Estd. 1962
"A++" Accredited by NAAC(2021)
With CGPA 3.52

SHIVAJI UNIVERSITY, KOLHAPUR - 416004,
MAHARASHTRA
PHONE : EPABX – 2609000,
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शिवाजी विद्यापीठ, कोल्हापूर - ४१६००४,महाराष्ट्र
दूरध्वनी - ईपीएबीएक्स - २६०९०००, अभ्यासमंडळे विभाग दुरध्वनी विभाग २३१–२६०९०९३/९४

SU/BOS/Science/ 41 **Date:** 17 OCT 2022

To,
The Principal,
All Affiliated Concerned Science Colleges/Institutions
Shivaji University, Kolhapur.

Subject :- Regarding syllabi of B. Sc.-M. Sc. in Nanoscience and Technology (5 Years Integrated) Part- I (NEP-2020) degree programme under the Faculty of Science and Technology as per National Education Policy 2020 .

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the syllabi and Nature of question paper of **B. Sc.-M. Sc. in Nanoscience and Technology (5 Years Integrated)** Part- I under the Faculty of Science and Technology **as per National Education Policy 2020 .**

Sr.No.	Faculty of Science and Technology	Programme/ Course
1	**Physics**	**B. Sc. -M. Sc. in Nanoscience and Technology (5 Years Integrated) Part- I**

This syllabi and nature of question paper shall be implemented from the Academic Year **2022-2023** onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in (students Online Syllabus)

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,

Dy Registrar

Copy to:

1	The Dean, Faculty of Science & Technology	7	Appointment Section
2	Director, Board of Examinations and Evaluation	8	P.G.Seminar Section
3	The Chairman, Respective Board of Studies	9	Computer Centre (I.T.)
4	B.Sc. Exam	10	Affiliation Section (U.G.)
5	Eligibility Section	11	Affiliation Section (P.G.)
6	O.E. I Section	12	P.G.Admission Section

Shivaji University, Kolhapur

Accredited by NAAC with 'A++' Grade

NATIONAL EDUCATION POLICY (NEP-2020)
Syllabus for
B. Sc.-M. Sc. in Nanoscience and Technology,
(5 Years Integrated) Program,
Part-I

Syllabus to be implemented from the academic year 2022-23 (August, 2022) onwards

Implementation: The implemented gradually as mentioned below –

B.Sc.-M. Sc. in Nanoscience and Technology (5-Years Integrated) Program

a) B.Sc.-M. Sc. (5 Years Integrated) Part – I from Academic year 2022-23
b) B.Sc. -M. Sc. (5 Years Integrated) Part – II from Academic year 2023-24
c) B.Sc. -M. Sc. (5 Years Integrated) Part – III from Academic year 2024-25
d) B.Sc. -M. Sc. (5 Years Integrated) Part – IV from Academic year 2025-26
e) B.Sc. -M. Sc. (5 Years Integrated) Part – V from Academic year 2026-27

Structure for BSc- M.Sc. (Nanoscience and Technology) (5 Years Integrated)

<table>
<tr><th>SEM</th><th>Discipline Specific Core Courses (DSC)</th><th>Discipline Specific Elective Courses (DSE)/ Open Elective (OE)</th><th>Ability Enhancement Compulsory Courses (AECC)/ Languages</th><th>Skill Enhancement Courses (SEC) (Multidisciplinary)</th><th>Total Credits</th></tr>
<tr><td rowspan="5">I</td><td>DSC-1A-Phy. (4+2)</td><td rowspan="5">DSE-1A-Maths (2)
/
DSE-2A- Life sci. (2)

(Any one)</td><td rowspan="5">AECC-1 (CGPA) English (2)</td><td rowspan="5">SEC-1 Multidisciplinary / NCC / NSS / Sports / Cultural / SSC (2)</td><td rowspan="5">34</td></tr>
<tr><td>DSC-2A-Chem. (4+2)</td></tr>
<tr><td>DSC-3A-Biotech. (4+2)</td></tr>
<tr><td>DSC-4A-Maths. (4+1*)</td></tr>
<tr><td>DSC-5A- Elect. (4+1*)</td></tr>
<tr><td rowspan="5">II</td><td>DSC-1B-Phy. (4+2)</td><td rowspan="5">DSE-1B-Maths (2)
/
DSE-2B- Life sci. (2)

(Any one)</td><td rowspan="5">AECC-2 (CGPA) English (2)</td><td rowspan="5">SEC-2 Multidisciplinary/ NCC / NSS / Sports / Cultural / SSC (2)</td><td rowspan="5">34</td></tr>
<tr><td>DSC-2B-Chem. (4+2)</td></tr>
<tr><td>DSC-3B-Biotech. (4+2)</td></tr>
<tr><td>DSC-4B-Maths. (4+1#)</td></tr>
<tr><td>DSC-5B- Elect. (4+1#)</td></tr>
<tr><td colspan="6">Practical examination will be conducted annually.
(*, #: - Combined Practical Exam will be conducted.)</td></tr>
<tr><td></td><td colspan="5">Option 1: Exit with Certificate Course in Science (with the completion of course equal to minimum of 68 credits)</td></tr>
</table>

SHIVAJI UNIVERSITY, KOLHAPUR
School of Nanoscience and Technology
B. Sc. –M.Sc. in Nanoscience and Technology,
(5 Years Integrated) Programme, Part – I, Semester- I,

Physics-Paper- I

DSC- 1A-Phys.: MECHANICS

(Theory: 60 Lectures)

Course Learning Outcomes:

After going through the course, the student should be able to

- Learn the vectors, vector calculus, ordinary differential equations. These basic mathematical structures are essential in solving problems in various branches of Physics.
- Understand laws of motion and their application to various dynamical situations, notion of inertial frames and concept of Galilean invariance. He / she will learn the concept of conservation of energy, momentum, angular momentum and apply them to basic problems.
- Understand the analogy between translational and rotational dynamics, and application of both motions simultaneously in analyzing rolling with slipping.
- Acquire basic knowledge of nanophysics like hydrophobic and superhydrophobic nanostructured surfaces, motion at nanoscale, frequency and elasticity of nanoscale matters.

