non-contact modes, different imaging modes of AFM, Force sensor, Deflection detection, working with biological samples.
**Electron Microscopy Based Methods:** Scanning electron microscope: performance of SEM; Transmission electron microscopy: construction and operation of TEM, electron diffraction, image interpretation, Comparison with optical microscopy.

**Qualitative Treatment:** Electron spectroscopy for chemical analysis (ESCA), ultraviolet photo electron spectroscopy (UPS), X-ray Photoelectron Spectroscopy/UV Photoelectron Spectroscopy, Auger electron spectroscopy (AES), Electron energy analyzers, X-ray absorption spectroscopy.

**Reference Books**

7. B. D. Cullity, X-ray Diffraction.
8. John P. Sibilia, A guide to material characterization and chemical analysis, VCH Publishers Inc. NY, 1988
MST-202: Ceramics

Max (Univ. Exam) Marks: 50  Time of examination: 3hrs.
Internal Assessment: 50  Total Credits: 4

Course Duration: 45 lectures of one hour each with 4 lectures per week.

Note for the paper setter: Total of 7 questions will be set with first question compulsory, three questions from part A and three questions from part B. Candidate will be required to attempt 5 questions in all, with first question compulsory and selecting two from each of the part A and part B.

PART A

Introduction, bonding and structures of ceramics, types of ceramics

Structural Ceramics: Carbides, nitrides, oxides, borides, composites. Synthesis, bonding: structures and applications

Electronic Ceramics: Ferro electrics, electrical insulators, smart ceramics, peizo electrics, PLZT sensors, metallized ceramics and superconducting ceramics

Magnetic Ceramics: Spinel Ferrites, Hexagonal Ferrites, Garnet processing and applications.

Special Glasses and Glass Ceramics: High-Purity silica glasses, Laser Glasses, optical; glasses, fiber glasses, oxide and non-oxide glasses, oxy-nitride glasses, photosensitive glasses, conducting glasses, glass ceramics, application of glass ceramics, glass for satellite application.

PART B

Introduction to Biomaterials, Characterization of biomaterials bulk and surface characterization including degradation, mechanical, electrical, thermal and tribiological properties

Hard Biomaterials: Metals (Steel, cobalt-chromium, titanium, new titanium alloys, shape memory alloys, niobium alloys, tantalum alloys). alumina, zirconia, diamond like carbon, hydroxyapatite, bioglass, refractory nitrides (TiN), and refractory carbides (TiC).
**Soft Biomaterials:** Biopolymers (collagen, proteoglycans, cellulose-their structure properties and applications). Surface modification of biomaterials, Rapid prototyping of biomaterials. Biocompatibility & tissue response to implanted biomaterials. Applications of polymers in tissue engineering and drug delivery.

**Bio-Ceramics:** Introduction, composition, interaction with biological systems, properties, applications.

**Reference Books**

2. D. W. Richerson, *Modern Ceramics Engineering properties, processing and use in design*, Marcel Dekker, Inc. N. Y.
MST-203: Solid State Phase Transformations

Max (Univ. Exam) Marks: 50 Time of examination: 3hrs.
Internal Assessment: 50 Total Credits: 4

Course Duration: 45 lectures of one hour each with 4 lectures per week.

Note for the paper setter: Total of 7 questions will be set with first question compulsory, three questions from part A and three questions from part B. Candidate will be required to attempt 5 questions in all, with first question compulsory and selecting two from each of the part A and part B.

PART A

Solidification: Solidification from liquid and vapor phase, Nucleation, growth of homogeneous and heterogeneous nucleation, Interface stability, development of microstructure, super cooling, equilibrium phase diagrams, eutectic and peritectic solidification and their microstructures.

Thermodynamics: Equilibrium conditions, statistical thermodynamics of ideal and regular binary solution, energy of mixing and activity, derivation of phase diagrams from the model of solutions, free energy and binary phase diagrams.

Ordering: Ordered and disordered transformation, intermediate phases and compounds, super-lattices, degree of order, ordered domains and their boundaries.

PART B

Heat treatment for steel: Transformation in steel, effect of alloying elements, various heat treatment processes, transformation in alloy steel, super-alloys

Cast Iron: Heat treatment of cast irons, thermo-mechanical treatments

Non-ferrous alloys: Ti alloys, Al alloys, Cu alloys and their transformation behaviour

Non-Metallic Systems: Overview of properties of ceramics and polymers
**Foundry Techniques**: Sand casting, permanent mould casting, investment casting and die casting, casting defects and their inspection.

**Forming Processes**: Fundamentals of metal forming, hot working processes (rolling, forging, extrusion), cold working processes (bending, shearing, squeezing etc).

