

**SARDAR PATEL UNIVERSITY  
VALLABH VIDYANAGAR**



**SYLLABUS EFFECTIVE FROM: 2017-18**  
**Syllabus for M.Sc. (Nano Science & Nano Technology)**  
**Semester : II**

**Subject Code: PS02CNST21**

**Total Credit: 04**

**Subject Name: ELECTRICAL PROPERTIES OF NANOMATERIALS**

<b>Unit</b>	<b>Unit Title</b>	<b>Weight-age (%)</b>
<b>1</b>	Introduction, valence electrons, role of valence electron in electrical conduction, electrical resistivity/conductivity, classification of materials based on resistivity, electrical charge carriers, electronic and ionic conduction, conductors, semiconductors and insulators. Electrons in a field free crystal, electron gas approximation, motion of charge carriers in applied electric field, drift velocity, calculation of drift velocity, $U_d$ , dependence of resistivity on temperature and structure.	<b>25%</b>
<b>2</b>	Energy band structure in solids, band theory, metals, semi-conductors and insulators, charge carriers in semiconductors, electrons and positive holes, mobility of charge carriers, generation and recombination of charge carriers. Intrinsic semiconductors, Extrinsic (doped) semiconductors, p-n junction, current flow through a biased junction, bipolar junction transistor, field effect transistor.	<b>25%</b>
<b>3</b>	Purification of semiconductors; Introduction, purification methods, zone refining, crystal growth methods, epitaxial growth, chemical vapor deposition method, Molecular Beam epitaxy.	<b>25%</b>
<b>4</b>	Introduction, conduction in ionic materials, conducting polymers, capacitance, field vectors and polarization. types of polarization, frequency dependence of dielectric constant, dielectric strength and dielectric materials.	<b>25%</b>

**Reference Books :**

1. Materials Science - J. C. Anderson, K. D. Baver, R. D. Rawlings, J. M. Alexander.
2. Basic Electronics and linear circuits – N. N. Bhargava, D. C. Kulshreshtha, S. C. Gupta.
3. Materials Science and Engineering An Introduction-William D. Callister Jr.

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Course: M.Sc.      Subject: Nano Science & Nano Technology  
Semester : II

Subject Code: PS02CNST22

Total Credit: 04

Subject Name: SPECTROSCOPY

Unit	Unit Title	Weight-age (%)
1	Atomic absorption and flame emission spectroscopy. uv, visible and photoelectron spectroscopy introduction, theoretical consideration, application & analytical techniques.	25%
2	Introduction of microwave spectroscopy, rigid rotors, microwave spectra of diatomic and linear triatomic molecules, numerical problems. Harmonic and anharmonic oscillation in presence of IR, group frequency concept and its limitation, classical theory of Raman effect, selection rule for IR/Raman active vibrations.	25%
3	Principle of NMR spectroscopy, chemical shift, local contribution to chemical shift, neighbour anisotropic contribution to chemical shift, ring current effect, spin-spin splitting and effect of spin-spin splitting on the spectrum. spin decoupling techniques, molecular structure studies by NMR.	25%
4	Mossbauer spectroscopy, resonance absorption in solids, the mossbauer effect, experimental set up, factors affecting the MB spectra, applications. Development of masers and lasers, principle of masers action and types of masers, laser-generation of coherent radiation, type of lasers, application of lasers.	25%

## Reference Books

- Fundamentals of Molecular Spectroscopy by C. N. Banwell.
- Physical Methods in Chemistry by R. s. Drago.
- Applications of Absorption Spectroscopy of Organic Compounds by J. R. Dyer.
- Solid State physics – Saxena, Gupta & Saxena, Pragati prakashan.
- Mossbauer Spectroscopy by G. M. Bancroft.

