

Shivaji University, Kolhapur.



Syllabus For

B. Sc. – M. Sc. Integrated
(Nanoscience and Technology)

B.Sc. Part –III

to be implemented from the academic year 2017-18

(June 2017) onwards.

SHIVAJI UNIVERSITY, KOLHAPUR
School of Nanoscience and Technology
(5 year integrated multidisciplinary 10 semester course)

Semester-V
Course Structure

Course NO.	Title	Credits		Examination/Evaluation of marks				Total
		L	P	T		P		
				Int.	Final	Int.	Final	
SNST-501T	Mathematical Methods, Statistical Physics and Solid State Physics	3	-	20	80	-	-	100
SNST-502T	Advanced Organic Chemistry	3	-	20	80	-	-	100
SNST-503T	Fundamentals of enzymology and Bioinformatics	3	-	20	80	-	-	100
SNST-504T	Science at Nanoscale	3	-	20	80	-	-	100
SNST-505T	Environmental Science and Environmental applications of Nanomaterials	3	-	20	80	-	-	100
SNST-506T	Scientific and Technical Writing-I (Non Credit course)	-	-	-	-	-	-	-
SNST-511P	Laboratory Course I	-	2	-	-	-	50	50
SNST-512P	Laboratory Course II	-	2	-	-	-	50	50
SNST-513P	Laboratory Course III	-	2	-	-	-	50	50
SNST-514P	Laboratory Course IV	-	2	-	-	-	50	50

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Semester-VI
Course Structure

Course NO.	Title	Credits		Examination/Evaluation of marks				Total
		L	P	T		P		
				Int.	Final	Int.	Final	
SNST-601T	Classical and Quantum Mechanics	3	-	20	80	-	-	100
SNST-602T	Medicinal Chemistry and Radioactivity	3	-	20	80	-	-	100
SNST-603T	Molecular biology and genetic engineering	3	-	20	80	-	-	100
SNST-604T	Properties of Nanomaterials	3	-	20	80	-	-	100
SNST-605T	Nanobiology and Nanomedicine	3	-	20	80	-	-	100
SNST-606T	Scientific and Technical Writing-II (Non Credit course)	-	-	-	-	-	-	-
SNST-611P	Laboratory Course I	-	2	-	-	-	50	50
SNST-612P	Laboratory Course II	-	2	-	-	-	50	50
SNST-613P	Laboratory Course III	-	2	-	-	-	50	50
SNST-614P	Laboratory Course IV	-	2	-	-	-	50	50

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Paper No: SNST-501T

Total Marks: 100
(80+20)

B. Sc. - III, Semester- V

Title of the Paper: Mathematical Methods, Statistical Physics and Solid State Physics

Topic No.	Credits: 3	Lectures 45
1	UNIT-I: Mathematical physics Introduction to Cartesian spherical, polar and cylindrical co-ordinate systems, concept of orthogonal curvilinear co-ordinates, gradient, divergence curl, del and Laplacian in orthogonal curvilinear system, concept of gradient, divergence and curl with physical significance extension of gradient, divergence, curl, del and Laplacian in spherical polar and cylindrical co-ordinate systems.	(15)
2	UNIT-II: Quantum statistics Bose-Einstein statistics, BE distribution law, derivation of Planck's radiation formula, deductions of Rayleigh-jean's law, Wien's law, Wien's displacement law and Stefan's law from Planck's formula. Fermi -Dirac statistics, FD distribution law, Applications FD distribution law, Fermi energy and Electron energy distribution, and Electronic specific heat.	(11)
3	UNIT-III: Defects in crystals Points Defects -Schottky defect Frenkel defect, Electronic defects, Compositional defects, energy of formation of vacancy defects, Number of vacancies at any temperature in elemental solids, Schottky defects in ionic solids. Line defects - Edge dislocation, Screw dislocation. Surface defects - Grain boundaries, stacking faults, twin boundary, volume imperfections.	(7)
4	UNIT-IV: Solid State Physics (A) Free Electron Theory Free electron model, Fermi-Dirac distribution, energy levels and energy density of orbital in one dimension. (B) Band theory of Solids Origin of energy bands, One electron approximation, Bloch theorem (statement only), motion of electron in one dimensional periodic potential (Kronig-Penny model), Brillouin zones (one dimension), effective mass of an electron, distinction between metals, semiconductors and insulators, Hall Effects (Expression for Hall voltage and Hall coefficient)	(12)

References:

1. Mathematical physics : H. K. DAS
2. Mathematical physics : B.S. RAJPUT

3. Solid state physics: S.O. PILLAI
4. Quantum mechanics: LOKNATHAN
5. Statistical mechanics: GUPTA KUMAR

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Paper No: SNST-511P

Total Marks: 50

B. Sc. - III, Semester- V

Title of the Paper: Laboratory-course I (PS)

Sr. No.	(Credit 2)
1.	Resonance Pendulum
2.	Y by Koeing method
3.	Thermal conductivity -Lee`s method
4.	Surface tension of liquid by drop method
5.	Thickness of thin film
6.	Diffraction due to single slit using sodium/ laser source
7.	Diffraction at straight edge
8.	Self inductance by Owen`s bridge
9.	Resistance of B.G. by half deflection method
10.	e/m by Thomson method/ Millikan`s oil drop method
11.	Sharpness of resonance in L-C-R series circuit
12.	P.O. box- Measurement of resistance of galvanometer (Kelvin`s method)

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Paper No: SNST-502T

Total Marks: 100
(80+20)