**Reference Books**

1. Phase Transformations in metals and alloys, D.A. Porter and K. Easterling
2. Principles of solidification, Bruce Chalmner, Willy.
5. Eutectic Solidification Processing, R. Elliott, Butterworthd
6. W.D. Callister, Wiley and Sons, Materials and Engineering- An Introduction
7. Rajan and Sharma: Heat treatment, New Delhi
11. V. Raghavan, Phase Transformation , New Delhi
MST-204: Semiconductors and Optoelectronic Materials

Max (Univ. Exam) Marks: 50

Time of examination: 3hrs.

Internal Assessment: 50

Total Credits: 4

Course Duration: 45 lectures of one hour each with 4 lectures per week.

Note for the paper setter: Total of 7 questions will be set with first question compulsory, three questions from part A and three questions from part B. Candidate will be required to attempt 5 questions in all, with first question compulsory and selecting two from each of the part A and part B.

PART A

Preparation and Characterization of Semiconductors: Types of semiconductors, charge carrier statistics, crystal growth, preparation and doping techniques of elemental and compound semiconductors, Metallization, Lithography and Etching, Bipolar and MOS device fabrication characterization (electrical, thermoelectric, magnetic and optical properties) of semiconductor materials.

Optical Properties of Semiconductors: Dipolar elements in direct gap semiconductors, optical susceptibility of a semiconductor, absorption and spontaneous emission, bimolecular recombination coefficient, condition for optical amplification in semiconductors.

PART B

Electronic and Electric Properties of Semiconductors: Boltzmann equation, scattering mechanisms, hot electrons, recombination, transport equation in a semiconductor.

Electronic and ionic conductivity, solid oxide fuel cells, ceramic semiconductors, linear dielectrics, dielectric properties.

Ferroelectric materials, piezoelectrics, ferro-piezoceramics, actuators and electrostrictions, pyroelectrics, electro-optics photorefractives, thin film capacitors.
Ferroic crystals, primary and secondary ferroics, proper ferroics, magnetoferroelectricity

**Application in Semiconductor Devices:**
Ge, Si, GaAs, Semiconductor device: metal-semiconductor and semiconductor heterojunctions, physics of bipolar devices, fundamentals of MOS and field effect devices, basics of solar cell, photodiodes, photodetectors.

**Reference Books**
2. J. Wilson and JFB Hawkes, Optoelectronics – PHI New Delhi
10. Introduction to Ferroic materials, Vinod K. Vadhawan, Gordan and Breach 2000
11. Optoelectronics, Emmanuel Rosencher and Broge Vinter, Cambridge University Press
MST-205: Polymers

Max (Univ. Exam) Marks: 50
Internal Assessment: 50

Time of examination: 3hrs.
Total Credits: 4

Course Duration: 45 lectures of one hour each with 4 lectures per week.

Note for the paper setter: Total of 7 questions will be set with first question compulsory, three questions from part A and three questions from part B. Candidate will be required to attempt 5 questions in all, with first question compulsory and selecting two from each of the part A and part B.

PART A

Basics: Basic concepts, classification of polymers, nomenclature of polymers, concepts such as monomers, oligomers, polymers, dendrimers: physical state (amorphous and crystalline) and functionality, stereo-regular polymers, copolymers, block and graft polymers, molecular forces and chemical bonding in polymers, polymerization mechanisms, addition and condensation including co-ordination, cationic, anionic, ring opening redox polymerization, living radical polymerization—atom transfer radical polymerization.

Methods of Polymerization: Bulk solution, precipitation polymerization, suspensions, emulsions, melts, polycondensation, solid phase, gas phase and (formulation, mechanism, properties of polymers produced, advantages and disadvantages of each technique), criteria of polymer solubility, solubility parameter, thermodynamics and phase equation of polymers solutions, fractionation of polymer by solubility.

Structure Property Relationship in Polymers: Configuration of polymer chains, crystallinity in polymers, crystallization and melting, strain inducing morphology, crystalline temperature, glass transition temperature, factors influencing T_g and T_m, polymer rheology, viscous, kinetic theory of rubber elasticity, viscoelasticity.
PART B

**Molecular Weight and Size:** Importance of weight, molecular weight distribution, concept of average molecular weights, measurement of molecular weight by end group analysis, colligative properties, light scattering, ultracentrifugation, dilute solution viscosity, gel permeating chromatography.

**Polymer Manufacturing:** Unit operations, polymer reactors, polymer isolation, handling and storage.

**Polymer Structure and Properties:** Polymer characterization, polymer modification, compounding and fabrication, testing, product design, applications and processing.

