



School of Nanoscience & Technology, Shivaji University, Kolhapur

IMPORTANT

Syllabus not to be considered for Oct. / Nov., 2020

Examination

B. Sc.- M. Sc. Part I, Sem 1		
Program	Sem / Paper	Syllabus not to be considered for examination
B. Sc.- M. Sc. I, Sem 1	Mechanics	<p>Unit-I 2 .Ordinary Differential Equations: Differential equation; ordinary and partial differential equations, 1st order homogeneous differential equations, 2nd order homogeneous differential equations with constant coefficients. Examples.</p> <p>Unit-III 2.Oscillations: Simple harmonic motion, Differential equation of SHM and its solutions, Kinetic and Potential Energy, Total Energy and their time averages, Damped oscillations, Forced oscillation,. Frequency of nanoscale matters.</p>
	DSC- 2A-Chem.: Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons.	Atomic Structure: Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra, Need of a new approach to Atomic structure. Surface area of atoms and nanoscale materials. What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2 , Schrödinger equation for hydrogen atom.

		<p>Radial and angular parts of the hydrogenic wavefunctions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum number m_l and m_s. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (m_s).</p> <p>Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (up to two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; cis - trans nomenclature; CIP Rules: R/S (for up to 2 chiral carbon atoms) and E / Z Nomenclature (for up to two C=C systems).</p>
	DSC- 3A-Biotech.:CELL BIOLOGY	<p>UNIT IV: Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extracellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction. Amyloid Fibrils as Self-Assembled Nano-Scale Bio-Assemblies. Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics and molecular basis of cancer. Basics of Stem cells, role of nanotechnology in stem cells.</p>
	DSC-4A-Maths.: DIFFERENTIAL CALCULUS	<p>Unit I : Types of discontinuities, Unit III: Applications to the partial derivatives.</p>
	DSC-5A-Electr.: NETWORK ANALYSIS AND ANALOG ELECTRONICS	<p>Unit IV: Cascaded Amplifiers: Two stage RC Coupled Amplifier and its Frequency Response. Feedback in Amplifiers: Concept of feedback, negative and positive feedback, advantages of negative feedback (Qualitative only). Sinusoidal Oscillators: Barkhausen criterion for sustained oscillations. Phase shift and Colpitt's oscillator. Determination of Frequency and Condition of</p>

		oscillation.
	AECC1-6AEng: English-I	Module IV - A) The Auspicious Vision- Tagore and B. The Book - Iftikar Rizvi

B. Sc.- M. Sc. Part II, Sem 3		
Program	Sem / Paper	Syllabus not to be considered for examination
	THERMAL PHYSICS AND STATISTICAL MECHANICS	Unit-III Kinetic Theory of Gases: (10 Lectures) Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.
B. Sc.- M. Sc. Part II, Sem 3	DSC- 8C-Chem.: SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY & FUNCTIONAL GROUP ORGANIC CHEMISTRY-II	Unit IV: Amino Acids, Peptides, Proteins and Carbohydrates: Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins. Determination of Primary structure of Peptides by degradation Edmann degradation (Nterminal) and C-terminal (thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & Cactivating groups and Merrifield solid-phase synthesis. Carbohydrates: Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disacharrides (sucrose, cellobiose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation. Concept of biomolecules as self-assembled nanomaterials. Introduction to biologically capped nanomaterials for use in SERS (Surface Enhanced Raman Spectroscopy), examples only.
	DSC- 9C-Biotech.: General Microbiology,	Advantages of microbial/biogenic nanomaterials synthesis methods Antimicrobial activity of nanomaterials- concept of

	Biochemistry and Nanobiotechnology	MIC, MBC, possible mechanisms of the antimicrobial activities, Isolation and enrichment of metal tolerant microorganisms
	DSC-10C-Stats.: Statistical Methods for Physical Sciences I	Unit – IV: Correlation and Regression: Correlation and regression (for ungrouped data): Bivariate data, scatter diagram, Karl Pearson's coefficient of correlation, Spearman's Rank Correlation 15 coefficient. Regression: least square method, regression coefficients, relation between correlation and regression coefficients. Concept of multiple linear regression, Plane of regression, Yule's notation, fitting of regression plane by method of least squares. Definition of partial regression coefficients and their interpretation. Residual: definition, order, properties. Concept of multiple and partial correlation. Definition, derivation and properties of multiple and partial correlation coefficients.
	DSC-11C- Elect.: Electronic Instrumentation	Unit IV: Data Converter and Data Acquisition System Data converter: D/A converter: Weighted resistor network and R-2R network, A/D Converter: A/D Converter circuit: parallel comparator, successive approximation, and dual slope ADC. Data Acquisition System: Block diagram of DAS, objective of DAS, single channel and multi channel Data Acquisition System, computer based data acquisition system and data loggers.