B. Sc. - III, Semester- V

Title of the Paper: Advanced Organic Chemistry

Topic No.	Credits: 3	Lectures 45
1	<p>Unit-I A] Concept of Chirality: Geometrical and optical isomers: Recognition of Symmetry elements and chiral centre, R-S nomenclature, Different types of optical isomerism. Conformational analysis of simple cyclic (Cyclohexene & monosubstituted cyclohexanes) & acyclic systems. Geometrical isomerism & configurations in monocyclic ring systems.</p> <p>B] Common organic reactions & mechanism Reactive intermediates: Formation & stability of Carbocations, Carbanions & carbenes & nitrenes. Familiar name reactions: Diels Alder reaction, Benzilic acid rearrangements, Oppenaur Oxidation, Meevwein Pandorf-Vevley reduction, Schmidt rearrangement, Wagner- Meevwein rearrangement, Reimerr-Tiemann reaction, Witting reactions</p>	(15)
2	<p>Unit-II Bioinorganic Chemistry: Introduction Bioinorganic Compounds Non photosynthetic process, Metalloporphirins, Cytochrome, Myoglobin, haemoglobin, oxygen transport. Photosynthesis ps-I & ps-II, Nitrogen fixation Role of essential and trace element in biological life, Biological co-ordination compounds and their applications.</p>	(11)
3	<p>Unit-III Polymers: Monomers, copolymerization, homopolymer, condensation polymerization, chain intiation, chain propagation, chain termination. Glass transition temperature. Natural and synthetic polymers and their common applications.</p>	(7)
4	<p>Unit-IV Boranes and Silicones: Classification of boranes, synthesis, properties & structure of diborane and borazine Inorganic polymers, Synthesis properties and structure of Phosphazens, silicates and silicones, Applications of Inorganic polymers</p>	(12)

References:

1. Inorganic Chemistry- Principles of structure & reactivity - James H. Huneey
2. Co-ordination Chemistry - R. Gopalan

3. Advanced Inorganic Chemistry - Agarwal & Keemti Lal.
4. Spectroscopy - H.Kaur.
5. Concise Inorganic Chemistry - J. D. Lee
6. Fundamental Concepts of Inorganic Chemistry Vol- I & II - Ashim Das
7. Nuclear Chemistry - B.K. Sharma.
8. Bioorganic & Bioinorganic and Supramolecular Chemistry - P.S.Kalsi & J.P.Kalsi.
9. Instrumental methods of Chemical Analysis - H. Kaur
10. Organic Chemistry –Volume I & II - I .L. Finar
11. Advanced Organic Chemistry – Jerry March's & Michel B. Smith
12. Physical Chemistry- J. C. Wang I. Tinoco, K.Sauer, & J. D. Duglisi.

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Paper No: SNST-512P

Total Marks: 50

B. Sc. - III, Semester- V

Title of the Paper: Laboratory-course II (CS)

Sr. No.	(Credit 2)
1.	Alloy analysis-analysis of Brass metal alloy
2.	Ore analysis-dolomite ore. Ca ⁺⁺ , SiO ₂ , Mg.
3.	Determination of acidity of Milk/Lassi
4.	Analysis of commercial sample (Talcum powder)
5.	Estimation percentage purity of given solution by FAS
6.	Redox titration
7.	Complexometric titration for estimation of zinc
8.	Preparation of potassium trioxato chromate (III)- K ₃ [Cr(C ₂ O ₄) ₃]
9.	Preparation of Reineck's salt (Ammonium tetrathiocyanatodiamine chromate) NH ₄ [(NH ₃) ₂ Cr(CNS) ₄]
10.	Determination of Hardness of water.
11.	Determination of Turbidity of water sample.
12.	Volumetric estimation of Copper and Nickel from the given solution
13.	Ore analysis-dolomite ore. Ca ⁺⁺ , SiO ₂ , Mg.
14.	Determination of acidity of Milk/Lassi
15.	Analysis of commercial sample (Talcum powder)

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Paper No: SNST-503T

Total Marks: 100
(80+20)

B. Sc. - III, Semester- V

Title of the Paper: Fundamentals of enzymology and Bioinformatics

Topic No.	Credits: 3	Lectures (45)
1	UNIT I Introduction: Definition, Basic terminologies, Classification, Nomenclature and Physico-chemical properties of enzymes, IUB system. Concepts of active site, binding site, enzyme-substrate complex, activation energy, Transition State Theory. Effects of pH, temperature and substrate concentration on enzyme activities. (10L)	10
2	UNIT II Enzyme Kinetics: Introduction: Michaelis - Menten Equation-form and derivation, steady state enzyme kinetics, Significance of V_{max} and K_m Enzyme activity: Specific activity, turnover number Enzyme inhibition: types of inhibitors-competitive, non-competitive and uncompetitive, feedback inhibition. Enzyme immobilization: Methods and significance (10L)	10
3	UNIT III Biochemical Techniques Introduction: Sub-cellular fractionation, Methods of lysis for plants, animals and microbial cells Centrifugation: Basic principle, Types and Importance Electrophoresis: SDS and Native PAGE, Staining techniques Chromatographic Techniques: Ion exchange, Gel filtration chromatography, Partition chromatography, Affinity chromatography, Paper chromatography, Thin Layer Chromatography. (13L)	13
4	UNIT IV Bioinformatics: Introduction to NCBI, Biological databases, Primary and Secondary protein sequence databases Proteomics: Protein sequence information, Physico-chemical properties, Sequence alignment Genomics: Human Genome Project, Goals, Rough and Final draft, Nucleic Acid Sequence databases, GenBank, EMBL, DDBJ, BLAST Structural Bioinformatics: Structural databases: PDB, NDB, MMDB Structure visualization: Ras-Mol, Kinemag, Phylogenetic tree (12L)	12

References:

1. Lehninger's Principles of Biochemistry by D.L. Nelson and M.M. Cox, CBS Publications, 2000
2. Biochemistry by Lubert Stryer, 4th Edition
3. Biochemistry by David Rawn
4. Garrett and Grisham - Biochemistry 2nd Edition
5. Biochemistry by J. L. Jain
6. Biochemistry by Roger Harper
7. Principles of protein structure by Shulz and Schirmer
8. Fundamentals of Enzymology by Royer
9. Fundamentals of Enzymology Price and Stevens
10. Enzymes Dixon and Webb
11. Immobilized Biocatalysts W. Hartneir
12. Computational Biochemistry, By: C. Stan Tsai, A John Wiley & Sons, Inc., publication