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Course: M.Sc.      Subject: Nano Science & Nano Technology  
Semester : II

Subject Code: **PS02CNST23**

Total Credit: **04**

Subject Name: **NANOSTRUCTURES AND METALLIC MATERIALS**

Unit	Unit Title	Weight-age (%)
1	<b>Metals and extractive metallurgy</b> , Deformation, Strain Hardening, Annealing, hot working, deformation & bonding process, superplastic forming, Solidification and grain size strengthening, microstructure and its relation to the properties. Homogeneous and heterogeneous nucleation, growth, types of growth, solidification time, casting, solidification defects, control of casting structure, solidification and metal joining.	25%
2	Phase and the Unary phase Diagram, solubility and solutions, Hume Rothery's rules of solid solubility, solid solution strengthening, isomorphous phase diagram, strength and phase diagram, solidification of solid solution alloys, equilibrium and non equilibrium solidification, segregation, castability.	25%
3	Principles of dispersion strengthening, intermetallic compounds, three phase reactions, eutectic phase diagram, eutectic system, peritectic reactions, monotectic reaction, ternary phase diagram, nucleation and growth in solid state reactions, alloys strengthening by exceeding solubility limit. Age hardening or precipitation hardening.	25%
4	Introduction, methods of preparation, rapid solidification techniques, mechanical consolidation of powder, Devitrification of metallic glasses. Types of transformation eutectic crystallization, primary crystallization, Amorphous phase separation, phase separation in bulk Glass forming alloys. Preparation, structure and properties of metals and nanostructured alloys of Al , Mg , Zr	25%

**Reference Books :**

1. The science & Engineering of Materials by Donald R. Askeland PWS-Kent Publishing Co.
2. Materials Science & Metallurgy by V.D. Kodgire Everest Publishing House.
3. Physical Metallurgy by V.Raghavan.
4. Materials Science by Manas Chanda

**SARDAR PATEL UNIVERSITY**Course: M.Sc. Subject: Nano Science. & Nano Technology

Semester : II

Subject Code: PS02ENST21

Total Credit: 04

Subject Name: (Elective 01) : SELECTED TOPICS IN NANOMATERIALS

Unit	Unit Title	Weight-age (%)
1	Fundamental concepts, Crystal lattice, Unit cell, Bravais lattice, Lattice planes and directions. Seven crystal systems, Miller Indices, Chemical bonding, Bond energy, Bond length, Types of bond.	25%
2	Vacancies and interstitials, Formation of point defect. Schottky and Frenkel defects, Diffusion in solid, Fick's laws. Dislocations, Edge, Screw and Mixed, Stress field energy, Force between dislocations, Forces on dislocations, Origin of dislocation, Frank read source, Grain boundaries, Twin boundaries, Observation of dislocation. Homogenous and heterogeneous nucleation, MBE, LPE, Crystal growth technique of Industrially important crystals.	25%
3	Methods of preparation of nano material, Physical techniques, Thermal techniques, Physical vapour deposition, Plasma techniques, Template method, Lithography Sol-gel, CVD, Emulsion, chemical radiation etc.	25%
4	Hall- Petch equation, Dependence of mechanical properties on microstructure and grain size.	25%

**Reference Books :**

1. Crystal Growth by J.C. Brice.
2. Introduction to dislocations by D. Hull
3. Fundamentals of solid physics by B.S. Saxena, R.C. Gupta & P.N. Saxena
4. Materials Science - \_ Manas Chandra
5. The Science and Engineering of Materials by Donald R. Askeland
6. Materials Science and Metallurgy by V.D. Kodgire Everest Publishing house.
7. Introduction to nanotechnology by Charles P. Poole Jr. et al. Wiley Interscience.
8. Handbook of Nanotechnology, Bharat Bhushan (Ed.) Springer Verlag.