B. Sc.- M. Sc. Part III, Sem 5		
Program	Sem / Paper	Syllabus not to be considered for examination
B. Sc.- M. Sc.Part III, Sem 5	DSE-1E-Phy. : Classical Mechanics, Classical Electrodynamics and Quantum Mechanics	<p>UNIT III Application of uncertainty principle-non existence of free electrons in the nucleus.</p> <p>Unit IV 2. Applications of Schrodinger Equation Particle in a rigid box (infinite potential well) in one dimension and three dimension, Step potential-reflection and transmission coefficients, Potential barrier- tunneling effect (qualitative treatment), One dimensional simple harmonic oscillator (operator method)- energy levels, zero point energy, Schrodinger equation for Hydrogen atom in spherical polar coordinates, Separation of radial and angular parts, Solution of radial part of Schrodinger's equation - Energy Eigen values.</p>
	DSE-5E: Active Inorganic, Organic Compounds and Industries	<p>Unit 4. Industries: Introduction. Manufacture of cane sugar in India: Extraction of juice, Clarification, Concentration, crystallization, centrifugation and other details of industrial process. Byproducts of sugar industry. Manufacture of Ethyl Alcohol from Molasses: by Fermentation.</p> <p>Manufacture of Industrial Heavy Chemicals Introduction. Manufacture of Ammonia (NH₃), Physico-chemical principles. Manufacture by Haber's process. Manufacture of Sulphuric acid (H₂SO₄). Physico-chemical principles. Manufacture by Contact process. Manufacture of Nitric acid (HNO₃). Physico-chemical principles. Manufacture by Ostwald's process (Ammonia oxidation process). Manufacture of Sodium carbonate(Na₂CO₃) (Washing soda). Physico-chemical principles. Manufacture by Solvay process. Petroleum industry</p>

		and eco-friendly fuels Petroleum industry Introduction, occurrence, composition of petroleum, resources, processing of petroleum, calorific value of fuel, cracking, octane rating (octane number), cetane number, flash point, petroleum refineries, applications of petrochemicals, synthetic petroleum, lubricating oils & additives. Fuels: Fuels and eco-friendly fuels: liquid, gaseous fuel (LPG, CNG), fossil fuels, diesel, biodiesel, gasoline, aviation fuels. Use of solar energy for power generation.
	DSE-2E-Chem.: Inorganic and Organic Chemistry	Unit 2. Metal Ligand bonding in Transition Metal Complexes and Co-ordination Chemistry : Crystal field theory (CFT) Introduction: Shapes of d-orbitals, Basic assumptions of CFT. Crystal field splitting of d-orbitals of metal ions in octahedral, tetrahedral, square planar complexes and John-Teller distortion. Factors affecting the Crystal field splitting. High spin and low spin octahedral complexes w.r.t. Co (II). Crystal Field stabilization energy (CFSE), Calculation with respect to octahedral complexes only. Limitations of CFT. Molecular orbital theory (MOT). Introduction, MOT of octahedral complexes with sigma bonding such as $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$, $[\text{CoF}_6]^{3-}$, $[\text{Co}(\text{NH}_3)_6]^{3+}$. Merits and demerits of MOT. Coordination Chemistry: Inorganic Reaction mechanism Introduction, Classification of Mechanism: Association, dissociation, interchange and the rate determining steps. $\text{S}_\text{N}1$ and $\text{S}_\text{N}2$ reactions for inert and labile complexes. Mechanism of substitution in cobalt (III) octahedral complexes. Trans effect and its theories. Applications of trans effect in synthesis of Pt (II) complexes.
	SEC1-6E Env. Nanotech	Unit IV: Definition and principles of Green Chemistry and it's, significance, Biosynthesis of nanoparticles from plants, fungi & microorganisms and their application. Energy efficient resources and materials in Nanotechnology, Biological Sensors and Detectors and their applications Future aspects and importance of Nanotechnology in environmental conservation.