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Paper No: SNST-513P

Total Marks: 50

B. Sc. - III, Semester- V

Title of the Paper: Laboratory-course III (LS)

No	Credit 2
1	Qualitative estimation of starch by iodine and Benedict test
2	Identification and quantitation of activity of α amylase/ β mylase/cellulase/amyloglucosidase/invertase/alkaline phosphatase [salivary/microbial/animal/plant source].
3	Determination of specific activity
4	Determination of activity in presence of activators.
5	Determination of activity in presence of inhibitors
6	Determination of optimum pH
7	Determination of optimum temperature
8	Determination of K_m and V_{max}
9	Determination of Competitive, non-competitive inhibitors
10	Getting an amino acid sequence, nucleotide sequence and BLAST
11	Multiple sequence alignment
12	Structure analysis: secondary, tertiary and Quaternary structure, bond angle, bond length, different interactions
	Ras-Mol, Kinemag

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Paper No: SNST-504T

Total Marks: 100
(80+20)

B. Sc. - III, Semester- V

Title of the Paper: Science at Nanoscale

Unit No.	Credits 3	Lectures (45)
I	UNIT I: Introduction to Nanoscience Nano and Nature: Nanoscopic colours (Butterfly wings), Bioluminescence (fireflies), Tribology (Gecko's Sticky Feet, Nasturtium Leaf-Lotus effect etc) in nature. The development of nanoscale science: size scale, Nanotechnology Timeline: Pre-18th Century, 19th Century, 20th Century, 21st Century. Generations of nanotechnology. Classification of nanomaterials: 0D, 1D, 2D and 3D and types of nanomaterials (QDs, QW, CNT's, Bucky Balls, Nanocomposites etc) Nanoscience: quantum mechanics, Brownian motion, surface forces, surface to volume ratio	12
II	UNIT II: Making of nanostructures: Top down Overview of top down nanofabrication processes. Mechanical grinding (ball milling), photolithography, electron beam lithography Thin film technologies: vacuum technology, Sputtering, PLD, CVD, ALD.	12
III	UNIT III: Making of nanostructures: Bottom up Overview of bottom up nanofabrication processes. Vapor – phase synthesis: Gas-Vapor deposition, Plasma – based synthesis, Molecular beam epitaxy, Inert gas condensation, Flame pyrolysis. Liquid phase synthesis: Colloidal methods, Solution precipitation, Electrodeposition, Sol-gel technique: Introduction. Sol-gel process sol-gel coating processes, Sol-gel applications, Self Assembly: LB, Hydrothermal synthesis, Vapour –liquid growth, Solid – state phase synthesis	11
IV	UNIT IV: Visualization and manipulation tools Microscopy: Optical, electron (SEM, TEM), SPM (STM, AFM) Optical Tweezers	10

References:

1. Nanotechnology: Technology Revolution of 21st Century by Rakesh Rathi, published by S.Chand.
2. Introduction to Nanoscience, by Stuart Lindsay.

3. Introduction to Nanomaterials and nanotechnology by Vladimir Pokropivny, Rynno Lohmus, Irina Hussainova, Alex Pokropivny and Sergey Vlassov
4. Nanomaterials by A.K. Bandyopadhyay; New Age International Publishers.
5. Nanotechnology by Mark Ratner and Daniel Ratner, Pearson Education.
6. Nano Essentials- T.Pradeep/TMH
7. Bharat Bhusan, "Springer Handbook of Nanotechnology", springer, Newyork, 2007
8. Hari Singh Nalwa, "Encyclopedia of Nanotechnology", USA 2011
9. James A. Schwarz, Cristian I. Contescu, Karol Putyera, "Dekker encyclopedia of nanoscience and nanotechnology" CRC Press, 2004.

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Paper No: SNST-505T

Total Marks: 100
(80+20)

B. Sc. - III, Semester- V

Title of the Paper: Environmental Science and Environmental applications of Nanomaterials

Unit No.	Credits 3	Lectures (45)
I	<p>UNIT I: Water Pollution:</p> <ol style="list-style-type: none"> 1. Water pollution, sources and measurement of water pollution. Need for water management, Wastewater collection, physico-chemical properties of wastewater, Water and Wastewater treatment, physical, chemical and biological treatment processes, Activated sludge, oxidation ditches, trickling filter, rotating discs, rotating drums, oxidation ponds. Anaerobic digestion, anaerobic filters, up flow anaerobic sludge blanket reactors. Treatment schemes for wastewaters of dairy, distillery, tannery, sugar, antibiotic industries. 2. Ground water pollution, sources, effects, control, consequences of ground water pollution. 3. Nanomaterials, Sources Nanoparticles in Drinking water, Domestic and industrial wastewater. Nano-technologies used in Water Treatments, Effluent Treatments. 4. The Environment (Protection) Act, 1986, The Water (Prevention and Control of Pollution) Act, 1974. 	11
II	<p>UNIT II: Air Pollution:</p> <ol style="list-style-type: none"> 1. Air pollution, Methods for the measurement of air pollution and its control, Nano pollution in the atmosphere, Sources of Nanomaterials in the Environment i.e. Natural and Anthropogenic. 2. Toxicity due to airborne Nanomaterials, Engineered nanomaterial's in the environment and Health Effects of Nanoparticles through Air, Absorption and pulmonary deposition of Nanoparticles, Elimination of dusts deposited in the lungs, Nanoparticles absorption mechanisms from air, Effects of ultrafine dusts. 3. The Air (Prevention and Control of Pollution) Act, 1981, Clean Air act and Nanotechnology. 	10
III	<p>UNIT III: Application of mesoporous silica to adsorption of toxic ions</p>	10