Unit No.	Topics	Total Lectures
Unit I	**1. Vectors (4 Lectures)** Vector algebra, Scalar and Vector products, Derivatives of a vector with respect to a parameter (velocity and acceleration), Problems. **2. Ordinary Differential Equations: (6 Lectures)** Differential equation; ordinary and partial differential equations, 1st order homogeneous differential equations, 2nd order homogeneous differential equations with constant coefficients, Problems. **3. Laws of Motion: (5 Lectures)** Frames of reference, Newton's Laws of motion (with proof), Problems.	**15**
Unit II	**1. Momentum and Energy: (9 Lectures)** Conservation of linear and angular momentum, work and energy theorem, conservation of energy (Single particle), Dynamics of a system of particles (linear momentum, angular momentum and energy), Center of mass, Motion of rockets (qualitative treatment only), Problems. **2. Rotational Motion: (6 Lectures)**	**15**

	Angular velocity, angular momentum and Torque, Kinetic energy of rotation and moment of Inertia, Moment of inertia of a spherical shell, solid cylinder (only about axis of symmetry), Motion of spherical Shell and solid cylinder rolling down an inclined plane, Problems.	
Unit III	**1. Gravitation: (9 Lectures)** Newton's Law of Gravitation, Motion of a particle in a central force field (motion in a plane, angular momentum is conserved, areal velocity is constant), Kepler's Laws (statement only), Satellite in circular orbit and applications, Geosynchronous orbits, Weightlessness, Basic idea of global positioning system (GPS), Problems. **2. Oscillations: (6 Lectures)** Simple harmonic motion, Differential equation of SHM and its solutions, Kinetic and Potential Energy, Total Energy and their time averages, Damped oscillations, Forced oscillations. Frequency of nanoscale matters, Problems.	**15**
Unit IV	**1. Elasticity: (9 Lectures)** Bending of beam, Bending moment, Cantilever (without considering weight of cantilever), Beam supported at both the ends (without considering weight of beam). Torsional oscillation, Work done in twisting a wire, Twisting couple on a cylinder - Torsional Pendulum-Determination of Rigidity modulus and moment of inertia, Determination of Y, η and σ by Searles method. Elasticity of nanoscale matters, Problems. **2. Surface Tension: (6 Lectures)** Surface tension (definition), Angle of contact and wettability, Relation between surface tension, excess of pressure and radius of curvature, Experimental determination of surface tension by Jaeger's method, Applications of surface tension. Hydrophobic and superhydrophobic nanostructured surface, Problems.	**15**

Note: *Students are not familiar with vector calculus. Hence all examples involve differentiation either in one dimension or with respect to the radial coordinate.*

Reference Books:

1. University Physics. FW Sears, MW Zemansky and HD Young13/e, 1986. Addison-Wesley

2. Mechanics Berkeley Physics course,v.1: Charles Kittel, et. Al. 2007, Tata McGraw-Hill

3. Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley eastern Ltd, New Delhi

4. Engineering Mechanics, Basudeb Bhattacharya, 2nd edn., 2015, Oxford University Press
5. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole
6. Physics – S.G. Starling and Woodal Longmams and Green Co. Ltd.
7. Elements of properties of matter – D.S. Mathur, Shamlal Charitable trust New Delhi
8. A text book of properties of matter–N.S. Khare and S. Kumar. Atmaram and sons New Delhi
9. Concepts of Physics –Vol.1 H.C. Verma -Bharati Bhavan Publishers
10. The big ideas of Nanoscale Science & Engineering- S. Stevens and M. Sutherland, CRC Press

B. Sc. –M.Sc. in Nanoscience and Technology,
(5 Years Integrated) Programme, Part – I, Semester- I,

Physics Laboratory – I

DSC- 1A-Phys.-LAB: MECHANICS

(Theory: 60 Lectures)

Course Learning outcomes:

After going through the course, the student should be able to,

- Extend the skills of handling various apparatus like micrometer screw gauge, vernier calliper and travelling microscope.
- Extend the skills and practical use of different types of pendulum.
- Aware of emerging needs in nanophysics and incorporate them into their practical ideas.

Sr. No.	Name of experiment
1	Measurements of length (or diameter) using Vernier caliper, Screw gauge and Travelling microscope.
2	To determine the Moment of Inertia of a Flywheel
3	To determine the Moment of inertia of a disc using auxiliary annular ring.
4	Young's modulus of material of Bar by vibration
5	Modulus of rigidity of material of wire by torsional oscillations
6	Y/η of Wire by Searle's method
7	To determine g by Bar Pendulum
8	To determine g by Kater's Pendulum
9	Poission ratio for rubber using rubber tube.
10	To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g.

Reference Books:

1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.

2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

4. College Practical Physics – Khanna and Gulati (S. Chand and Co. Ltd, Delhi)

5. Practical Physics – Gupta and Kumar (Pragati Prakation Meerat)
6. Advanced Level Practical Physics – J.M. Nelcon, J.M. Ogloom (EIBS).
7. A Text Book of Practical Physics - Shrinivasan and Balasubramanyam.
8. Engineering Practical Physics- S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.

B. Sc. –M.Sc. in Nanoscience and Technology,

(5 Years Integrated) Programme, Part – I, Semester- I,

Chemistry-Paper- I

DSC- 2A-Chem.: ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS

Theory: 60 Lectures

Unit No.	Topics	Total Lectures
Unit I	**Atomic Structure:** **(A)** ***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. (07) **(B)** ***Quantum mechanics:*** Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3pand 3dorbitals (Only graphical representation). (07)	**14**
Unit II	**Chemical Bonding and Molecular Structure:** ***(A) Ionic Bonding***: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. (04) ***(B) Covalent bonding***: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. (04)	**16**

	(C) MO Approach: Rules for the LCAO method, bonding and antibonding. MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods(including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+. (08)	
Unit III	**Fundamentals of Organic Chemistry:** ***(A) Physical Effects, Electronic Displacements***: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. (07). ***(B) Reactive Intermediates***: Carbocations, Carbanions and Carbon free radicals. (07). ***(C) Stereochemistry:*** Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. (04).	**18**
Unit IV	**Aliphatic Hydrocarbons:** ***(A) Alkanes:*** (Upto 5 Carbons). *Preparation*: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions*: Free radical Substitution: Halogenation. (04) ***(B) Alkenes:*** (Upto 5 Carbons) *Preparation*: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis-alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions*: cis addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti- Markownikoff's addition). (04) ***(C) Alkynes:*** (Upto 5 Carbons) *Preparation*: Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. *Reactions*:	**12**

	formation of metal acetylides, addition of bromine and alkaline $KMnO_4$ and oxidation with hot alk. $KMnO_4$. (04)	