	DSE-4E :Physics and Chemistry at Nanoscale	Visualization and manipulation tools Microscopy: Basics, Working principle and applications. Optical microscopy, Scanning electron microscopy (SEM), Transmission electron microscopy (TEM). Difference between SEM and TEM.Scanning Probe Microscope (SPM) techniques: Scanning Tunneling Microscopy (STM) and Atomic force microscopy. Optical Tweezers: Basics, Working principles and applications.
	DSE-3E-Biotech.:Fundamentals of Enzymology and Nanoenzymology	Concept of nanoenzymes:Nanozymes in bionanotechnology, Natural enzymes, artificial enzymes, nanoenzymes, Various nanomaterial based nanoenzymes, Applications of nanoenzymes for sensing and imaging, nucleic acid sensing, as aptasensors, for immunoassay, for detection of cells and bacteria, for imaging, Nanozymes for therapeutics.

B. Sc.- M. Sc. Part IV, Sem 7 / M. Sc. I, Sem 1

Program	Sem / Paper	Syllabus not to be considered for examination
B. Sc.- M. Sc. Part IV, Sem 7	SNST-701T: Semiconductor Physics	Junctions-II: Capacitance Of Pn Junctions, The Varactor Diode, effects of contact potential on carrier injection, recombination and generation the transition region, ohmic losses, grade d junctions, schottky barriers rectifying contacts, ohmic contacts, heterojunction tions, AlGaAs-GaAs heterojunction.
	SNST-704T Nanocoatings and Applications	Anti-icing Nanocoatings: Introduction, Need of anti icing nanocoatings, Applications of Anti-icing Nanocoatings. hermal barrier and flamer retardant Nanocoatings: Introduction, Applications of Thermal barrier and flamer retardant Nanocoatings. UV-resistant Nanocoatings: Introduction, Necessity of UV resistant nanocoatings, Types of UV resistance Nanocoatings, Applications of hydrophobic nanocoatings. Conductive Nanocoatings: Introduction, Necessity of Conductive Nanocoatings, Conductivity fundamentals, Coating BuildUp, Control of optoelectronic properties, Methods of Coatings Characterization, Properties of Coatings, Applications of conductive nanocoatings.
	SNST – 703 T: Functional Nanomaterials	Unit IV: Polymer nanocomposites: Introduction and review of Polymer, Introduction to Block copolymers, Properties of polymers; solid, glass transition temperature, crystalline-melting temperature, thermal transitions, viscoelasticity and rubber elasticity. Polymer additives: plasticizers, fillers and reinforcement: Polymer blends, toughen plastics and phase separated blends. Polymer composites: mechanical properties and composite fabrication. Introduction to polymer nanocomposites: Basic materials for polymer nanocomposite technology. Fabrication techniques: Solution intercalation, melt intercalation, roll milling, emulsion polymerization, in-situ polymerization and high-shear mixing. Characterization of polymer nanocomposites, Properties of polymer nanocomposites: Thermoplastic nanocomposites, Thermoset

		Nanocomposites, Elastomer Nanocomposites. Applications of polymer nanocomposites in: high temperature, paint formulation, Automobiles, Aerospace, Injection Molded Products, Coatings, Adhesives, Fire-retardants, Packaging Materials, Microelectronic Packaging, Optical Integrated Circuits, Drug Delivery, Sensors, Membranes, Medical Devices, Consumer Goods.
	SNST - 702 T Carbonaceous materials	Carbon Nanotubes: Synthesis Methods and Growth Mechanisms: High temperature method, Arc discharge, General technical features of the production process, Growth Mechanism, Laser Ablation of Graphite, Low temperature method, Chemical Vapor deposition (CVD) process, Vapor liquid solid model, Catalytic role. Purification and functionalization: Methods of Purification, Methods of Functionalization (Chemical and Physical), Advantage of purification and functionalization, Separation of cnts: based on chirality, semiconducting, metallic, Applications of Carbon nanotube, Field emission, Li-ion battery, Supercapacitor, Sensors, Solar cell , CNT-polymer composite and avionics EM shielding.
	SNST-705T Nanobiotechnology	Nanotechnology and its application in food industry: Nanotechnology and food packaging, natural biopolymers, advantages of nanomaterials in food packaging applications, outstanding issues, risks and regulations, public perception. Nanotechnology in Agriculture, Precision farming, Smart delivery system, Insecticides using nanotechnology, Potential of nanofertilizers.

B. Sc.- M. Sc. Part V, Sem 9 / M. Sc II, Sem 3

Program	Sem / Paper	Syllabus not to be considered for examination
B. Sc.- M. Sc.Part V, Sem 9		20 % Volume of project research work will not be considered for the semester examination