	<ol style="list-style-type: none"> 1. Introduction: Why mesoporous materials?, environmentally toxic anions, hierarchy of solid structures and adsorption. 2. Functionalization of mesoporous silicas: Decoration of the pore surface with an organic layer, transition metal cation-incorporated adsorption sites, structures of the adsorption sites. 3. Important characteristics for environmental applications: Inhibition of adsorption by other anions, recyclability of used adsorbents. 	
IV	<p>UNIT IV: Inorganic Nanomaterials for environmental applications</p> <ol style="list-style-type: none"> 1. Introduction to environmental applications: Sensing of chemical pollutants (Gas sensors: Introduction), basic sensing mechanism, oxidizing and reducing gases and their chemical reactions, synthesis of ZnO nanorods by solution based approaches, use of nanostructured ZnO as gas sensor. 2. Photocatalytic degradation of organic pollutants in waste water: Introduction, basic mechanism and operating principle of photocatalysis, fabrication of TiO₂ nanotubes by aqueous and non-aqueous electrolytes, photocatalytic activity of TiO₂ nanotubes. 3. Introduction to biosensors: Introduction, application of TiO₂ nanotubes as biosensors. 	11

References:

1. D. Drobne, 'Nanotoxicology for safe and Sustainable Nanotechnology', 58, pp. 471-478, December 2007.
2. Environmental Chemistry, A.K. De, Wiley Eastern Ltd, New Delhi, 2003.
3. Environmental Science, WP Cunningham and BW Saigo., 5th edition, Mc Graw Hill, 1999.
4. A Reference handbook of Nanotoxicology by M.Zafar Nyamadzi, Gunter Oberdörster, Eva Oberdorster and Jan Oberdorster, Environmental Health Perspectives, Volume 113 Number 7 , July 2005.
5. Wastewater Engineering – Treatment, Disposal and Reuse, Metcalf and Eddy, Inc., Tata Mc Graw Hill, New Delhi, 2004.
6. Environmental chemistry, A.K. De, Wiley Eastern Ltd, New Delhi, 2003.
7. Environmental Science, WP Cunningham & BW Saigo., 5th edition, Mc Graw Hill, 1999.
8. Nanotechnology: Environmental Law, Policy, and Business Considerations Edited by Lynn L. Bergeson, American Bar Association, Section Of Environment, Energy and Resource, ISBN-13:978-160442-582-6.

9. Nanotechnology 101 edited by John F. Mongillo Greenwood press, 88-post road west, west port CT 06881 An Imprint of greenwood publishing group, Inc. Printed in USA ISBN 13:978-0-313-33880-9 Published in 2007 ISSN: 1931-3950.
10. U.S. Environmental Protection Agency Nanotechnology White Paper.
11. Environmental applications of nanomaterials: synthesis, sorbents and sensors, 2nd edition, Glen E Fryxell, Guozhonga Cao, Imperial College Press.

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Paper No: SNST-514P

Total Marks: 50

B. Sc. - III, Semester- V

Title of the Paper: Laboratory-course IV
(Science at Nanoscale and Environment Nanoscience)

Sr. No.	Credit 2
1.	Synthesis of TiO ₂ nanotubes by electrochemical anodization
2.	Synthesis of silver nanoparticles by chemical method
3.	Synthesis of silver nanoparticles by using biological method
4.	Synthesis of silver nanowires by self seeding polyol method
5.	Synthesis of ZnO nanorods by hydrothermal method
6.	Synthesis of CdSe quantum dots by hot injection method
7.	Synthesis of Graphene oxide by modified Hummers method
8.	Synthesis of Polyaniline nanofibers by CBD method
9.	Synthesis of nanofibers by electrospinning method
10.	Electrodeposition of MnO ₂
11.	Preparation of AAO nanotemplate
12.	Synthesis of Fe ₂ O ₃ by sol-gel method
13.	Transparent conducting oxides by spray pyrolysis method
14.	CNT by CVD
15.	Preparation of superhydrophobic nanocoatings by sol-gel method
16.	Environmental Sampling methods and analytical preparations
17.	Air pollution monitoring and analysis
18.	Determination of total alkalinity and acidity of a water sample.
19.	Chemical Oxygen Demand, Dissolved Oxygen and Biological Oxygen Demand
20.	Total Hardness, Sulphates , Nitrates and Chlorides
21.	Physical Properties of Minerals, ore and Rocks
22.	Optical properties of Minerals and Study of crystal systems
23.	Photogrammetry, Interpretation of Aerial Photographs / Digital Image Processing
24.	Data capturing through GPS and Study of GIS softwares

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Paper No: SNST-506T

B. Sc. - III, Semester- V

Title of the Paper: Scientific and Technical Writing-I

Topic Number	Non Credit Course	Lectures
1	Types of Writing: Scientific articles, research papers and proposals	10
2	Composition: Title, paragraph writing, Introduction, Writing main body, figures and tables, referencing, plagiarism, Abstracts, summary writing	
3	Style: Objectivity, clarity, formality, hedging, signposting	
4	Assignment-I: Present any paper from Nature Nanotechnology or Nature Material	

References:

1. Practical handbook for scientific and technical writers, Z. Svobodova et al. L, Da Vinci Program, European Commission
2. The fine art of technical writing by C. R. Perry, Createspace publisher.

