



Sunbeam College for Women



Autonomous Post Graduate College
Accredited 'A' Grade by NAAC
BHAGWANPUR, VARANASI-221005 (U.P.)

B.Sc. V Sem.

ACADEMIC PLANNER

2025-26

Lecture Plan
B.Sc. 5th Semester
Session- 2025-26

Syllabus by NEP

Programme/Class: Degree	Year: Third	Semester: Fifth
Subject: Physics		
Course Code: B010501T	Course Title: Classical & Statistical Mechanics	
Course Outcomes (COs)		
<ol style="list-style-type: none"> 1. Understand the concepts of generalized coordinates and D'Alembert's principle. 2. Understand the Lagrangian dynamics and the importance of cyclic coordinates. 3. Comprehend the difference between Lagrangian and Hamiltonian dynamics. 4. Study the important features of central force and its application in Kepler's problem. 5. Recognize the difference between macrostate and microstate. 6. Comprehend the concept of ensembles. 7. Understand the classical and quantum statistical distribution laws. 8. Study the applications of statistical distribution laws. 		
Credits: 4	Core Compulsory / Elective	
Max. Marks: 25+75	Min. Passing Marks:	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0		
Unit		No. of Lectures
PART A		
Introduction to Classical Mechanics		
	Constrained Motion	
I	Constraints - Definition, Classification and Examples. Degrees of Freedom and Configuration space. Constrained system, Forces of constraint and Constrained motion. Generalised coordinates, Transformation equations and Generalised notations & relations. Principle of Virtual work and D'Alembert's principle.	6
	Lagrangian Formalism	
II	Lagrangian for conservative & non-conservative systems, Lagrange's equation of motion (no derivation), Comparison of Newtonian & Lagrangian formulations, Cyclic coordinates, and Conservation laws (with proofs and properties of kinetic energy function included). Simple examples based on Lagrangian formulation.	9
	Hamiltonian Formalism	
III	Phase space, Hamiltonian for conservative & non-conservative systems, Physical significance of Hamiltonian, Hamilton's equation of motion (no derivation), Comparison of Lagrangian & Hamiltonian formulations, Cyclic coordinates, and Construction of Hamiltonian from Lagrangian. Simple examples based on Hamiltonian formulation.	8
	Central Force	
IV	Definition and properties (with prove) of central force. Equation of motion and differential equation of orbit. Bound & unbound orbits, stable & non-stable orbits, closed & open orbits and Bertrand's theorem. Motion under inverse square law of force and derivation of Kepler's laws. Laplace-Runge-Lenz vector (Runge-Lenz vector) and its applications.	7

PART B		
Introduction to Statistical Mechanics		
V	Macrostate & Microstate Macrostate, Microstate, Number of accessible microstates and Postulate of equal a priori. Phase space, Phase trajectory, Volume element in phase space, Quantisation of phase space and number of accessible microstates for free particle in 1D, free particle in 3D & harmonic oscillator in 1D.	6
VI	Concept of Ensemble Problem with time average, concept of ensemble, postulate of ensemble average and Liouville's theorem (proof included). Micro Canonical, Canonical & Grand Canonical ensembles. Thermodynamic Probability, Postulate of Equilibrium and Boltzmann Entropy relation.	6
VII	Distribution Laws Statistical Distribution Laws: Expressions for number of accessible microstates, probability & number of particles in i th state at equilibrium for Maxwell-Boltzmann, Bose-Einstein & Fermi-Dirac statistics. Comparison of statistical distribution laws and their physical significance. Canonical Distribution Law: Boltzmann's Canonical Distribution Law, Boltzmann's Partition Function, Proof of Equipartition Theorem (Law of Equipartition of energy) and relation between Partition function and Thermodynamic potentials.	10
VIII	Applications of Statistical Distribution Laws Application of Bose-Einstein Distribution Law: Photons in a black body cavity and derivation of Planck's Distribution Law. Application of Fermi-Dirac Distribution Law: Free electrons in a metal, Definition of Fermi energy, Determination of Fermi energy at absolute zero, Kinetic energy of Fermi gas at absolute zero and concept of Density of States (Density of Orbitals).	8

Sunbeam College for Women Bhagwanpur, Varanasi

LECTURE PLAN

Academic session 2025-2026

B.Sc. - Fifth Semester

Physics- Part A (Paper: B010501T)

Subject Teacher: Dr. Amit Kumar

Reference Books:

Part A:

1. "Classical Mechanics" by Herbert Goldstein, Charles P. Poole, John L. Safko, Publication: Pearson Education, India, 2011, 3E.
2. "Classical Mechanics" by N.C. Rana, P.S. Joag, Publication: McGraw Hill, 2017.
3. "Introduction to Classical Mechanics" by R.G. Takwale, P.S. Puranik, Publication: McGraw Hill, 2017.
4. "Classical Mechanics" by J.C. Upadhyay, Publication: Himalaya Publishing House.
5. "Classical Mechanics" by S. L. Gupta, V. Kumar & H. V. Sharma, Publication: Pragati Prakashan.