Reference Books:

1. Lee, J.D.Concise Inorganic ChemistryELBS, 1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L.Basic Inorganic Chemistry, 3rd Ed., Wiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry, John Wiley & Sons.
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.
5. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
6. McMurry, J. E. Fundamentals of Organic Chemistry, 7thEd. Cengage Learning India Edition, 2013.
7. Sykes, P.A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
8. Eliel, E.L. Stereochemistry of Carbon Compounds, Tata McGraw Hill education, 2000.
9. Finar, I. L. Organic Chemistry (Vol. I & II), E.L.B.S.
10. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
11. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
12. Introduction to Nanoscience and Nanotechnology, Gabor L. Hornyak, H.F. Tibbals, Joydeep Dutta, John J. Moore, CRC Press.

B. Sc. –M.Sc. in Nanoscience and Technology,
(5 Years Integrated) Programme, Part – I, Semester- I,

Chemistry Laboratory – 1

DSC- 2A-Chem.-LAB: ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS

(Practical: 60 Lectures)

Section A: Inorganic Chemistry - Volumetric Analysis:

1. To prepare standard 0.1 N KMnO4 solution and to determine the strength of given oxalic acid solution.
2. To determine quantity of Fe (II) ions from the given solutions by titrating it with 0.1 N K_2Cr2O7 solution by using internal indicator
3. To estimate amount of Cu (II) ions by iodometric titration by using Na2S2O3 solution.
4. To standardize supplied EDTA solution by titrating with 0.01 M ZnSO4 solution and to estimate amount of calcium from given solution by using Erio-T as an indicator.
5. Quality control-To determines percentage purity of the given sample of soda ash Na_2CO_3 by titrimetric method.
6. Estimation of amount of Acetic acid from the given vinegar sample by titrimetric method
7. Chromatography : Separation and identification of cations by Paper Chromatographic technique from the following mixtures:

a) $Ni^{2+} + Cu^{2+}$

b) $Ni^{2+} + Co^{2+}$

Section B: Organic Chemistry:

1. Estimation of aniline. (by bromination method)
2. Estimation of acetamide.
3. Estimation of Aspirin.
2. Organic Qualitative Analysis: Detection of physical constant, type, functional group, elements, and Confirmatory test.

Identification of Organic Compounds (at least eight) (four containing at least one extra element- N, S, Cl. Br, I)

a) Acids: Oxalic acid, Benzoic acid, cinnamic acid

b) Phenols: Beta-Naphthol, Resorcinol

c) Base: Aniline, p-Nitroaniline

d) Neutral: Acetone, Acetanilide, Chloroform, m-Dinitrobenzene, Thiourea, Bromobenzene

Reference Books:

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
4. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.

B. Sc. –M.Sc. in Nanoscience and Technology,
(5 Years Integrated) Programme, Part – I, Semester- I,

Biotechnology-Paper- I
DSC- 3A-Biotech.: CELL BIOLOGY

Theory: 60 Lectures

Unit No.	Topics	Total Lectures
Unit I	Cell: Introduction and classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells. Cell Membrane and Permeability: Chemical components of biological membranes, organization, models and dynamic nature. Cell recognition and membrane transport system.	**15**
Unit II	Membrane Vacuolar system, Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion/targeting. Lysosomes: Vacuoles and micro bodies: Structure and functions. Ribosomes: Structures and function including role in protein synthesis. Mitochondria: Structure and function, Genomes, biogenesis. Chloroplasts: Structure and function, genomes, biogenesis. Nucleus: Structure and function, chromosomes and their structure.	**15**
Unit III	Cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments. Cell wall, Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction. Glycocalyx as an extracellular matrix in prokaryotes-presence and advantages. Cell cycle, phases of cell cycle, regulations and cancer. Basics of Stem cells	**15**
Unit IV	Cellular Nanomachines and building blocks of life, Phospholipid membrane: Natural Biological Assembly at the Nano-Scale. Biological Nano-Motors: Kinesin and Dynein. Ion Channels: Nano-Pores of High Specificity. Nucleic Acids: The Genetic Information Media and a template for Nano-technological Applications. Amyloid Fibrils as Self-	**15**

	Assembled Nano-Scale Bio-Assemblies. Role of nanotechnology in cancer research.	

SUGGESTED READING FOR CELL BIOLOGY

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.

2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition Lippincott Williams and Wilkins, Philadelphia.

3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

B. Sc. –M.Sc. in Nanoscience and Technology,
(5 Years Integrated) Programme, Part – I, Semester- I,

Biotechnology Laboratory – 1
DSC-3A-Biotech. - LAB: BIOTECHNOLOGY

(Theory: 60 Lectures)

PRACTICALS

1. Study the effect of temperature and organic solvents on semi permeable membrane.
2. Demonstration of dialysis.
3. Study of plasmolysis and de-plasmolysis.
4. Cell fractionation and determination of enzyme activity in organelles using sprouted seed or any other suitable source.
5. Study of structure of any Prokaryotic and Eukaryotic cell.
6. Microtomy: Fixation, block making, section cutting, double staining of animal tissues like liver, esophagus, stomach, pancreas, intestine, kidney, ovary, testes.
7. Cell division in onion root tip/ insect gonads.
8. Preparation of Nuclear, Mitochondrial & cytoplasmic fractions.
9. Isolation of chloroplast from plant leaves

Suggested Reading for Biotechnology Lab 3A

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition.Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASMPress & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