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Paper No: SNST-601T

Total Marks: 100
(80+20)

B. Sc. - III, Semester- VI

Title of the Paper: Classical and Quantum Mechanics

Topic Number	Credits: 3	Lectures 45
1	UNIT I: Langrangian Formulation- Constraints, degree of freedom, generalized co-ordinates, principle of virtual work, D'Alembert's principle, Langrange's equation from D'Alembert's principle. Applications of Langrange's equation to (i) A particle in space (Cartesian co-ordinates) (ii) Atwood's machine.	(13)
2	UNIT II: A)Techniques of calculus of variation: Hamilton's principle, deduction of Hamilton's principle from D'Alembert's principle, deduction of Langrange's equation from Hamilton's principle. Applications – (1) Shortest distance between two points in a plane. (2) Brachistochrone problem. (B)Coupled Oscillation: Frequencies of coupled oscillatory systems , normal modes and normal co-ordinates, energy of coupled oscillation,energy transfer in oscillatory system.	(10)
3	UNIT III: Operators in Quantum Mechanics: Definition of operators, Linear momentum operator (p), kinetic energy operator (T), Hamiltonian operator (H), parity operator (π) and angular momentum operature (L) in Cartesian co-ordinates, commutators, commutator brackets involving position, linear momentum and angular momentum operators (raising and lowering) operators L_+ and L_- , Eigen values of L^2 and L_z and degeneracy of states.	(12)
4	UNIT IV: Hydrogen atom Schrodinger's equation for hydrogen atom ,separation of radial and angular parts, solution of radial Schrodinger's equation to obtain energy value , Significance of quantum numbers n, l m_l and m_s .	(10)

References:

1. Mathematical physics : H. K. DAS
2. Mathematical physics : B.S. RAJPUT
3. Solid state physics: S.O. PILLAI
4. Quantum mechanics: LOKNATHAN
5. Statistical mechanics: GUPTA KUMAR
6. Statistical mechanics: F.REIF

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Paper No: SNST-611P

Total Marks: 50

B. Sc. - III, Semester- VI

Title of the Paper: Laboratory-course - I (PS)

Sr. No.	Credit 2
1.	Surface tension by Fergusson`s modified method
2.	Y-by Cornu`s method
3.	Stefan`s Fourth power law
4.	Cardinal points by Newtons`s method
5.	Diffraction due to cylindrical obstacle
6.	Spherical aberration
7.	Self inductance by Rayleigh method
8.	High resistance by leakage
9.	Absolute capacity of a condenser (Worsnop and Flint)
10.	Polar graph using photo cell/ photo voltaic cell
11.	Hystersis curve by CRO.
12.	Hall effect

Note: Study tour may be arranged for B. Sc. III class students.

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Paper No: SNST-602T

Total Marks: 100
(80+20)

B. Sc. - III, Semester- VI

Title of the Paper: Medicinal Chemistry and Radioactivity

Topic Number	Credits: 3	Lectures 45
1	<p>Unit 1: Medicinal and Pharmaceutical Chemistry Introduction to Indian pharamacopia and British pharamacopia Action of drugs on various systems. Classification of drugs based on activity. Synthesis and uses of the following drugs:</p> <ol style="list-style-type: none"> 1. Antimalerials –Paludrin 2. Antituberculars- Isoniazidd and Ethambutol 3. C.N.S drugs- Phenobarbitone 4. Antidiabetics-Tolbutamide 5. Antiinflammatory drugs-ibuprofen 6. Antibiotic-Chloromycetin 	(15)
2	<p>Unit 2: Agrochemicals 1]Agrochemicals, & their Classification A] General idea of Pesticides. B] Synthesis & uses of the following 1] Endosulphan 2] Carbaryl 3]Dimethoate 4]Indol acetic acid (IAA) C]Introduction & general survey of Insect repellent & Insect Pheromones D] Introduction of Plant Growth regulators. 2] Concept of Fertilizer: General Principle of plant nutrients.</p>	(11)
3	<p>Unit 3: Electrochemistry Electromotive force (convention reduction potentials to be used) Introduction 1] Thermodynamics of electrode potentials, equation for Electrode & cell potentials in terms of activities. 2] Types of Electrodes: Description in terms of construction Representation half of cell reaction and equation for 3] Reversible and Irreversible cells 4] Equilibrium constant from cell emf, Determination of the Thermodynamic equilibrium</p>	(7)
4	<p>Unit 4: Acids & Bases and Nuclear & Radiochemistry A) Hard and Soft Acids and Bases Theory: Classification on HSAB theory. B) B) Nuclear & Radiochemistry Radioactivity, Nuclear decay & stability of atomic nucleus. Nuclear</p>	(12)

	reactions & Chemical reactions Classification of Nuclear reaction. Q-value of Nuclear reactions. Radiation Chemistry interaction of radiation with matter. Principle of tracer technique & applications of radioactivity.	
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References

1. Fundamentals of concepts of Inorganic Chemistry –Volume I & II: Ashim K. Das.
2. Elements of Nuclear Chemistry: R.Gopalan
3. Introductory – Nuclear Physics: R.K.Puri & V.K. Babber
4. Essentials of Nuclear Chemistry –A.J.Arnikaar.
5. Nuclear Chemistry - B.K. Sharma.
6. Nuclear Chemistry-B.G.Harvey
7. Physical Chemistry-Atkins
8. N.N.Melnikow: Chemistry of Pesticides, Springer
9. M.B.Grean, G.S. Hartely West: Chemicals for Crop Protection & Pest Management, Pergamon
10. R.Cremlyn: Pesticides
11. K.H.Buchel: Chemistry of Pesticides
12. H.B.Scher: Advances in Pesticides formulation Technology (ACS)
13. Wilson & Gisvold: Textbook of Organic Medical and Pharmaceutical Chemistry
14. O.D.Tyagi: Synthetic Drugs.
15. R.B.Silverman: The Organic Chemistry of Drug design & drug action: Academic Press.
16. Lednicer & Mitscher: The Organic Chemistry of Drug Synthesis (I.W) (Volume6)
17. W.O.Foye: Principle of Medicinal Chemistry

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Paper No: SNST-612P

Total Marks: 50

B. Sc. - III, Semester- VI

Title of the Paper: Laboratory-course - II (CS)