Part B:

1. "Statistical Physics (In SI Units): Berkeley Physics Course Vol 5" by F. Reif, Publication: McGraw Hill, 2017, 1e
2. "Fundamentals of Statistical Mechanics" by B.B. Laud, Publication: New Age International Private Limited, 2020, 2e
3. "Statistical Mechanics" by B.K. Agarwal, M. Eisner, Publication: New Age International Private Limited, 2007, 2e
4. "Elementary Statistical Mechanics" by S. L. Gupta and V. Kumar, Publication: Pragati Prakashan Meerut

S. N.	Unit	Month	Week	No. of Lectures	Topics
1.	Part A Unit I + Part B Unit V	July (12 days)	3 rd	5	Constrained Motion: Constraints - Definition, Classification of constraints and Examples. Degrees of Freedom and Configuration space. Constrained system, Forces of constraint. Constrained motion.
			4 th	5	Generalised coordinates Transformation equations, Generalised notations. Generalised relations. Principle of Virtual work and D'Alembert's principle.
			5 th	2	Macrostate & Microstate: Macrostate, Microstate, Number of accessible microstates. Postulate of equal a priori probability.
2.	Part B Unit V + Part A Unit II + Part B Unit VI	August (19 days)	1 st	3	Phase space. Phase trajectory, Volume element in phase space, Quantisation of phase space. Number of accessible microstates for free particle in 1D, free particle in 3D.
			2 nd	3	Number of accessible microstates for harmonic oscillator in 1D. Lagrangian Formalism: Lagrangian for conservative and non-conservative systems. Lagrange's equation of motion (no derivation).
			3 rd	3	Comparison of Newtonian & Lagrangian formulations. Cyclic coordinates, and Conservation laws (with proofs and properties of kinetic energy function included).
			4 th	5	Simple examples based on Lagrangian formulation (Simple pendulum, Compound pendulum, Atwood's machine etc.).
			5 th	5	Concept of Ensemble: Problem with time average. Concept of ensemble, postulate of ensemble average.

					<i>Liouville's theorem (proof included). Micro Canonical, Canonical & Grand Canonical ensembles.</i>
3.	<i>Part B Unit VI + Part A Unit III + Part B Unit VII</i>	September (19 Days)	1 st	4	<i>Thermodynamic Probability, Postulate of Equilibrium and Boltzmann Entropy relation. Hamiltonian Formalism: Phase space, Hamiltonian for conservative & non-conservative systems.</i>
			2 nd	5	<i>Physical significance of Hamiltonian. Hamilton's equation of motion (no derivation). Comparison of Lagrangian & Hamiltonian formulations, Cyclic coordinates. Construction of Hamiltonian from Lagrangian. Simple examples based on Hamiltonian formulation.</i>
			3 rd	5	<i>Distribution Laws: Statistical Distribution Laws: Expressions for number of accessible microstates. Probability & number of particles in i^{th} state at equilibrium for Maxwell-Boltzmann Statistics.</i>
			4 th	5	<i>Probability & number of particles in i^{th} state at equilibrium for Bose-Einstein & Fermi-Dirac statistics. Comparison of statistical distribution laws and their physical significance. Canonical Distribution Law: Boltzmann's Canonical Distribution Law.</i>
			5 th	--	***** ***
4.	<i>Part B Unit VII + Part A Unit IV</i>	October (13 Days)	1 st	--	***** ***
			2 nd	5	<i>Boltzmann's Partition Function, Proof of Equipartition Theorem (Law of Equipartition of energy).</i>
			3 rd	3	<i>Central Force: Definition and properties (with prove) of central force. Equation of motion and differential equation of orbit. Bound & unbound orbits.</i>
			4 th	3	<i>Stable & non-stable orbits, closed & open orbits and Bertrand's theorem. Motion under inverse square law of force and derivation of Kepler's laws.</i>
			5 th	2	<i>Laplace-Runge-Lenz vector (Runge-Lenz vector) and its applications.</i>

Sunbeam College for Women Bhagwanpur, Varanasi

LECTURE PLAN

Academic session 2025-2026

Class/Section – B.Sc. 3rd [PMC] – 5th semester

Teacher Name: Dr. Devendra Mohan Upadhyay

Course Name: Paper 2:-Quantum Mechanics & Spectroscopy

Course Code: B010502T

Reference Book:

PART A

1. D.J. Griffiths, “Introduction to Quantum Mechanics”, Pearson Education, India, 2004, 2e
2. E. Wichmann, “Quantum Physics (In SI Units): Berkeley Physics Course Vol 4”, McGraw Hill, 2017
3. Richard P. Feynman, Robert B. Leighton, Matthew Sands, “The Feynman Lectures on Physics - Vol. 3”,
Pearson Education Limited, 2012
4. R Murugesan, Kiruthiga Sivaprasath, “Modern Physics”, S. Chand Publishing, 2019, 18e

PART B

1. H.E. White, “Introduction to Atomic Spectra”, McGraw Hill, 1934
2. C.N. Banwell, E.M. McCash, “Fundamentals of Molecular Spectroscopy”, McGraw Hill, 2017, 4e
3. R Murugesan, Kiruthiga Sivaprasath, “Modern Physics”, S. Chand Publishing, 2019, 18e
4. S.L. Gupta, V. Kumar, R.C. Sharma, “Elements of Spectroscopy”, Pragati Prakashan, Meerut, 2015, 27e

Lecture Plan

Month	Unit	Week	No. of Planned Lecture	Topic
July	I	1 st		
		2 nd	-----	
		3 rd	2	Paper 2-Part A-Unit 1:- Operator Formalism: Operators: Review of matrix algebra, definition of an operator, special operators,
		4 th	5	operator algebra and operators corresponding to various physical-dynamical variables. Commutators: Definition, commutator algebra and commutation relations among position, linear momentum & angular momentum and energy & time. Simple problems based on commutation relations.
August	II	5 th	4	Part A- Unit 2:- Eigen & Expectation Values Eigen & Expectation Values: Eigen equation for an operator, eigen state (value) and eigen functions. Linear superposition of eigen functions and Non-degenerate & Degenerate eigen states.
		1 st	1	Expectation value pertaining to an operator and its physical interpretation.
		2 nd	4	Hermitian Operators: Definition, properties and applications. Prove of the hermitian nature of various physical-dynamical operators. Paper 2-Part B-Unit V:- Vector Atomic Model Inadequacies of Bohr and Bohr-Sommerfeld atomic models w.r.t. spectrum of Hydrogen atom (fine structure of H-alpha line).