B. Sc. –M.Sc. in Nanoscience and Technology,
(5 Years Integrated) Programme, Part – I, Semester- I,

Mathematics-Paper- I

DSC-4A-Maths.: DIFFERENTIAL CALCULUS

Theory: 60 Lectures

Unit No.	Topics	Total Lectures
Unit I	Limit and Continuity (ε and δ definition), Types of discontinuities, Differentiability of function of one variable, Successive differentiation, Leibnitz's theorem.	**15**
Unit II	Rolle's theorem, Lagrange's Mean Value theorem, Cauchy's Mean Value Theorem, Maclaurin's series of sin x, cos x, e^x, log(l+x), $(l+x)^m$, Indeterminate forms.	**15**
Unit III	Partial differentiation, Composite function, Chain Rule and Total Derivative, Euler's theorem on homogeneous functions, Maxima and Minima of functions of two variables.	**15**
Unit IV	(A) Numerical Differentiation(i) Introduction, Definition(ii) Numerical differentiation using Newton's forward difference interpolation formula, (iii) Newton's backward difference interpolation formula, (iv) Sterling's Central difference interpolation formula, (v) Newton's divided difference formula. (B) Complex Numbers (i) Rectangular, polar and exponential forms of complex numbers, (ii) De-Moivre's Theorem, (iii) Powers, roots and log of complex numbers	**15**

Books Recommended:

1. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002.
2. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007.
3. Finite differences and Numerical Analysis, H.C. Saxena , S.Chand and Company.
4. Complex Numbers, Algebra and Geometry: G. V. Kumbhojkar and H. V. Kumbhojkar,
5. Jamnadas and Com. Bombay, 1982

B. Sc. –M.Sc. in Nanoscience and Technology,
(5 Years Integrated) Programme, Part – I, Semester- I,

Laboratory – 1

DSC-4A-Maths.-LAB: DIFFERENTIAL CALCULUS

Practical: 30 Lectures

1. Examples on Newtons forward difference formula
2. Examples on Newtons backward difference formula
3. Examples on Central Difference formula
4. Examples on Differentiation at non-tabular values
5. Lagranges method for undetermined multipliers
6. Jacobian-I
7. Jacobian-II
8. Numerical Methods for solution of Linear equations; Gaussian elimination Method
9. Numerical Methods for solution of Linear equations; Gauss Jordan Method Numerical Methods for solution of Linear equations; Gauss Seidel Method

B. Sc. –M.Sc. in Nanoscience and Technology, (5 Years Integrated) Programme, Part – I, Semester- I,

Electronics-Paper- I

DSC-5A-Electr.: NETWORK ANALYSIS AND ANALOG ELECTRONICS

Theory: 60 Lectures

Unit No.	Topics	Total Lectures
Unit I	**Circuit Analysis:** Passive and Active Elements, Introduction to Resistor, Capacitor, Inductor, Memristor and Transformer. Concept of Voltage and Current Sources. Kirchhoff's Current Law, Kirchhoff's Voltage Law. Principal of Duality. Superposition Theorem. Thevenin's Theorem. Norton's Theorem. Maximum Power Transfer Theorem. Two Port Networks: z, y and h parameters and their conversion.	**14**
Unit II	**Junction Diode and its applications:** Semiconductor theory, PN junction diode (Ideal and practical)- constructions, Formation of Depletion Layer, Diode Equation and I-V characteristics. Idea of static and dynamic resistance. Zener diode, Reverse saturation current, Zener and avalanche breakdown. Qualitative idea of Schottky diode, Photo diode and Light Emitting Diode (LED). Rectifiers- Half wave rectifier, Full wave rectifiers (center tapped and bridge), circuit diagrams, working and waveforms, ripple factor and efficiency. Filters- shunt capacitor filter, series inductor filter, its role in power supply, output waveform, and working. Regulation - Line and load regulation, Zener diode as voltage regulator.	**18**
Unit III	**Bipolar Junction Transistor:** Theory and working of BJT, Basic configurations (CB, CE & CC), Characteristics of transistor in CE and CB configurations, Regions of operation (active, cut off and saturation), applications as an amplifier and switch. Current gains α and β. Relations between α and β. dc load line and Q point. **Amplifiers:** Transistor biasing and Stabilization circuits- Fixed Bias and Voltage Divider Bias. Thermal runaway, stability and stability factor S. Transistor as a two port network, h-parameter equivalent circuit. Small	**15**

	signal analysis of single stage CE amplifier. Input and Output impedance, Current and Voltage gains.	
Unit IV	**Cascaded Amplifiers:** Coupling Methods (RC & DC), 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 oscillation. **Unipolar Devices**: JFET & MOSFET. Construction, working and I-V characteristics (output and transfer), Pinchoff voltage. UJT, basic construction, working, equivalent circuit and I-V characteristics.	**13**

Reference Books:

• Electric Circuits, S. A. Nasar, Schaum's outline series, Tata McGraw Hill (2004)

• Electrical Circuits, M. Nahvi & J. Edminister, Schaum's Outline Series, Tata McGraw-Hill (2005)

• A Text Book of Applied Electronics -R. S. Sedha, Revised Edition 2014, S. Chand Publication

• Electrical Circuits, K.A. Smith and R.E. Alley, 2014, Cambridge University Press

• Network, Lines and Fields, J.D.Ryder, Prentice Hall of India.

• Electronic Devices and Circuits, David A. Bell, 5th Edition 2015, Oxford University Press.

• Allen Mottershead, Electronic Devices and Circuits, Goodyear Publishing Corporation.

• Electronic Circuits: Discrete and Integrated, D.L. Schilling and C. Belove, Tata McGraw Hill

• Electrical Circuit Analysis, Mahadevan and Chitra, PHI Learning

• Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press.

• J. J. Cathey, 2000 Solved Problems in Electronics, Schaum's outline Series, Tata McGraw Hill (1991)

B. Sc. –M.Sc. in Nanoscience and Technology,

(5 Years Integrated) Programme, Part – I, Semester- I,

Electronics Laboratory – 1

DSC-5A-Electr.-LAB: NETWORK ANALYSIS AND ANALOG ELECTRONICS

Theory: 30 Lectures

ANY FIVE EXPERIMENTS SHOULD BE COMPLETED FROM THE FOLLOWING BESIDES #1

#1. To familiarize with basic electronic components (R, C, L, diodes, transistors),

digital Multimeter, Function Generator and Oscilloscope.