Sr. No.	(Credit 2)
1.	Colorimetric estimation of Fe and Cu
2.	pH metric titration
3.	Determination of energy of activation of organic reaction
4.	Conductometric titration of weak acid V/s weak bases
5.	To determine the equivalent conductivity of a weak electrolyte at different concentrations, and hence the dissociation constant of electrolyte.
6.	To determine the relative strength of two acids by conductance measurements.
7.	To determine solubility of a sparingly soluble salt in water by conductance measurements.
8.	To determine the composition of a mixture of acetic acid & hydrochloric acid by Conductometric titration.
9.	Verification of Ostwalds dilution law & determination of the dissociation constant of a weak monobasic acid conductometrically.
10.	To determine the solubility product of silver chloride using chemical cell.
11.	To find the stability constant of the silver ammonia complex.
12.	Estimation of Glucose.
13.	Determination of acid Value of the given oil.
14.	Estimation of available Nitrogen from urea.
15.	Preparation of P-Iodonitrobenzene from p-Nitroaniline.
16.	Preparation of p-Nitroacetanilide from Acetanilide
17.	Preparation Benzene azo-B-naphthol.

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Paper No: SNST-603T

Total Marks: 100
(80+20)

B. Sc. - III, Semester- VI

Title of the Paper: Molecular biology and genetic engineering

No	Topic	Lectures (45)
1	UNIT I Nucleic acid: History, nucleic acid as genetic material. Nucleic Acid Structure and Chemistry, nitrogenous bases, purine and pyrimidine bases Sugar-Phosphate Chain Conformations, Base Pairing, Base Stacking, Hydrophobic and Ionic Interactions. Different forms of DNA, A form, B, form, Z form. Other Functions of Nucleotides (4L). DNA Replication: An Overview, Replication Forks, Role of DNA Gyrase, Semidiscontinuous Replication, RNA Primers. Enzymes of Replication, DNA Polymerase I, DNA Polymerase III Unwinding DNA: Helicases and Single-Strand Binding Protein, DNA Ligase, Primase, Topoisomerase, Prokaryotic Replication: <i>Escherichia coli</i> , Fidelity of Replication Eukaryotic Replication: The Cell Cycle, Eukaryotic Replication Mechanisms, Reverse Transcriptase, telomeres and Telomerase. Repair of DNA, Direct Reversal of Damage, Excision Repair, Mismatch Repair, The SOS Response, Double-Strand Break Repair Identification of Carcinogens. (8L)	12
2	UNIT II Transcription: The Role of RNA in Protein Synthesis, Enzyme Induction, Messenger RNA. RNA Polymerase, Template Binding, Chain Initiation, Chain Elongation, Chain Termination Eukaryotic RNA Polymerases Post-Transcriptional Processing: Messenger RNA Processing, Ribosomal RNA Processing, Transfer RNA Processing Control of Transcription in Prokaryotes: Promoters, concept of operon, lac operon, <i>araBAD</i> Operon An Example of Gene Activation, Sequence-Specific Protein-DNA Interactions, Riboswitches. (8L)	8
3	UNIT III Translation: The Genetic, Nature of the Code, Codons. Transfer RNA and Its Aminoacylation, Primary and Secondary Structures of tRNA, Tertiary Structure of tRNA Aminoacyl-tRNA Synthetases, Codon-Anticodon Interactions, Nonsense Suppression Ribosomes and Polypeptide Synthesis: Ribosome Structure, Polypeptide Synthesis: An Overview, Chain Initiation Chain Elongation, Translational Accuracy, Chain Termination, Protein Synthesis Inhibitors:	10

	<p>Antibiotics</p> <p>Control of Eukaryotic Translation: A. Regulation of eIF2, Regulation of eIF4E, mRNA Masking and Cytoplasmic Polyadenylation, Antisense Oligonucleotides.</p> <p>Post-Translational Modification: Proteolytic Cleavage, Covalent Modification, Protein Splicing: Inteins and Exteins (10)</p>	
4	<p style="text-align: center;">UNIT IV</p> <p>Nucleic Acids and Allied Techniques</p> <p>Isolation of DNA from plants, animals and microbial sources, Isolation of plasmid DNA, Agarose gel electrophoresis</p> <p>PCR: Introduction, Principle, Working, Uses</p> <p>Blotting techniques: Southern and Western Blotting</p> <p>DNA sequencing: Sanger's method, Maxam-Gilbert method (5L).</p> <p>Recombinant DNA Technology</p> <p>Enzymes involved: Taq polymerase, Restriction endonucleases, Exonucleases, End modification enzymes, Ligases</p> <p>Vectors: Properties of a good vectors, Plasmids, Phages, Cosmids, Artificial vectors, Animal Virus derived vectors</p> <p>Transformation: Chemical and physical methods, Role of Agrobacteria (Ti and Ri plasmids) Construction of cDNA libraries, Cloning libraries</p> <p>Applications of Recombinant DNA Technology: Transgenics and their applications in Medicine, Agriculture and Veterinary science (10)</p>	15

References:

1. Molecular Biology of the Cell by Bruce Alberts
2. Molecular biology of the Gene by Watson
3. The Cell, a molecular approach by Cooper and Hausman
4. The Cell Biology by Gerald Karp
5. Sambrook J, Fritsch E. F. and Maniatis (1989) Molecular cloning, vol. I, II, III, 2nd edition, Cold spring harbor laboratory press, New York.
6. DNA Cloning : A practical approach D.M. Glover and D.B. Hames, RL Press, Oxford, 1995
7. Methods in Enzymology Guide to Molecular Cloning Techniques, Vol. 152 S.L. Berger and A. R. Kimmel, Academic Press Inc, San Diego, 1996
8. Methods in Enzymology Gene Expression Technology, Vol. 185 D.V. Goedel, Academic Press Inc., San Diego, 1990
9. DNA Science: A First Course in Recombinant Technology, D.A. Mickloss and G.A. Freyer, Cold Spring Harbor Laboratory Press, New York, 1990
10. Molecular Biotechnology, 2nd Ed. S. B. Primrose, Blackwell Scientific publishers, Oxford, 1994
11. Route Maps in Gene Technology, M.R. Walker, and R. Rapley, Blakwell Science, Oxford, 1997
12. Genetic Engineering : An Introduction to Gene Analysis and Exploitation in Eukaryotes, S. M. Kingsman, Blackwell Scientific Publications, Oxford, 1998