		3rd	4	Modification due to finite mass of nucleus and Deuteron spectrum. Vector atomic model (Stern-Gerlach experiment included) physical & geometrical interpretations of various quantum numbers for single & many valence electron systems.
		4th	5	LS & jj couplings, spectroscopic notation for energy states, selection rules for transition of electrons and intensity rules for spectral lines. Fine structure of H-alpha line on the basis of vector atomic model.
		5th	5	Paper 2-Part B-Unit VI:- Spectra of Alkali & Alkaline Elements Spectra of alkali elements: Screening constants for s, p, d & f orbitals; sharp, principle, diffuse & fundamental series; doublet structure of spectra and fine structure of Sodium D line.
September	III	1st	5	Spectra of alkaline elements: Singlet and triplet structure of spectra. Paper 2-Part A-Unit 3:- Uncertainty Principle & Schrodinger Equation: Uncertainty Principle: Commutativity & simultaneity (theorems with proofs).
		2nd	5	Non commutativity of operators as the basis for uncertainty principle and derivation of general form of uncertainty principle through Schwarz inequality Uncertainty principle for various conjugate pairs of physical dynamical parameters and its applications.
		3rd	4	Schrodinger Equation: Derivation of time independent & time dependent forms, Equation of motion of an operator in Schrodinger representation.
		4th	5	Paper 2-Part B-Unit VII: X-Rays & X-Ray Spectra Nature & production, Continuous X-ray spectrum & Duane-Hunt's law, Characteristic X-ray spectrum & Mosley's law, Fine structure of Characteristic X-ray spectrum, and X-ray absorption spectrum.
		5th	----	
October	IV	1st	---	
		2nd	5	Paper 2-Part A-Unit 4:- Applications of Schrodinger Equation Application to 1D Problems: Infinite Square well potential (Particle in 1D box), Finite Square well potential, Potential step, Rectangular potential barrier and 1D Harmonic oscillator.
		3rd	4	Application to 3D Problems: Infinite Square well potential (Particle in a 3D box) and the Hydrogen atom (radial distribution function and radial probability included). (Direct solutions of Hermite, Associated Legendre and Associated Laguerre differential equations to be substituted).
		4th	1	Paper 2-Part B-Unit VIII:- Molecular Spectra Discrete set of energies of a molecule, electronic, vibrational and rotational energies.
		5th	4	Quantisation of vibrational energies, transition rules and pure vibrational spectra. Quantisation of rotational energies, transition rules, pure rotational spectra and determination of inter nuclear distance. Rotational-Vibrational spectra; transition rules; fundamental band & hot band; O, P, Q, R, S branches. fundamental band & hot band; O, P, Q, R, S branches.
Total Number of Class			63	

Sunbeam College for Women Bhagwanpur, Varanasi

LECTURE PLAN

Academic session 2025-2026

Class/Section – B.Sc. 3rd Year [PMC] – 5th semester

Teacher Name: Dr. Devendra Mohan Upadhyay and Dr. Amit Kumar

Course Name: Paper 2:-Demonstrative Aspects of Optics & Laser

Course Code: B010503P

Lecture Plan				
Month	Unit	Week	No. of Planned Lecture	Topic
July		1st	0	
		2nd	0	
		3rd	2	Push-Pull Amplifier, Photo Diode, Planck's constant, Clipper and clamper, Thermistor and Polarimeter
		4th	4	Push-Pull Amplifier, Photo Diode, Planck's constant, Clipper and clamper, Thermistor and Polarimeter
		5th	2	Push-Pull Amplifier, Photo Diode, Planck's constant, Clipper and clamper, Thermistor and Polarimeter
August	V	1st	2	Push-Pull Amplifier, Photo Diode, Planck's constant, Clipper and clamper, Thermistor and Polarimeter
		2nd	4	Push-Pull Amplifier, Photo Diode, Planck's constant, Clipper and clamper, Thermistor and Polarimeter
		3rd	4	Push-Pull Amplifier, Photo Diode, Planck's constant, Clipper and clamper, Thermistor and Polarimeter
		4th	4	Push-Pull Amplifier, Photo Diode, Planck's constant, Clipper and clamper, Thermistor and Polarimeter
		5th	4	Push-Pull Amplifier, Photo Diode, Planck's constant, Clipper and clamper, Thermistor and Polarimeter
September	VI	1st	2	Push-Pull Amplifier, Photo Diode, Planck's constant, Clipper and clamper, Thermistor and Polarimeter
		2nd	4	Push-Pull Amplifier, Photo Diode, Planck's constant, Clipper and clamper, Thermistor and Polarimeter
		3rd	2	Push-Pull Amplifier, Photo Diode, Planck's constant, Clipper and clamper, Thermistor and Polarimeter
		4th	4	Push-Pull Amplifier, Photo Diode, Planck's constant, Clipper and clamper, Thermistor and Polarimeter
		5th	0	
October	VII	1st	0	Push-Pull Amplifier, Photo Diode, Planck's constant, Clipper and clamper, Thermistor and Polarimeter
		2nd	4	Push-Pull Amplifier, Photo Diode, Planck's constant, Clipper and clamper, Thermistor and Polarimeter
		3rd	4	Push-Pull Amplifier, Photo Diode, Planck's constant, Clipper and clamper, Thermistor and Polarimeter
		4th	2	Push-Pull Amplifier, Photo Diode, Planck's constant, Clipper and clamper, Thermistor and Polarimeter
		5th	2	
Total Number of Class			50	

Linear Algebra (Paper - 1) Part - B (Course Code: B030501T)

Subject Teacher: Dr. Manish Srivastava

Lecture Plan

Sl. No.	Unit	Month	Week	No. of Lectures	Topics
1	V	July	3rd	3	Vector spaces, Elementary Properties of a Vector Space, Subspaces, Theorems on vector sub space.
			4th	6	Linear sum of two subspaces, Direct sum of vector subspaces, Linear Combination of Vectors, Linear span, Independence and dependence of vectors, Basis and Dimension.
			5th	4	Quotient space and Theorems.
2	VI, VII & VIII	August	1st	2	Linear transformations.
			2nd	5	The Algebra of linear transformations, Rank nullity theorem.
			3rd	5	Representation of Linear transformations as matrices, Linear Functional.
			4th	6	Dual space, Characteristic values, Cayley Hamilton Theorem.
			5th	6	Inner product spaces and norms, Cauchy - Schwarz inequality, Orthogonal vectors.
3	VIII	September	1st	5	Orthonormal sets and bases, Bessel's inequality for finite dimensional spaces, Gram - Schmidt orthogonalization process.