2. Measurement of Amplitude, Frequency & Phase difference using Oscilloscope.

3. Verification of (a) Thevenin's theorem and (b) Norton's theorem.

4. Verification of the Maximum Power Transfer Theorem

5. Study of the I-V Characteristics of (a) p-n junction Diode, and (b) Zener diode.

6. Study of (a) Half wave rectifier and (b) Full wave rectifier (FWR).

7. Study the effect of (a) C- filter and (b) L-filter on the output of FWR

8. Study of the Zener diode as voltage regulator.

9. Study of the output and transfer I-V characteristics of common source JFET.

10. Study of Fixed Bias and Voltage divider bias configuration for CE transistor.

11. Study of the RC Phase Shift Oscillator.

12. Study of the Colpitts oscillator.

B. Sc. –M.Sc. in Nanoscience and Technology,

(5 Years Integrated) Programme, Part – I, Semester- I,

DSE-1A: Fundamentals of Mathematical Computing and Calculus - I

Theory: 30 Lectures

Unit No.	Topics	Total Lectures
Unit I	Review of Real number systems and algebraic operations, solutions of polynomial equations, review of trigonometric functions, Introduction to complex numbers, introduction to functions, Graphs of functions	**15**
Unit II	Limits and Continuity, of functions of one variable, geometrically understanding the concepts of limits and continuity, introduction to differentiation of a function of one variable, physical significance of concept of differentiation, formulae of differentiation, properties of differentiation	**15**

B. Sc. –M.Sc. in Nanoscience and Technology,

(5 Years Integrated) Programme, Part – I, Semester- I,

DSE-2A: Fundamental Understanding of Life Sciences - I

Theory: 30 Lectures

Unit	Topics	Lectures
I	**Understanding of the Life:** Concept and characteristics of life, theory of origin of life, cell theory, understanding the diversity of life, three-domain system, six kingdom system, major and minor living organisms, classification of organisms based on cellular structures. World microbes and viruses.	15
II	**Growth and development of live forms:** Cell cycle, Types of cell division, Significance of meiosis and mitosis, Cell death. Growth, types of growth, phases of growth, growth curves, growth rates. Sexual and asexual reproduction in plants.	15

Suggested reading resources:

- Verma P. S. and Agarwal V. K. 2018. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand Limited.
- 11^{th} and 12^{th} Standard Biology Textbooks

SHIVAJI UNIVERSITY, KOLHAPUR
School of Nanoscience and Technology
B. Sc. –M.Sc. in Nanoscience and Technology,
(5 Years Integrated) Programme, Part – I, Semester- II,

Physics-Paper- II
DSC-1B-Phys.: ELECTRICITY AND MAGNETISM
(Theory: 60 Lectures)

Course Learning outcomes:

After going through the course, the student should be able to

- Acquire basic knowledge of physics behind the vector analysis, electrostatics, a. c. circuits, magnetism, electromagnetic wave propagation, electromagnetic induction and Maxwell's equations.
- Understand the various applications of the concepts related with electricity and magnetism.
- Aware of basic concepts from nanophysics like electrostatic at nanoscale, memristor circuits at nanoscale, spintronics and nanoelectrodynamics.

Unit No.	Topics	Total Lectures
Unit I	**Vector Analysis**: **(15 Lectures)** Concept of triple product of vectors, scalar triple product and its significance, vector triple product, Scaler and Vector fields, Gradient, Divergence and their significance, Line integral, Curl or Vector field its significance, Surface and Volume integrals of vector fields, Gauss divergence theorem, Stoke's theorem and Greens symmetrical theorem (Statement of each theorem), Problems.	**15**
Unit II	**Electrostatics: (15 Lectures)** Electrostatic Field, electric flux, Gauss's theorem of electrostatics, Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere, Calculation of electric field from potential, Capacitance of an isolated spherical conductor, parallel plate, spherical and cylindrical condenser, Energy per unit volume in electrostatic field, Dielectric medium, Polarisation, Displacement vector, Gauss's theorem in dielectrics, Parallel	**15**

	plate capacitor completely filled with dielectric. Electrostatic at nanoscale, Problems.	
Unit III	**1. A.C. Circuits: (7 Lectures)** Complex numbers and their application in solving A. C. series LCR circuit, complex impedance, Reactance, Admittance, and Susceptance, Resonance in LCR series circuit, Sharpness of resonance (qualitative treatment only), Q-factor (definition only) A.C. Bridge - Owen's Bridge. Memristor circuits at nanoscale, Problems. **2. Magnetism: (8 Lectures)** Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current, Divergence and curl of magnetic field, Magnetic vector potential, Ampere's circuital law, Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility, Brief introduction of dia- magnetic material, para-magnetic material and ferro-magnetic materials. Introduction to spintronics, Problems.	**15**
Unit IV	**1. Electromagnetic Induction: (5 Lectures)** Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils, Energy stored in magnetic field, Problems. **2. Maxwell's equations and Electromagnetic wave propagation: (10 Lectures)** Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization. Introduction to nanoelectrodynamics, Problems.	**15**

Reference Books:

1. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education.
2. Electricity and Magnetism, J.H. Fewkes & J. Yarwood. Vol. I, 1991, Oxford Univ. Press.
3. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
4. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
5. D.J. Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin Cummings.
6. Electricity and Magnetism – Khare and Shrivastav.

7. Foundations of Electromagnetic Theory – Rritz and Milford.
8. University Physics 9th edition – Young and Freedman.
9. Concepts of Physics Vol-2 H. C. Verma
10. The big ideas of Nanoscale Science & Engineering- S. Stevens and M. Sutherland, CRC Press.

B. Sc. –M.Sc. in Nanoscience and Technology, (5 Years Integrated) Programme, Part – I, Semester- II,

Physics Laboratory –2

DSC-1B-Phys.-LAB.: ELECTRICITY AND MAGNETISM

Practical: 60 Lectures

Course Learning outcomes:

After going through the course, the student should be able to

- Extend the skills of handling multimeter, battery eliminator and frequency generator.
- Extend the skills and practical use of sonometer, ballistic galvanometer and different types of LCR circuits.