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(5 year integrated multidisciplinary 10 semester course)

Paper No: SNST-613P

Total Marks: 50

B. Sc. - III, Semester- VI

Title of the Paper: Laboratory-course - III (LS)

No	Credit 2
1	Isolation of DNA from bacterial, plant and fungal sources
2	Quantitative estimation of DNA (spectrophotometer).
3	Separation of DNA by Agarose Gel Electrophoresis
4	Demonstration of PCR
5	Amplification of DNA by PCR
6	Preparation of competent cells
7	Plasmid Transformation in competent cells.
8	Isolation of plamids by miniprep method
9	Isolation of plamids by midiprep method.
10	Isolation of RNA
11	Isolation of proteins
12	Separation of proteins by SDS PAGE
13	Separation of proteins by Native PAGE
14	Demonstration of DNA sequencer

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Paper No: SNST-604T

Total Marks: 100
(80+20)

B. Sc. - III, Semester- VI

Title of the Paper: Properties of Nanomaterials

Unit No.	Credits 3	Lectures (45)
I	<p>UNIT I: Physical Properties of Nanomaterials Melting point and phase transition processes at nanoscale materials, Size-induced metal-insulator-transition (SIMIT), Mechanical Characterization – modulus and load carrying capability of nano region/ compression micro hardness – fatigue – abrasion and wear resistance – superplasticity –nanoindentation. Nanotribology – Surfaces and interfaces in nanostructures. Grain boundaries in Nanocrystalline materials. Thermodynamics of Nanomaterials. SURFACE PROPERTIES: Surface energy – chemical potential as a function of surface curvature-Electrostatic stabilization- surface charge density-electric potential at the proximity of solid surface-Van der Waals attraction potential, Introduction, Mechanical properties, Melting point and lattice constants, Electrical conductivity (Surface scattering, Change of electronic structure, quantum transport).</p>	12
II	<p>UNIT II: Electronic Properties of Nanomaterials Electronic Structure of Nanoparticles, Zero dimensional, one-dimensional and two dimensional nanostructures- clusters of metals and semiconductors, nanowires. Electronic transport in 1,2 and 3 dimensions- Quantum confinement - energy subbands - density of states- Effective mass - Drude conduction - mean free path in 3D - ballistic conduction - Coulomb blockade - phase coherence length - quantized conductance-diffusive transport. Quantization of resistance - Single electron transistors – Esaki and resonant tunneling diodes Fundamentals of electrical conductivity in nanotubes and nanorods, carbon nanotubes. Photoconductivity of nanorods, electrical conductivity of nanocomposites.</p>	12
III	<p>UNIT III: Optical properties of Nanomaterials Absorption: direct and indirect band gap transitions, Emission: photoluminescence and Raman scattering, Emission: chemiluminescence and electroluminescence, shape dependent optical properties, doped semiconductors: absorption and luminescence, optical properties of metal oxide nanomaterials: optical absorption and optical emission, strong absorption and lack of emission, surface Plasmon resonance, Applications of optical properties of</p>	11

	nanomaterials: luminescence based detection, surface Plasmon resonance detection, PV solar cells, photoelectrochemical cells, light emitting diodes.	
IV	UNIT IV: Magnetic properties of Nanomaterials Origin of magnetism in materials, Classification into Dia-, Para- and Ferro-magnetic materials, Hysteresis in ferromagnetic materials, domains, soft and hard magnetic materials, Coercivity vs particle size, Single domain particles, superparamagnetism, Exchange coupling in magnetic multilayers (RKKY Coupling), Giant Magnetoresistance (GMR), Origin of GMR, Oscillatory exchange coupling, Exchange biasing, spin valve, perpendicular magnetic recording.	10

References:

1. Nanotechnology: Technology Revolution of 21st Century by Rakesh Rathi, published by S. Chand.
2. Introduction to Nanoscience, by Stuart Lindsay.
3. Introduction to Nanomaterials and nanotechnology by Vladimir Pokropivny, Rynno Lohmus, Irina Hussainova, Alex Pokropivny and Sergey Vlassov
4. Nanomaterials by A.K. Bandyopadhyay; New Age International Publishers.
5. Nanotechnology by Mark Ratner and Daniel Ratner, Pearson Education.
6. Nano Essentials- T.Pradeep/TMH
7. Bharat Bhusan, "Springer Handbook of Nanotechnology", springer, Newyork, 2007
8. Hari Singh Nalwa, "Encyclopedia of Nanotechnology", USA 2011
9. James A. Schwarz, Cristian I. Contescu, Karol Putyera, "Dekker encyclopedia of nanoscience and nanotechnology" CRC Press, 2004.
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15. Paras. N. Prasad, Nanophotonics. New Jersey, USA: John Wiley & Sons Inc., 2004.
16. Dr. Parag Diwan And Ashish Bharadwaj, Nano Electronics, Pentagon press, 2006
17. Optical properties and spectroscopy of nanomaterials by Jin Zhong Zhang, World Scientific Publisher
18. Nanostructures & Nanomaterials: Synthesis, Properties & Applications, Guozhong Cao
19. Modern magnetic materials, Robert C. O'Handley
20. Spin Electronics, M. Ziese, M. Thornton (Eds.)