Suggested Readings:

1. Bhupender Singh, Sudhir K. Pundir (Pragati Publication)
2. H.K. Dass, Rama Verma, Rajnish Verma (S. Chand Publication)
3. Seymour Lipschutz, Mare Lars Lipson (Mc Graw Hill Education Private Limited)

Sunbeam College for Women, Bhagwanpur, Varanasi

B. Sc. V Semester (Session: 2025-26)

Tensor Analysis (Paper - 2) Part - B (Course Code: B030502T)

Subject Teacher: Dr. Manish Srivastava

Lecture Plan

Sl. No.	Unit	Month	Week	No. of Lectures	Topics
1	V & VI	September	2nd	6	Tensor Algebra- Superscript, Subscript, Summation Convention, Dummy Suffix, Real Suffix, Transformation of Coordinates, Kronecker Delta, Contravariant and covariant vectors and tensors.
			3rd	5	Mixed tensors, Tensors of Rank two, Transformation formulae, Multiplication of tensors, Contraction, Inner product, Symmetric and skew symmetric tensors, Quotient law.
			4th	6	Conjugate tensors, Associated tensors with example, Reciprocal tensors, Christoffel's Symbols, Law of transformation of Christoffel's symbols, Covariant differentiation, Covariant differentiation of Covariant tensors of order two.
2	VII & VIII	October	2nd	6	Gradient of scalars, Divergence of a covariant vector, covariant vector and conservative vectors, Laplacian of an invariant,
			3rd	5	Curl of a covariant vector, Irrotational vector with examples.
			4th	2	Riemannian space.
			5th	5	Riemannian curvatures and their properties, Geodesics, geodesic curvature, Ricci tensor.
3	VIII	November	1st	1	Scalar curvature, Einstein space and Einstein tensor.

Suggested Readings:

1. Tensors- Mathematics of Differential Geometry by Z. Ahsan, PHI, 2015
2. R.S. Mishra, A Course in Tensors with Applications to Riemannian Geometry, Pothishala, Allahabad.
3. J.P. Chauhan, Differential Geometry & Tensor Analysis, Krishna Publishers

B.Sc. Vth SEM Syllabus by NEP

Course Code: B030502T	
Course Title: Differential Geometry & Tensor Analysis	
<p>Course outcomes: CO1: After Successful completion of this course, students should be able to determine and calculate curvature of curves in different coordinate systems. CO2: This course covers the Local theory of Curves, Local theory of surfaces, Geodesics, Geodesics curvature, Geodesic polars, Curvature of curves on sur-faces, Gaussian curvature, Normal curvature etc.</p> <p>CO3: After Successful completion of this course, students should have the knowledge of tensor algebra, different types of tensors, Riemannian space, Ricci tensor, Einstein space and Einstein tensor etc.</p>	
Credits: 5	Core Compulsory / Elective
Max. Marks: 25+75	Min. Passing Marks:
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 5-0-0	
Part- A	
Differential Geometry	
PART- A	
Unit	
I	
Local theory of curves-Space curves, Examples, Plane Curves, tangent and normal and binormal, Osculating Plane, normal plane and rectifying plane, Osculating circle, osculating sphere Helices, Serret-Frenet apparatus, contact between curve and surfaces, tangent sur-faces, involutes and evolutes of curves, Bertrand curves, Intrinsic equations, fundamental existence theorem for space curves.	
II	
Local Theory of Surfaces- Parametric patches on surface curve of a surface, family of surfaces (one parameter), edge of regression, rues surfaces, skew ruled surfaces and developable surfaces, surfaces of revolution, Helicoids.	
III	
Metric-first fundamental form and arc length, Direction coefficients, families of curves, intrinsic properties, geodesics, canonical geo-desic equations, normal properties of geodesics, geodesics curvature, Geodesic polars.	
IV	
Gauss-Bonnet theorem, curvature of curves on surfaces, Gaussian curvature, normal curvature, Meunier's theorem, mean curvature, Gaussian curvature, umbilic points, lines of curvature, Rodrigue's formula, Euler's theorem.	

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Suggested Readings (Part-A Differential Geometry):

1. T.J. Willmore, An Introduction to Differential Geometry, Dover Publications, 2012.
2. B. O'Neill, Elementary Differential Geometry, 2nd Ed., Academic Press, 2006.
3. C.E. Weatherburn, Differential Geometry of Three Dimensions, Cambridge University Press 2003.
4. D.J. Struik, Lectures on Classical Differential Geometry, Dover Publications, 1988.
5. S. Lang, Fundamentals of Differential Geometry, Springer, 1999.
6. B. Spain, Tensor Calculus: A Concise Course, Dover Publications, 2003.
7. An Introduction to Differential Geometry (with the use of tensor Calculus), L. P. Eisenhart, Princeton University Press, 1940.
8. Tensor Analysis, Theory and Applications to Geometry and Mechanics of Continua, 2nd Edition, I. S. Sokolnikoff, John Wiley and Sons., 1964.
9. D. Somasundaram, Differential Geometry: A First Course, Alpha Science International.
10. Suggested digital platform: NPTEL/SWAYAM/MOOCs
11. Course Books (text/reference) published in Hindi may be prescribed by the Universities at local levels.
12. Krishna publication.