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**Course: M.Sc.      Subject: Nano Science. & Nano Technology  
Semester : II**

**Subject Code: PS02ENST22**

**Total Credit: 04**

**Subject Name: (Elective 02): ENGINEERING POLYMERS & NANOCOMPOSITES**

<b>Unit</b>	<b>Unit Title</b>	<b>Weight-age (%)</b>
<b>1</b>	Introduction, types and methods for preparation, characterization and applications of polyblends, alloys and IPN.	<b>25%</b>
<b>2</b>	Adhesive bonding, theories of adhesion, requirements for a good bond, mechanism of bond failure, surface preparation, primers and adhesion promoters, role of surfactants and other additives in adhesives, coatings, paints, commercial adhesives based on casein, starch, polyvinyl alcohol, rubber based adhesives, high temperature adhesives, hot melt adhesive, pressure sensitive adhesives.	<b>25%</b>
<b>3</b>	Structures, synthesis, properties and applications of selected engineering plastics such as, polyphenylene, poly (Phenylene oxide)s, poly (ether ketone)s, polyimides, polyamide-imide, poly(phenylene sulfide)s, polysulfones, poly ether-imides, Polycarbonates, Polybutylene terephthalates, Polyacetals, polymeric adsorbents, polymer electrolyte membrane	<b>25%</b>
<b>4</b>	Nanoclays – preparation, structures, and properties; carbon nanomaterials as reinforcements, other inorganic nanomaterials, preparation techniques for nanocomposites, properties and applications of nanocomposites.	<b>25%</b>

**Reference Books**

1. Plastic materials by J.A. Brydson.
2. Handbook of adhesive tech by Pizzi, A, Mittal K.A.
3. Functional Nanomaterials.

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**Course: M.Sc.      Subject: Nano Science & Nano Technology  
Semester : II**

**Subject Code: PS02CNST24**

**Total Credit: 04**

**Subject Name: Practical I**

<b>Unit</b>	<b>Unit Title</b>	<b>Weight-age (%)</b>
	Four probe method Determination of resistivity of Germanium crystal at different temperature and estimation of energy band gap. Determination of specific resistivity of discs of arbitrary shape by Van der PAUW method. Determination of reverse saturation current $I_0$ and material constant, ideality factor. Determination of temperature coefficient of junction voltage and energy band gap. Study of depletion capacitance and its variation with reverse bias. Study of Hall effect and estimation of Hall coefficient $R_H$ , carrier density ( $n$ ) and carrier mobility of $M$ . Germanium sample n-type Germanium sample p-type Indian Arsenide (In As) Crystallisation of alkali halide (NaCl) by aqueous solution method. Direct observation of dislocations in alkali halide crystals by etching method.	<b>100%</b>

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**Course: M.Sc.      Subject: Nano Science. & Nano Technology  
Semester : II**

**Subject Code: PS02CNST25**

**Total Credit: 04**

**Subject Name: Practical II**

<b>Unit</b>	<b>Unit Title</b>	<b>Weight-age (%)</b>
<b>1</b>	Determination of percentage of nitrogen by Kjeldhal's method in the given sample Determination of Percentage of acetyl groups in the given sample Determination of Molecular weight by steam distillation method in the given sample Determination of Hydrolyzable chlorine content of resin. Determination of gel time, peak exotherm temp. using dynamic & isothermal curing processes for thermosets. Determination of Oxirane oxygen content & molecular wt of epoxy resin. Determination of Aluminium in the given solution Determination of Nickel in the given solution Determination of iron in FeCl <sub>3</sub> solution Determination of strength of silver in AgNO <sub>3</sub> solution Determination of Calcium in the unknown solution Determination of chloride content in water. Determination of Hardness of water. Analysis of different constituents present in the given solution.  Experiments can be added or deleted depending upon current advancements.	<b>100%</b>

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**Course: M.Sc.      Subject: Nano Science. & Nano Technology  
Semester : II**

**Subject Code: PS02CNST26**

**Total Credit: 01**

**Subject Name: Comprehensive Viva**

<b>Unit</b>	<b>Unit Title</b>	<b>Weight -age (%)</b>
		<b>100%</b>