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Paper No: SNST-605T

Total Marks: 100
(80+20)

B. Sc. - III, Semester- VI

Title of the Paper: Nanobiology and Nanomedicine

Topic No.	Credits: 3	Lectures 45
1.	<p>Unit- I: Introduction to Nanobiology and Nanomedicine Nanobiology – Introduction. Biological Nanostructures and natural biological assemblies at nanoscale: Bacterial S layers, phospholipid membranes, viruses, Nucleic acids, Oligosaccharides, polysaccharides, biological polymers, Proteins. Biological nanomotors, protein assemblies: Kinesin and dynein, cilia. Bacterial flagella: structure and function; nanomotor. Ion channels: nanopores of high specificity. Bioinspired nanomaterials: DNA and peptide based. Interaction between biomolecules and nanoparticle surfaces.</p>	10
2.	<p>Unit- II: Synthesis of Nanomaterials and nanoformulations Types of nanomaterials: Inorganic metal nanoparticles, carbon dots, nanotubes, nanowires, fullerenes, colloids, clusters, powders, rods, thin films etc. Top down and bottom up approach for synthesis of nanomaterials. Synthesis of nanomaterials using physical, chemical and Biological methods. Characterization techniques for nanomaterials. Nanobioassemblies: Different types of inorganic materials used for the synthesis of hybrid nano-bio Assemblies. Concept of drug and formulation/dosage form. Physicochemical and biological properties of drugs. Routes of dosage form administration. Formulation of nanocrystals, nanoemulsions, polymeric micelles. Introduction to liposome and solid lipid nanoparticles (SLN). Fate of nanoformulations in body.</p>	12
3.	<p>Unit- III: Nanodiagnostics Nanotechnology in molecular imaging. Materials for use in diagnostic and therapeutic applications. Diagnosis using nanomaterials, Nanoparticles for bioanalytical applications, Nanoparticles for MRI, X Ray, ultrasonography, gamma ray imaging. Nanoparticles and quantum dots as molecular labels. Diagnostic Nanochips, lab on chips (microfluidic technology) and microelectromechanical systems (MEMS). Biosensor and nanobiosensor basic concepts, characterization, perception, Defferent types of nanobiosensors; Nanobiosensors for medical diagnostics. Nanoprobes for analytical applications.</p>	13
4.	<p>Unit- IV: Nanomedicine</p>	10

	<p>Applications of nano in biology. Concept of disease, Cause and molecular/cellular progression of key diseases including infectious, inherited diseases, immunological diseases and cancer. Approach to developing nanomedicines. Various kinds of nanosystems in use. Nanodrug administration nano-devices for drug delivery and theranostics. Introduction to the potentials, applications and challenges of nanomedicine. Nanomedicine and tissue engineering, nanobiomachines and nanorobots.</p>	
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References:

1. Charles P. Poole Jr. and Franks. J. Qwens (2003) Introduction to Nanotechnology. John Wiley and Sons.
2. Ehud Gazit (2007) Plenty of Room for Biology at the Bottom: An Introduction to Bionanotechnology. Imperial college Press
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Review articles:

1. Kroll A. (2012) Nanobiology-convergence of disciplines inspires great applications. Cellular and Molecular Life Sciences 69:335-336.
2. Armentano I., Dottori M., Fortunati E., Mattioli S., Kenny JM. (2010) Biodegradable polymer matrix nanocomposites for tissue engineering: A review. Polymer Degradation and Stability 95: 2126-2146.
3. Liu H., Webster TJ. (2007) Nanomedicine for implants: A review of studies and necessary experimental tools. Biomaterials 28: 354–369.
4. Jain RK and Stylianopoulos T. (2010) Delivering nanomedicine to solid tumors. Nature Reviews Clinical Oncology 7: 653-664.
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Advanced study material and updates in the field should be checked using Internet resources

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Paper No: SNST-614P

Total Marks: 50

B. Sc. - III, Semester- VI

Title of the Paper: Laboratory-course - IV
(Properties of Nanomaterials and Nanobiology- Nanomedicine)

Sr. No.	Credit 2
1.	Structural properties of nanomaterials by XRD
2.	Analysis of surface morphology by AFM
3.	Morphological study by SEM
4.	Structural properties by STM
5.	Quantum size effect in nanomaterials
6.	Use of FT-IR for functional group identification (in CNT, graphene etc.)
7.	Photoluminescence study of nanomaterials
8.	Hall effect measurement
9.	Electrical resistivity of Nanorods and nanotubes
10.	Hysteresis loop tracer
11.	Photocatalytic degradation of dyes
12.	Mechanical properties of nanomaterials
13.	Magnetic experiment (Related to GMR)
14.	Collection of data on various editions of IP, gross additions and deletions per edition and sources of some commonly available drugs.
15.	Determination of saturation and Biopharmaceutics solubility of some drugs.
16.	Determination of partition coefficient of benzoic acid between water and benzene.
17.	Preparation and evaluation of Paracetamol syrup.
18.	Studies on dissolution rate of some tablet formulations.
19.	Demonstration of drug diffusion in agar plate.
20.	Drug diffusion through polymeric membrane using diffusion cell.
21.	Determination of degree of hydrolysis of given ester.
22.	Synthesis of metal nanoparticles using synthetic/green route
23.	Studies on excretion of drug in urine.
24.	Preparation of nanoformulation and its evaluation.
25.	Demonstration of design of nanodiagnosics device.

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Paper No: SNST-606T

B. Sc. - III, Semester- VI

Title of the Paper: Scientific and Technical Writing-II

Topic Number	Non Credit Course	Lectures 10
1	Language functions: Agreeing disagreeing, classifying, comparing, contrasting, defining, emphasizing, generalizing, paraphrasing and quoting	
2	Grammar: Adverbs, articles, numbers, passive voice, punctuation, verb tenses, word order	
3	Words: Abbreviations, prefixes and suffixes	
4	Assignment-II: Writing of research article	

References:

1. Practical handbook for scientific and technical writers, Z. Svobodova et al. L, Da Vinci Program, European Commission
2. The fine art of technical writing by C. R. Perry, Createspace publisher.