Sunbeam College for Women Bhagwanpur, Varanasi

LECTURE PLAN

Academic session 2025-2026

B.Sc. - Vth Semester

Math- Part A (Paper: Differential Geometry)

Subject Teacher: Dharmendra Dubey

S.N.	Unit	Month	Week	No. of Lectures	Topics
1.	I	September	I	6	Local theory of curves-Space curves, Examples, Plane Curves, tangent and normal and binormal, Osculating Plane, normal plane and rectifying plane
			II	7	Osculating circle, osculating sphere, Helices, Serret-Frenet Formulae, contact between curve and surfaces,
			III	6	involutives and evolutes of curves, Bertrand curves,
			IV	7	Intrinsic equations, fundamental existence theorem for space curves
2.	I & II	October	I	--	
			II	7	Local Theory of Surfaces- Parametric patches on surface curve of a surface, family of surfaces (one parameter),
			III	6	Edge of regression, ruled surfaces skew ruled surfaces and developable surfaces, surfaces of revolution, Helicoids Metric-first fundamental form and arc length.
			IV	2	Direction coefficients, families of curves, intrinsic
3.	III & IV	November	V	6	properties, geodesics, canonical geodesic equations, normal properties of geodesics, geodesics curvature, Geodesic polars. Gauss-Bonnet theorem, curvature of curves on surfaces,
					properties, geodesics, canonical geodesic equations, normal properties of geodesics, geodesics curvature, Geodesic polars.

Total number of lecture-44

BACHELOR OF SCIENCE (BOTANY)

Programme/Class: <i>Bachelor of Science</i>	Year: III	Semester: V Paper-I
Subject: BOTANY		
Course Code: B040501T	Course Title: Plant Physiology, Metabolism & Biochemistry	

Course outcomes:

After the completion of the course the students will be able to:

1. Understand the role of Physiological and metabolic processes for plant growth and development.
2. Learn the symptoms of Mineral Deficiency in crops and their management.
3. Assimilate Knowledge about Biochemical constitution of plant diversity.
4. Know the role of plants in development of natural products, nutraceuticals, dietary supplements, antioxidants

Credits: 4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week) **4-0-0**

Unit	Topic	No. of Lectures(60hrs)
I	Plant water relation, Mineral Nutrition, Transpiration and translocation in phloem Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation. Criteria of essentiality of elements; Role of essential elements; Symptoms of mineral deficiency in major crops, Transport of ions across cell membrane, active and passive transport, Composition of phloem sap, girdling experiment; Pressure flow model.	7
II	Carbon Oxidation Krebs cycle, Glycolysis, fate of pyruvate- aerobic and anaerobic respiration and fermentation, regulation of glycolysis, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate, regulation of Kerbs cycle, mitochondrial electron transport, oxidative phosphorylation, ATP-Synthetase, Chemiosmotic mechanism, P/O ratio , cyanide-resistant respiration, factors affecting respiration.	7
III	Nitrogen Metabolism Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes), Physiology and biochemistry of nitrogen fixation, Ammonia assimilation (GS-GOGAT), reductive amination and transamination, amino acid synthesis.	8
IV	Lipid Metabolism & Photosynthesis Lipid Metabolism : Synthesis and breakdown of triglycerides, -oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilization of lipids during seed germination, -oxidation. ; Photosynthesis: Pigments, Action spectra and Enhancement effect, Electron transport system and Photophosphorylation, C3 & C4 photosynthesis, CAM- Reaction and Significance	7
V	Plant Development, Movements, Dormancy & Responses Developmental roles of Phytohormones (auxins, gibberellins, cytokinins, ABA, ethylene.) autonomic & paratonic movements, Control and Coordination in plants, Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red-light responses on photomorphogenesis, Seed physiology & Dormancy, Vernalization & Senescence	8

VI	Biomolecules <i>Carbohydrates:</i> Nomenclature and classification; Role of monosaccharides (glucose, fructose, sugar alcohols mannitol and sorbitol); Disaccharides (sucrose, maltose, lactose), Oligosaccharides and polysaccharides (structural-cellulose, hemicelluloses, pectin, chitin, mucilage; storage –starch, inulin). <i>Lipids:</i> Storage lipids: Fatty acids structure and functions, Structural lipids: Phosphoglycerides; Lipid functions: cell signals, cofactors, prostaglandins, Introduction of lipid micelles, monolayers, bilayers	8
VII	Proteins: Structure of amino acids; Peptide bonds; Levels of protein structure-primary, secondary, Ramchandran plot,tertiary and quarternary; Isoelectric point; Protein denaturation and biological roles of proteins Nucleic acids: Structure of nitrogenous bases; Structure and function of nucleic acids,Nucleic acid denaturation &Re-naturation ,MiRNA	7
VIII	Enzymes: Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; mechanism of action (activation energy, lock and key hypothesis, induced - fit theory), enzyme inhibition and factors affecting enzyme activity,Allosteric enzymes & Abzymes. Phytonutrients, Nutraceuticals, dietary supplements and antioxidants.	8

Suggested Readings:

Course Books published in Hindi may be prescribed by the Universities.