Sr. No.	Name of experiment
1	To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses.
2	Measurement of constants of B. G.
3	Determine a high resistance by Leakage Method
4	To compare capacitances using De'Sauty's bridge
5	Measurement of field strength B and its variation in a Solenoid (Determine dB/dx)
6	Impedance of series LCR circuit.
7	To study the series LCR circuit and Determine its (a) Resonant Frequency, (b) Quality Factor
8	To study a parallel LCR circuit and Determine its (a) Anti-resonant frequency and (b) Quality factor Q
9	Frequency of A. C. mains by sonometer
10	To verify the Thevenin's / Norton's theorem

Reference Books:

1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. College Practical Physics – Khanna and Gulati (S. Chand and Co. Ltd, Delhi)
5. Practical Physics – Gupta and Kumar (Pragati Prakation Meerat)
6. Advanced Level Practical Physics – J.M. Nelcon, J.M. Ogloom (EIBS)
7. A Text Book of Practical Physics - Shrinivasan and Balasubramanyam
8. Engineering Practical Physics- S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.

B. Sc. –M.Sc. in Nanoscience and Technology,
(5 Years Integrated) Programme, Part – I, Semester- II,

Chemistry-Paper- II
DSC-2B-Chem.: CHEMICAL ENERGETICS, EQUILIBRIA &FUNCTIONAL ORGANIC CHEMISTRY

(Theory: 60 Lectures)

Unit No.	Topics	Total Lectures
Unit I	**Chemical Energetic & Chemical Equilibrium:** (A) Chemical Energetic: Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances. Introduction to nanoscale thermodynamics. (10) (B) Chemical Equilibrium: Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔGo, Le Chatelier's principle. (8)	**18**
Unit II	**Ionic Equilibria:** Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, common ion effect. Salt hydrolysis-calculation of hydrolysis constant. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. (12)	**12**
Unit III	**Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.** ***(A) Aromatic hydrocarbons:*** Preparation (CaBe benzene): from phenol, by decarboxylation, from acetylene, from benzene	**16**

	sulphonic acid. Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation). (08) ***(B) Alkyl and Aryl Halides*** ***Alkyl Halides*** (Upto S Carbons) Types of Nucleophilic Substitution (SN^1, SN^2 and SN^i) reactions. *Preparation*: from alkenes and alcohols. *Reactions*. hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. (04) ***Aryl Halides*** *Preparation*: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions. *Reactions* (Chlorobenzene): Aromatic nucleophilic substitution (replacement by —OH group) and effect of nitro substituent. Benzyne Mechanism: KNH_2 H_3 (or $NaNH_2$, H_3) Reactivity. (04)	
Unit IV	**<u>Alcohols, Phenols and Ethers (Upto 5 Carbons)</u>** ***(A) Alcohols:*** *Preparation*: Preparation of 1°, 2°and 3°alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. *Reactions*: With sodium, HX (Lucas test), esterification, oxidation (with alk. $KMnO_4$, acidic dichromate, cone. HNO_3). (07) ***(B) Phenols:*** (Phenol case) *Preparation*: Cumene hydroperoxide method, from diazonium salts. *Reactions*: Electrophilic substitution: Nitration, halogenation and sulphonation. (04) ***(C) Ethers (aliphatic and aromatic)***: Cleavage of ethers with HI. Aldehydes and ketones (aliphatic and aromatic): (Formaldehye, acetaldehyde, acetone and benzaldehyde) *Preparation*: from acid chlorides and from nitriles. Reactions — Reaction with HCN, ROH, $NaHSO_3$. NH_2-G derivatives. (07)	**18**

Reference Books:

1. Graham Solomon, T W., Fryhle, C.B. & Dnyder, S.A.Organic Chemistry,JohnWiley & Sons (2014).

2. McMurry, J.E. Fundamentals of Organic Chemistry, 7thEd. Cengage Learning India Edition, 2013.
3. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, NewDelhi (1988).
4. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
5. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
6. Bahl, A. & Bahl, B. S. Advanced Organic Chemistry, S. Chand, 2010.
7. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
8. Castellan, G.W. Physical Chemistry 4thEd. Narosa (2004).
9. Kotz, J.C., Treichel, P.M. & Townsend, J. R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009).
10. Mahan, B. H. University Chemistry 3'dEd. Narosa (1998).
11. Petrucci, R. H. General Chemistry 5thEd. Macmillan Publishing Co.: New York (1985).
12. Introduction to Nanoscience and Nanotechnology, Gabor L. Hornyak, H.F. Tibbals, Joydeep Dutta, John J. Moore, CRC Press.

B. Sc. –M.Sc. in Nanoscience and Technology, (5 Years Integrated) Programme, Part – I, Semester- II,

Chemistry Laboratory – 2

DSC-2B-Chem.-LAB: CHEMICAL ENERGETICS, EQUILIBRIA &

FUNCTIONAL ORGANIC CHEMISTRY

(Practical: 60 Lectures)

Section A: Physical Chemistry

Thermochemistry

1. Determination of equivalent weight of Mg by Eudiometer.
2. Study of specific reaction rate of hydrolysis of methyl acetate in presence of HCl.
3. Determination of heat of ionization of weak acid by using polythene bottle.
4. Determination of heat capacity of calorimeter for different volumes.
5. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
6. Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl).
7. Determination of enthalpy of hydration of copper sulphate.
8. Study of the solubility of benzoic acid in water and determination of ΔH.

Ionic equilibria

pH measurements

a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.

b) Preparation of buffer solutions:

(i) Sodium acetate-acetic acid.

(ii) Ammonium chloride-ammonium hydroxide.

Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Section B: Organic Chemistry

1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2. Criteria of Purity: Determination of melting and boiling points.
3. Preparations: Mechanism of various reactions involved to be discussed.

Recrystallisation, determination of melting point and calculation of quantitative yields to be done.

(a) Bromination of Phenol/Aniline

(b) Benzoylation of amines/phenols

(c) Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone

Reference Books

1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.

2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.

3. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).

4. Practical book of Physical Chemistry: Nadkarni, Kothari & Lawande.

5. Experimental Physical Chemistry: A. Findlay.

6. Systematic Experimental Physical Chemistry: S. W. Rajbhoj, Chondhekar. (Anjali Publication.)

7. Experiments in Physical Chemistry: R. C. Das and B. Behra. (Tata Mc Graw Hill)

8) Advanced Practical Physical Chemistry: J. B. Yadav (Goel Publishing House.)

