SARDAR PATEL UNIVERSITY
VALLABH VIDYANAGAR

SYLLABUS EFFECTIVE FROM: 2017-18

Syllabus for M.Sc. (Nano Science & Nano Technology)

Semester : I

Subject Code: PS01CNST21 **Total Credit: 04**

Subject Name: FUNDAMENTAL MATERIALS SCIENCE

Unit	Unit Title	Weight-age (%)
1	Classes of Naostructured materials, Zero dimensional nanostructures, one dimensional and two dimensional nanostructures, basic techniques for preparation of nanomaterials.	25%
2	Surface Energy, Chemical potential as a function of surface curvature, covalent and noncovalent interactions, Intramolecular and Intermolecular Potential energies and Forces, van-der Waals attraction potential, interaction between two particles, DLVO theory, steric stabilization, mixed steric and electric interactions.	25%
3	Laws of thermodynamics, Thermodynamics functions, Heat capacity, Enthalpy, Internal Energy, Gibbs potential, Heat content, Entropy, Free energy, Reversible & ir-reversible process, Adiabatic process, carnot cycle, Refrigeration Engine.,Gibbs Helmholtz equations and its limitation, Nernst heat theorem, Consequences of third law. Thermodynamics of small systems.	25%
4	Inadequacy of classical concepts of Black Body Radiation of Plank's quantum hypothesis, electromagnetic radiation. Wave particle duality, space quantization, limitations of the oldquantum theory matter waves, the uncertainly principle the formulation of quantum mechanics.The schrodinger equation in one and three dimension, Physical Interpretation and conditions on the wave function, expectation values, stationary states. A particle in a square well potential, in a box, towards potential step. Exactly soluble eigenvalue problems, the simple harmonic oscillator, angular momentum and parity, the rigid rotator, a particle in a central potential, the Hydrogen atom problem, the anisotropic and isotropic oscillators.Approximation methods perturbative theory for discrete levels, equations in various orders of perturbation theory, the non-degenerate first and second order case, stark effect and its applications, the variation methods for ground state and excited state trial functions linear in variational parameters, the Hydrogen molecules.	25%

Reference Books :

1. Thermodynamics for Chemists – Glasstone
2. Thermodynamics, Kinetic Theory & Statistical Thermodynamics - F.W. Sears, G.Salinger
3. Molecular Statistics for Students of Chemistry – L.A. Woodwar.
4. A text book of Quantum Mechanics by P.M. Mathews & K. Venkatesan.
5 Materials Science and Engineering, An Introduction-William D. Callister.
6. Nanostructures and Nanomaterials-synthesis, properties and applications-Gouzhong Gao

SARDAR PATEL UNIVERSITY

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

Semester : I

Subject Code: PS01CNST22 **Total Credit: 04**

Subject Name: INTERFACES AND ADHESION IN MATERIALS

Unit	Unit Title	Weight-age (%)
1	Introduction to Materials & Materials Science. Type of materials, **Smart materials**,Properties of materials, levels of structure and **surface modification-etching**, grinding, processing of materials, structure- property – processing relationship. Environmental effect of Materials behavior, Materials selection.	25%
2	Adhesion science, Definition of terms, Adhesion between two dry solids, Adsorption forces at solid surfaces, nature of real surface, methods of achieving surface contact, the liquid-solid interface, Laplace law, Young equation, wetting characteristics, electrostatic theory of adhesion, mechanical theory of adhesion, diffusion theory of adhesion, weak boundary layers.	25%
3	Brief history, laws of friction and their interpretation, effect of surface topography, chemistry, mechanical and physical properties. Wear of materials including metals, ceramics, polymers and their testing. Types of wear, Influence of environmental aspects. Archard wear law, Beneficial wear. Lubrication, Lubricants, boundary and hydrodynamic theory. Effect of additive and viscosity on surface protection. Lubrication at low and high temperatures, theory of lubrications.	25%
4	Adsorption, desorption, adsorption of gases by solids, physical adsorption experimental methods, Langmuir, BET and other theories, specific surface area determination. Chemisorption and its importance in the oxidation of metal catalysis, **catalyst and types of catalyst, materials science in catalyst, catalyst action.**	25%

Reference Books :

1. Handbook of Adhesion by D E Packham
2. The Science and Engineering of Materials by Donald R. Askeland.
3. Handbook of Adhesive Technology by A Pizzi, K.L Mittal
4. Catalyst by B. Viswanathanan