- पादप शरीर क्रिया विज्ञान तथा जैव रसायन लेखक :डॉ एच एस श्रीवास्तव प्रकाशन: रस्तोगी प्रकाशन , मेरठ
- पादप शरीर क्रिया विज्ञान एवं जैव रसायन लेखक सिंह ,पांडे तथा जैन प्रकाशन :रस्तोगी प्रकाशन ,मेरठ
- पादप कार्यिकी एवं जनन विज्ञान. Madan Kumar. 2020.
- Plant Physiology and Biochemistry ISBN #:81-301-0035-5Sunil D Purohit, K. Ahmed & Gotam K Kukda Edition: 2013Pages: 368 + VIII Text Book (Hindi)**
- पादप कार्यिकी एवं जैव रसायन Dhankar - Sharma - Trivedi RBD Publishing
- Hopkins, W.G. & Hiiner, N.P. Introduction to Plant Physiology (3rd ed.) 2004, John Wiley & Sons.
- A Handbook On Mineral Nutrition And Diagnostic Techniques For Nutritional Disorders Of Crops (pb)ISBN : 9788177543377Edition : 01Year : 2011Author : Pathmanabhan G , Vanangamudi M , Chandrasekaran CN , Sathyamoorthi K , Babu CR , Babu RC , Boopathi PNPublisher : Agrobios (India)
- Jain, V.K. Fundamental of Plant Physiology (7th ed.) 2004. S. Chand and Company.
- Salisbury, F.B. & Ross, C.W. Plant Physiology (4th ed.), 1992, Wadsworth Publishing Company.
- Panday, S.N. & Sinha, B.K. Plant Physiology (4th ed.), 2006, Vikas Publishing House Pvt. Ltd.
- Mukherjee, S. & Ghosh, A. Plant Physiology (2nd ed.), 2005, New Central Book Agency.
- Chaudhuri, D., Kar, D.K., and Halder, S.A. Handbook of Plant Biosynthetic Pthways 2008, New Central Book. Agencies.
- Voet, D. and Voet, J.G., Bio-Chemistry (3rd ed.), 2005, John Wiley & Sons.
- Mathews, C.K., Van Holder, K.E. & Ahren, K.G. Bio-Chemistry (3rd ed.), 2000, Pearson Education.
- Lehninger Principles of Biochemistry. Sixth Edition. 2013. David L. Nelson, Michael M. Cox. Freeman, Macmillan. 11.
- Verma, S.K. Plant Physiology and Biochemistry, V. Chakrabarti & Sons, New Delhi.
- Buchanon, Gruissen and Jones. Plant Physiology & Biochemistry: Biochemistry and Molecular Biology of plants, 2000, I.K. International.
- Ramesh Gupta. Efficacy, Safety and Toxicity brings together all current knowledge regarding nutraceuticals and their potential toxic effects. 2016. Elsevier.
- Harborne, J.B. 1973 .Phytochemical Methods. John Wiley & Sons, New York.
- Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008 Molecular Biology of the Gene 6th edition. Cold Spring Harbour Lab. Press, Pearson Pub.
- P.K. Gupta. BIOTECHNOLOGY AND GENOMICS. Rastogi Publications, 7th Reprint (1st Edition): 2016-2017 **This course can be opted as an elective by the students of following subjects:** Open to all but special for following: B.Sc. Math, B.Sc. Statistics, B.Sc. Nutrition, B.Sc. Biophysics, B.Sc. Biotech,

Suggested Continuous Evaluation Methods: Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

Course prerequisites:

Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry/ Biotech/ /Gardening)

Facilities: Smart and Interactive Class

Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts

Suggested equivalent online courses:

<https://www.classcentral.com/course/swayam-plant-physiology-and-metabolism-17732>

<https://www.wiziq.com/course/3249-plant-physiology-in-10-live-online-classes>

<https://www.easybiologyclass.com/plant-physiology-free-lecture-notes-online-tutorials-lecture-notes-ppts-mcqs/>

https://onlinecourses.swayam2.ac.in/cec19_bt09/preview

Sunbeam College for Women, Bhagwanpur
B.Sc. - V Semester [BOTANY] Paper - I (Plant Physiology, Metabolism and Biochemistry)

Course Code :- BS2640501T, Plant Physiology, Metabolism and Biochemistry

Lecture Plan - Dr. Yashveer Singh (2025-26)

Reference Books:

Dr. S. K. Gupta (Plant Physiology, Metabolism and Biochemistry)

H. S. Srivastava (Plant Physiology and Biochemistry)

B. P. Pandey (Plant Physiology, Metabolism and Biochemistry)

M. P. Singh (Plant Physiology, Metabolism and Biochemistry)

S.No.	Unit	Month	Week	No. of Lectures	Topics		
1	I	JULY (27 Days)	3rd	3	Cell as a physiological unit (Protoplasm).		
					Phisio-chemical properties of water and Types of soil water.		
					Solution, suspension , Emulsion and Colloidal system.		
			4th	4	Water potential and its components Diffusion and osmosis.		
					Osmotic potential ,Diffusion Pressure Deficit (DPD) and Suction Pressure (SP)		
					Transpiration and its Singificance , Factors Affecting Transpiration.		
					Stomatal movements (Opening and Closing Mechanism of Stomata)		
			5th	3	Root Pressure and guttation.		
					Criteria of essentiality of elements,		
Role of essential elements in plant growth.							
2	II & III	AUGUST (24 days)	1st	2	Symptom of mineral deficiency in major crops.		
					Ascent of sap, Transport of ions across cell membranes.		
			2nd	4	Active and Passive transport. Translocation of solute ,		
					Girdling experiment, Pressure flow Model.		
					Carbon oxidation- Glycolysis and its regulation.		
			BOTANY MINOR PROJECT				
			3rd	3	Aerobic and Anaerobic respiraton.		
Kreb's Cycle and its regulation .							