9) Practical Physical Chemistry: B. D. Khosala. (R. Chand & Sons)

7) Experiments in Chemistry: D. V. Jahagirdar.

10) A Text Book of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis: A.I. Vogel (Third Ed.) (ELBS)

B. Sc. –M.Sc. in Nanoscience and Technology, (5 Years Integrated) Programme, Part – I, Semester- II,

Biotechnology-Paper- II

DSC-3B-Biotech.: MAMMALIAN PHYSIOLOGY

(Theory: 60 Lectures)

Unit No.	Topics	Total Lectures
Unit I	**Digestion, Respiration and Circulation:** Digestion: Mechanism of digestion & absorption of carbohydrates, proteins, lipids and nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juice Respiration: Exchange of gases, Transport of O2 and CO2, Oxygen dissociation curve, Chloride shift. Circulation: Composition of blood, Plasma proteins & their role, blood cells, Hematopoiesis, Mechanism of coagulation of blood. Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heart beat.	**15**
Unit II	**Muscle physiology and osmoregulation:** Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction. Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation.	**15**
Unit III	**Nervous and endocrine coordination** Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, saltatory conduction, Neurotransmitters. Mechanism of action of hormones (insulin and steroids) Different endocrine glands– Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions.	**15**
Unit IV	**Nanotechnology – Mammalian physiology interface** Exploratory Design in Medical Nanotechnology.	**15**

	Respirocytes: A Mechanical Artificial Red Cell. Role of nanotechnology in tissue engineering. Nanotechnology in neuroscience, nanotube microelectrodes neurotransmitter measurements in the brain. Artificial synapse. Toxicity of nanoparticles. Fate of nanoparticles in body. Nanoparticles - Blood Components Interactions.	

Suggested Reading for Mammalian Physiology

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.

2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition. John wiley & sons, Inc.

3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

B. Sc. –M.Sc. in Nanoscience and Technology, (5 Years Integrated) Programme, Part – I, Semester- II,

Biotechnology Laboratory – 2

DSC-3B-Biotech. - LAB: MAMMALIAN PHYSIOLOGY

Practical: 60 Lectures

1. Finding the coagulation time of blood
2. Determination of blood groups
3. Counting of mammalian RBCs
4. Determination of TLC and DLC
5. Demonstration of action of an enzyme
6. Determination of Hemoglobin
7. Demonstration of pulse oximeter
8. Physiological studies of biological samples

Suggested Reading for Biotechnology Lab 3B

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.

2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition. John wiley & sons,Inc.

B. Sc. –M.Sc. in Nanoscience and Technology, (5 Years Integrated) Programme, Part – I, Semester- II,

Mathematics-Paper- II

DSC-4B-Maths.: DIFFERENTIAL EQUATIONS

(Theory: 60 Lectures)

Unit No.	Topics	Total Lectures
Unit I	First order exact differential equations. Integrating factors, rules to find an integrating factor.First order higher degree equations solvable for x, y, p.	**15**
Unit II	**(A) Applications of differential equations:** Newton's law of Cooling, Kirchoff's law of electrical circuits, motion under gravity, simple harmonic motion. (B) **Numerical Solution of Ordinary Differential Equations of first order and first degree:** Introduction, (ii) Solution by Picard's method, (iii) Taylor's series method, (iv) Euler's method, (v) Modified Euler's method, (vi) Runge-Kutta second and fourth order Method	**15**
Unit III	Methods for solving higher-order differential equations, Solving a differential equation by reducing its order. Linear homogenous equations with constant coefficients, Linear non-homogenous equations.	**15**
Unit IV	The method of variation of parameters. The Cauchy-Euler equation, Simultaneous differential equations, Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations	**15**

Books Recommended:

1. Shepley L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, 1984.
2. I. Sneddon, Elements of Partial Differential Equations, McGraw-Hill, International Edition.
3. Introductory Methods of Numerical Analysis, S.S. Sastry, 3rd edition, Prentice Hall of India, 1999.

B. Sc. –M.Sc. in Nanoscience and Technology,
(5 Years Integrated) Programme, Part – I, Semester- II,

Mathematics Laboratory – 2

DSC-4B-Maths. -LAB: DIFFERENTIAL EQUATIONS

Practical: (30 Lectures)

1. Examples on Picards Mathod

2. Examples on Eulers Mathod

3. Examples on Eulers Modified Mathod

4. Examples on Taylors series method

5. Examples on Runge-Kutta Method

6. Applications of Differential equations: Orthogonal Trajectories

7. Examples on Newtons Law of cooling

8. Examples on Basic Electrical Circuits

9. Laplace Transform-I

10. Laplace Transform -II

11. Laplace Transform-III

12. Inverse Laplace Transform

13. Applications of Laplace Transform to solve Differential Equations

B. Sc. –M.Sc. in Nanoscience and Technology, (5 Years Integrated) Programme, Part – I, Semester- II,

Electronics-Paper- II

DSC-5B-Electr.: LINEAR AND DIGITAL INTEGRATED CIRCUITS

(Theory: 60 Lectures)

Unit No.	Topics	Total Lectures
Unit I	**Operational Amplifier (Black box approach):** Difference amplifier, Block diagram of an Operational Amplifier, Characteristics of an Ideal and Practical Operational Amplifier (IC 741), Open and closed loop configuration, Frequency Response. CMRR. Slew Rate and concept of Virtual Ground. **(5 Lectures)** **Applications of Op-Amps**: (1) Inverting and non-inverting amplifiers, (2) Summing and Difference Amplifier, (3) Differentiator, (4) Integrator, (5) Wein bridge oscillator, (6) Comparator and Zero-crossing detector, and (7) Active low pass and high pass Butterworth filter (1st order only). (**12 Lectures**)	**17**
Unit II	**Number System and Codes**: Decimal, Binary, Octal and Hexadecimal number systems, base conversions. Representation of signed and unsigned numbers, BCD and ASCII codes. Binary and Hexadecimal arithmetic; addition, subtraction by 2's complement method. (**9 Lectures**) **Logic Gates and Boolean algebra**: Logic Gates- OR, AND, NOT, NOR, NAND, XOR and XNOR. Positive and Negative logic, Universality of NAND and NOR gates, Basic postulates and fundamental theorems of Boolean algebra, De Morgan's Theorems, tristate gate. **(4 Lectures)**	**13**
Unit III	**Combinational Logic Analysis and Design**: Standard representation of logic functions (SOP and POS), Karnaugh map minimization techniques (up to 4 variables for SOP). (**5 Lectures**)	**11**