SARDAR PATEL UNIVERSITY

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

Semester : I

Subject Code: PS01CNST23 **Total Credit: 04**

Subject Name: BASIC ASPECTS OF VACUUM TECHNOLOGY AND THIN FILMS

Unit	Unit Title	Weight-age (%)
1	Introduction, history and development of vacuum technology, units of vacuum, classification of vacuum ranges, vacuum pumps for low, medium and high range. Vacuum gauges – an introduction, pressure/vacuum gauges for low, medium,high and ultrahigh vacuum, materials for vacuum system, leak detection and repair in vacuum system.	25%
2	Thermodynamics and kinetics foundation, equilibrium vapour pressure of materials clausius clapeyron equation, atomistic concept of gas pressure and temperature, impingement rate of molecules on a surface and free path of gas molecules.	25%
3	Substrates an introduction, substrate materials, requirements of a substrate material, importance of substrate cleaning, substrate cleaning methods. Thin film preparation methods, evaporation phenomena of compounds, evaporation with and without dissociation, evaporation of alloys and mixtures, special evaporation techniques.	25%
4	Condensation, nucleation and stages of thin film growth, deposition rates monitoring and film thickness, sources of electrical resistively in metallic films, commonly measured quantities for thin films, film resistor/capacitor materials.	25%

Reference Books :

1. Vacuum Science and Technology – V.V. Rao, T.B.Ghosh K.L. Chopra
2. Handbook of Thin Films – L. I. Maissel and R. Glang
3. Thin Film phenomena – K. L. Chopra

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

Semester : I

Subject Code: PS01CNST24 **Total Credit: 04**

Subject Name: BASIC CONCEPTS IN POLYMER SCIENCE

Unit	Unit Title	Weight-age (%)
1	Basic concepts of high polymer system, macromolecular concept, structural feature of polymer, length to diameter ratio, classification, structure property relationship. Step reaction polymerization, radical chain polymerization, ionic and co-ordination chain polymerization, copolymerization	25%
2	Polymerization techniques like bulk polymerization, solution polymerisation. suspension polymerisation, emulsion polymerisation, melt polycondensation, solution poly condensation, solid & gas phase polymerization. molecular weight distributions and averages, measurement principal methods & their range of application. analytical techniques for molecular weight determination, GPC and HPLC.	25%
3	Chemical bonds, polymer solubility, chemical reactivity, effect of thermal, photochemical and high energy radiation, aging and weathering, diffusion and permeability, toxicity. Rheoproperties such as stress and strain, ideal elastic solid, newtonian and nonnewtonian fluid, apparent viscosity, the power law, molecular hole concept, waissenberg effect, measurement of flow, melt fracture, time dependent flow, viscoelastic material and its mechanical model, relaxation, hysteresis and creep.	25%
4	Polymer single crystals, lamellae, disorder & nature of the fold surface, crystallization from melt, degree of crystallisation, crystallits, structural regularity and crystallizability, factors affecting crystallisabillity, helix structure, spherulites. Configuration of polymer chains, crystal structure of polymer, morphology of crystalline polymer, crystallization and melting.Glass transition temperature, melting temperature, measurement methods, factors affecting glass transition temp and properties. Heat distortion temperature.	25%

Reference Books:

1. Polymer Science by V R. Gowarikar
2. Polymer Science and Tech. of Plastics and Rubber by P Ghosh
3. Polymer Science by Billmeyer
4. Introduction to polymers by R.J. Young and P.A. Lovell.

SARDAR PATEL UNIVERSITY

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

Semester : I

Subject Code: PS01CNST25 **Total Credit: 04**

Subject Name: PRACTICAL – I

Unit	Unit Title	Weight-age (%)
	Operation of vacuum coating unit. Deposition of metallic thin film using vacuum coating unit. Determination of specific heat of graphite at different temperatures Estimation of thickness of film by multiple beam interferometry method. Preparation of thin film resistor using vacuum coating unit. Estimation of inter planar spacing and unit cell dimensions using electron diffraction pattern. Determination of electrical conductivity of graphite at room temperatures. Determination of depth of scratch by MBI method.	**100%**

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

Semester : I

Subject Code: PS01CNST26 **Total Credit: 04**

Subject Name: PRACTICAL – II

Unit	Unit Title	Weight-age (%)
	Preparation of phenol-formaldehyde resin (resole) Preparation of phenol-formaldehyde resin (Novolac) Preparation of urea-formaldehyde resin. Preparation of melamine-formaldehyde resin. Preparation of epoxy resin (Solid and liquid) Emulsion polymerization of methylmethacrylate Preparation of unsaturated polyester. Determination of free phenol content in Novolac resin. Determination of Free formaldehyde in PF, and UF and MF resin. Determination of epoxy equivalent weight of epoxy resin. Determination of acid value in polyester. ***Experiments can be added or deleted depending upon current advancements in Nanoscience & Nanotechnology.**	**100%**

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

Semester : I

Subject Code: PS01CNT07 **Total Credit: 01**

Subject Name: Comprehensive Viva

Unit	Unit Title	Weight-age (%)
		100%