					Decarboxylation of Pyruvate.
			4th	4	Mitochondrial electron Transport System (ETS). Oxidative phosphorylation. Pentose Phosphate Pathway (PPP) Fermentation, ATP Synthetase. Cyanide Resistant respiration, P/O ratio,
			5th	5	factors affecting respiration. Nitrogen Metabolism- Nitrate assimilation- Nitrogen - cycle. Physiology and Biochemistry of N ₂ - fixation,, Ammonia Assimilation (GS-GOGAT) Pathway BOTANY MINOR PROJECT
3	III + IV+V	SEPTEMBER (22 Days)	1st	4	Amination and transamination, Amino acid Synthesis. Lipid Metabolism- Synthesis and Breakdown of triglycerides. Oxidation, glyoxylate cycle, Gluconeogenesis and its role in mobilization of lipids during seed germination.
			2nd	5	Photosynthesis - photosynthetic pigments Photosynthesis-action spectra and enhancement effect . Electron Transport System and Phosphorylation. PS I & II, Hill or Light reaction. BOTANY MINOR PROJECT
			3rd	5	C3 and C4 Photosynthesis and their differences, CAM reaction and its significance. Developmental roles of phytohormones - Auxins and Cytokinins, Developmental roles of phytohormones - Gibberellins, ABA and Ethylene. BOTANY MINOR PROJECT
			4th	5	Plant movement - autonomic and paratonic movements. Photoperiodisms (SDP, LDP, NDP) Phytochrome - red and far red light on seed physiology and dormancy. Vernalization and senescence.

					Biomolecules : Carbohydrates Nomenclature and classification.
			5th	0	
4	V+VI+VII	October (18 Days)	1st	1	BOTANY MINOR PROJECT
			2nd	5	Role of monosaccharides(Glucose, Fructose, Mannitol, Sorbitol)
					Disaccharides (sucrose, maltose, Lactose)
					Polysaccharides (Structural- Cellulose, Hemicellulose, Pectin, and Mucilage)
					Polysaccharides (Storage- Starch and Inulin)
					Lipids- Storage Lipids- Fatty acids (Structure and function)
			3rd	4	Structural Lipids- Phosphoglyceraldehydes
					Lipid functions as cell signals, cofactors,
					Lipid Functions as Prostaglandins
					Introduction of lipid micelles, monolayers and bilayers
			4th	2	Proteins - Structure of amino acids, peptide bonds
					Levels of protein structure - primary and secondary structure
			5th	4	Tertiary and quaternary structure of proteins
					Isoelectric point and protein denaturation.
					Biological roles of proteins.
					REVISION

Programme/Class: Bachelor of Science		Year: III	Semester: V Paper-II
Subject: BOTANY			
Course Code: B040502T		Course Title: Molecular Biology & Bioinformatics	
Course outcomes:			
After the completion of the course the students will be able to:			
1. Understand nucleic acids, organization of DNA in prokaryotes and Eukaryotes, DNA replication mechanism, genetic code and transcription process.			
2. Know about Processing and modification of RNA and translation process, function and regulation of expression.			
3. Gain working knowledge of the practical and theoretical concepts of bioinformatics			
Credits: 4		CC / Elective	
Max. Marks: 25+75		Min. Passing Marks:	
Total No. of Lectures-Tutorials-Practical (in hours per week) 4-0-0			
Unit	Topic	No. of Lectures(60hrs)	
I	Genetic material Miescher to Watson and Crick- historic perspective, Griffith's and Avery's transformation experiments, Hershey-Chase, bacteriophage experiment, DNA structure, types of DNA, types of genetic material. DNA replication (Prokaryotes and eukaryotes): semi – conservative. DNA replication (Prokaryotes and eukaryotes): bidirectional replication, semi-conservative, semi discontinuous RNA priming, θ (theta) mode of replication, replication of linear, dsDNA, replicating the 5' end of linear chromosome including replication enzymes.	7	
II	Transcription & Regulation of gene expression Types of structures of RNA (mRNA, tRNA, rRNA), RNA polymerase- various types; Translation, (Prokaryotes and eukaryotes), genetic code. Regulation of gene expression in Prokaryotes: Lac operon and Tryptophan operon; and in Eukaryotes	7	
III	Principles & Techniques of genetic engineering Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i.e. RAPD, RFLP, SNPs; DNA sequencing, PCR and Reverse Transcriptase-PCR. Hybridoma and monoclonal antibodies, ELISA and Immunodetection. Antibody Engineering.	8	
IV	Applications of Genetic engineering Pest resistant (Bt-cotton); herbicide resistant plants (RoundUp Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); Industrial enzymes (Aspergillase, Protease, Lipase); Genetically Engineered Products, Biosafety concerns..	7	
V	Bioinformatics & its applications Computer fundamentals - programming languages in bioinformatics, role of supercomputers in biology. Historical background. Scope of bioinformatics - Genomics, Transcriptomics, Proteomics, Metabolomics, Molecular Phylogeny, computer aided Drug Design (structure based and ligand based approaches), Systems Biology and Functional Biology. Applications and Limitations of bioinformatics.	8	
VI	Biological databases : Introduction to biological databases - primary, secondary and composite databases, NCBI, nucleic acid databases (GenBank, EMBL, DDBJ, NDB), protein databases (PIR, Swiss-Prot, TrEMBL, PDB), metabolic pathway database (KEGG, EcoCyc, and MetaCyc), small molecule databases (PubChem,)	8	

VII	Data Generation and Data Retrieval Generation of data (Gene sequencing, Protein sequencing, Mass spectrometry, Microarray), Sequence submission tools (BankIt, Sequin, Webin); Sequence file format (flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence annotation; Data retrieval systems (SRS, Entrez)	7
VIII	Phylogenetic analysis Similarity, identity and homology, Alignment local and global alignment, pairwise and multiple sequence alignments, alignment algorithms. Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA); Phylogenetic analysis: Construction of phylogenetic tree, dendrograms, methods of construction of phylogenetic trees.	8

Suggested Readings:

Course Books published in Hindi may be prescribed by the Universities.