	Arithmetic Circuits: Binary Addition. Half and Full Adder. Half and Full Subtractor, 4-bit binary Adder/Subtractor. (**3 Lectures**) **Data processing circuits**: Multiplexers, De-multiplexers, Decoders, Encoders. (**3 Lectures**)	
Unit IV	**Sequential Circuits**: SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. Master-slave JK Flip-Flop. (**9 Lectures**) **Shift registers**: Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits). (2 **Lectures**) **Counters (4 bits):** Ring Counter. Synchronous counters, Asynchronous counters, Decade Counter. **(4 Lectures**) **Digital Logic Families:** Logic levels, propagation delay time, power dissipation, fan-out and fan-in, noise margin, logic families and their characteristics- DTL, TTL, CMOS and ECL. **(4 Lectures)**	**19**

Reference Books:

- OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall
- Operational Amplifiers and Linear ICs, David A. Bell, 3rd Edition, 2011, Oxford University Press.
- Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed., 2011, Tata McGraw
- Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
- Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
- Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer, 2001, PHI Learning.
- Thomas L. Flyod, Digital Fundamentals, Pearson Education Asia (1994).
- Modern Digital Electronics, R. P. Jain, Tata McGraw Hill
- R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)

B. Sc. –M.Sc. in Nanoscience and Technology, (5 Years Integrated) Programme, Part – I, Semester- II,

Electronics Laboratory – 2

DSC-5B-Electr. -LAB: LINEAR AND DIGITAL INTEGRATED CIRCUITS

Practical: (30 Lectures)

ANY FIVE EXPERIMENTS SHOULD BE COMPLETED FROM THE FOLLOWING

1. To design an inverting amplifier and non-inverting amplifier using Op-amp (741,351) for dc voltage of given gain

2. (a) To design inverting amplifier using Op-amp (741,351) & study its frequency response.
   (b) To study the zero-crossing detector and comparator.

3. Study the application of Op-Amp. as an Adder and Subtractor.

4. To investigate the use of an op-amp as an Integrator and Differentiator.

5. To design a Wien bridge oscillator for given frequency using an op-amp.

6. (a) To design a combinational logic system for a specified Truth Table.
   (b) To convert Boolean expression into logic circuit & design it using logic gate ICs.

7. To construct and verify Half Adder and Full Adder using logic gates.

8. To construct and verify Half Subtractor and Full Subtractor using logic gates.

9. Study of 4 bit binary adder and subtractor using Full adder IC.

10. Study of Multiplexers and De-multiplexers.

11. (a) To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates.
    (b) To build JK Master-slave flip-flop using Flip-Flop ICs.

12. To build a Counter using D-type/JK Flip-Flop ICs and study timing diagram.

B. Sc. –M.Sc. in Nanoscience and Technology,

(5 Years Integrated) Programme, Part – I, Semester- II,

DSE-1B: Fundamentals of Mathematical Computing and Calculus - II

Theory: 30 Lectures

Unit No.	Topics	Total Lectures
Unit I	Introduction of Differential equations, The role of integration in solving differential equations, Notion of integration as an antiderivative, geometric interpretation of integration, Study of formulae of integration	**15**
Unit II	Properties of integration, integration by parts, Integration by substitution, Integration by partial fraction, Concept of definite integration, Solutions of differential equations by using variable separable method, Solutions of differential equations by using substitutions	**15**

B. Sc. –M.Sc. in Nanoscience and Technology,

(5 Years Integrated) Programme, Part – I, Semester- II,

DSE-2B-Fundamental Understanding of Life Sciences -II

Theory: 30 Lectures

Unit	Topics	Lectures
I	**Immunology, Diseases and Disorders:** Overview of immune system, innate and adaptive immunity, cells and organs of immune system, Introduction to the concept of antigen, antigenicity, immunogenicity, Antibody. Human Health and Diseases, Correlation between diseases and health.	15
II	**Biotechnology:** Traditional and Modern Biotechnology, Principles and Processes of Biotechnology, Tools and techniques for gene cloning / rDNA technology, Applications of Biotechnology in Healthcare, Agriculture, Genetically Modified Organisms (GMOs), Transgenic plants and animals.	15

Suggested reading resources:

- Verma P. S. and Agarwal V. K. 2018. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand Limited.
- 11^{th} and 12^{th} Standard Biology Textbooks

NATURE OF QUESTION PAPER

B. Sc. –M. Sc. Nanoscience and Technology (5 Years Integrated Course)

SCHOOL OF NANOSCIENCE AND TECHNOLOGY

All Questions are compulsory

Time duration (3 hours) **Total Marks: 80**

Q. 1.Select the correct answers: MCQ **1 x 8 = 8**

i) ii)

iii) iv)

v) vi)

vii) viii)

Q. 2. Write short notes on: **2 x 4 = 8**

a) b)

c) d)

Q. 3. Answer any six of the following: **4 x 6 = 24**

a)

b)

c)

d)

e)

f)

g)

h)

Q.4. Answer any five of the following: **8 x 5 = 40**

a)
b)
c)
d)
e)
f)

NATURE OF QUESTION PAPER

B. Sc. –M. Sc. Nanoscience and Technology (5 Years Integrated Course)

SCHOOL OF NANOSCIENCE AND TECHNOLOGY

All Questions are compulsory

Time duration (3 hours) **Total Marks: 40**

Q. 1. Select the correct answers: MCQ **1 x 4 = 4**

i)

ii)

iii)

iv)

Q. 2. Write short notes on: **2 x 2 = 4**

a) b)

Q. 3. Answer any two of the following: **4 x 2 = 8**

a)

b)

c)

Q.4. Answer any three of the following: **8 x 3 = 24**

a)
b)
c)
d)