**Frontiers of Polymer Materials:** Conducting polymers like polypyrrole, polythiophene, polyaniline, biomedical polymers, magnetic polymers, non linear optical polymers, liquid crystal polymers.

**Problems with the Polymers:** Thermoxidative degradation, fire hazards, toxicity, effluent disposal, feedstock scarcity.

**Reference Books**

9. Nick Tucker and Mark Johnson, Rapra technology ltd, UK, Low environmental impact polymers
MST-201: Advanced Material Characterization (Practical)

Max (Univ. Exam) Marks: 50  Time of examination: 3hrs.
Internal Assessment: 50  Total Credits: 4

Course Duration: Two laboratory sessions of 3 hours per week.

1. Introduction to working of rotary and diffusion vacuum pumps.
2. Determination of crystal structure and grain size by X-ray powder diffraction.
3. Distinction between SEM and TEM images by analyzing the micrographs.
5. FTIR spectrum and its interpretation.
6. Thermographic Analysis.
THIRD SEMESTER

MST-301: Magnetism and Superconductivity

Max (Univ. Exam) Marks: 50

Time of examination:
3hrs.

Internal Assessment: 50

Total Credits: 4

Course Duration: 45 lectures of one hour each with 4 lectures per week.

Note for the paper setter: Total of 7 questions will be set with first question compulsory, three questions from part A and three questions from part B. Candidate will be required to attempt 5 questions in all, with first question compulsory and selecting two from each of the part A and part B.

PART A

Magnetism and Magnetic Materials
PART B

Superconductivity


Type-II Superconductivity: Pinning of Vortices, High Temperature Superconductors, Flux Flow, Flux Creep, Fluctuation effects, Levitation and Electrical Power Applications of HTSC.

Reference Books

MST-302: Nanomaterials

Max (Univ. Exam) Marks: 50  Time of examination: 3hrs.
Internal Assessment: 50  Total Credits: 4

Course Duration: 45 lectures of one hour each with 4 lectures per week.

Note for the Paper Setter: Total of 7 questions will be set with first question compulsory, three questions from part A and three questions from part B. Candidate will be required to attempt 5 questions in all, with first question compulsory and selecting two from each of the part A and part B.

PART A

Recapitulation of Nanomaterials.

Synthesis Methods: Specific production techniques like chemical vapor deposition, arc ignition, ion beam deposition, Formation of clusters and nanoparticles from supersaturated vapor and selected properties (Vapour-liquid-Solid method, Template based synthesis), sputtering and thermal evaporation and laser methods, ball milling, chemical bath deposition, Synthesis of nanoparticles by chemical routes, cluster beam evaporation.

Effect of Chemistry of Nanostructured Materials:
Modification of nanoparticles, Langmuir Blodgett films, Self assembled surface films, binding of molecules on solid substrate surfaces, Electrostatic Stabilization, Steric Stabilization

PART B


Applications: Biomedical imaging, nanofluidics, photonic crystals and optoelectronics. Nanoelectronics, nanobiometrics, Nanomechanics, band gap engineered quantum devices, nanobots.
Potential adverse effects of nanomaterials on environment and human health, Environmental fate and behavior of nanomaterials

**Reference Books**

1. D. Bimerg, M. Grandmann and N. N. Ledentsov, Quantum Dot Heterostructures, John Wiley and Sons.
2. K. P. Jain, Physics of Semiconductor Nanostructures, Narosa Publication.
4. G. Timp, Nanotechnology by Springer- Verlag 1999
5. A. S. Edlestein and R. C. Cammaratx, Nanomaterials, synthesis, Properties and applications, Inst of Physics Publishing Bristol
7. Owen and Poole, Introduction to Nanotechnology, Wiley
8. A. K. Bandopadhyay, Nano-materials, New Age International
10. Cao, Guozhong, Nanostructures and Nanomaterials - Synthesis, Properties and Applications
MST-303: PRELIMINARY THESIS WORK (LITERATURE SURVEY)

Internal Assessment : 100       Total Credits: 10

Each student will be allotted supervisors for his/her thesis work and in consultancy with supervisor the literature survey of the topic chosen will be undertaken to define his/her thesis problem. The student will spend a minimum of six hours per week on literature survey work. This progress of this work will be monitored by internal committee.

FOURTH SEMESTER

MST-401: Major Project (Thesis)

Max Marks: 100       Internal Assessment : 100       Total Credits: 15

Each student will be required to work on major project approved by department faculty that will span fourth semester during which periodic progress reports will be monitored. At the end of fourth semester the student will submit the thesis based upon his/her project work and project progress will be evaluated by department faculty.