1. **Dr Pooja Rai.** आण्विक जीव विज्ञान एवं जैव तकनीकी, **Bhopal**
2. **Sharma - Trivedi Molecular Biology And Biotechnology** (आण्विक जीव विज्ञान एवं जैव प्रौद्योगिकि) **by RBD Publisher**
3. Plant Physiology and Biochemistry ISBN #: 81-301-0035-5 Author: Sunil D Purohit, K. Ahmed & Gotam K Kukda Edition: 2013 Pages: 368 + VIII Type: Text Book (Hindi)
4. Molecular Biology Biotechnology ISBN #: 81-301-0033-9 Author: Sunil D Purohit & Gotam K Kukda Edition: 2013 Pages: 366 + X Type: Text Book (Hindi) Apex Publishing House, Udaipur, Rajasthan
5. Bioinformatics Paperback – 1 January 2015 by [Dr Archana Pandeya](#) (Author), [Santosh Choubey](#) (Editor), & [2 More](#) Hindi AISECT Ltd.
6. BIOTECHNOLOGY AND GENETIC ENGINEERING (Hindi, Hardcover, Dr. Archana Nigam)

1. Primrose, SB. 1995. Principles of Genome Analysis. Blackwell Science Ltd. Oxford, UK..
2. E.J. Gardner and D.P. Snustad. PRINCIPAL OF GENETICS (1984), John Wiley & Sons, New York.
3. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008 Molecular Biology of the Gene 6th edition. Cold Spring Harbour Lab. Press, Pearson Pub.
4. Freifelder - Molecular Biology.
5. P.K. Gupta. BIOTECHNOLOGY AND GENOMICS. Rastogi Publications, 7th Reprint (1st Edition): 2016-2017.
6. Ghosh, Z., Mallick, B. (2008). Bioinformatics – Principles and Applications, 1st edition. New Delhi, Delhi: Oxford University Press.
7. Baxevanis, A.D. and Ouellette, B.F., John (2005). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd edition. New Jersey, U.S.: Wiley & Sons, Inc.
8. Roy, D. (2009). Bioinformatics, 1st edition. New Delhi, Delhi: Narosa Publishing House.
9. Andreas, D., Baxevanis, B.F., Francis, Ouellette. (2004). Bioinformatics: A practical guide to the analysis of genes and proteins, 3rd edition. New Jersey, U.S.: John Wiley and Sons.
10. Pevsner J. (2009). Bioinformatics and Functional Genomics, 2nd edition. New Jersey, U.S.: Wiley Blackwell.
11. Xiong J. (2006). Essential Bioinformatics, 1st edition. Cambridge, U.K.: Cambridge University Press
12. A Textbook Of Basic And Molecular Genetics (pb) ISBN : 9788188826193 Edition : 01 Year : 2018 Author : Dr. Parihar P

This course can be opted as an elective by the students of following subjects:

Open to all but special for following: B.Sc. Math, B.Sc. Statistics, B.Sc. Nutrition, B.Sc. Biophysics, B.Sc. Biotech, B.Sc. Forestry, B.Sc. Agriculture.

Suggested Continuous Evaluation Methods: Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Course prerequisites:

Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry/ Biotech)

Facilities: Smart and Interactive Class

Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts

Suggested equivalent online courses:

<https://www.edx.org/learn/molecular-biology>

<https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>

<https://www.classcentral.com/course/swayam-genetic-engineering-theory-and-application-14090>

<https://www.coursera.org/courses?query=genetics>

<https://www.coursera.org/courses?query=molecular%20biology>

<https://www.edx.org/learn/genetic-engineering>

<https://www.mooc-list.com/tags/genetic-engineering>

<https://www.classcentral.com/course/edx-molecular-biology-part-1-dna-replication-and-repair-2907>

<https://nptel.ac.in/courses/102/103/102103013/>

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

Programme/Class: Bachelor of Science	Year: III	Semester: V Paper-III
Subject: Botany		
Course Code: B040503P	Course Title: Experiments in physiology, Biochemistry & molecular biology	

Course outcomes:

After the completion of the course the students will be able to:

1. Know and authentic the physiological processes undergoing in plants along with their metabolism
2. Identify Mineral deficiencies based on visual symptoms
3. Understand and develop skill for conducting molecular experiments for genetic engineering

Credits: 2	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:
Total No. of Lectures-Tutorials-Practical (in hours per week) 0-0-2	

Unit	Topic* <i>*(Perform any three from each unit based on facility)</i>	No. of Lectures(60 hrs)
I	<p>Plant water relation, Mineral Nutrition and translocation in phloem</p> <ol style="list-style-type: none"> 1. Determination of osmotic potential of plant cell sap by plasmolytic method using leaves of Rhoec / Tradescantia. 2. Osmosis – by potato osmoscope experiment 3. Effect of temperature on absorption of water by storage tissue and determination of Q10. 4. Experiment to demonstrate the transpiration phenomenon with the bell jar method 5. Experiment for demonstration of Transpiration by Four-Leaf Experiment: 6. Structure of stomata (dicot & monocot) 7. Determination of rate of transpiration using cobalt chloride method. 8. Experiment to measure the rate of transpiration by using Farmer’s Potometer 9. Experiment to measure the rate of transpiration by using Ganong’s potometer 10. Effect of Temperature on membrane permeability by colorimetric method. 11. Study of mineral deficiency symptoms using plant material/photographs. 	8
I	<p>Nitrogen Metabolism, Photo Synthesis & Respiration</p> <ol style="list-style-type: none"> 1. A basic idea of chromatography: Principle, paper chromatography and column chromatography; demonstration of column chromatography. 2. Separation of plastidial pigments by solvent and paper chromatography. 3. Estimation of total chlorophyll content from different chronologically aged leaves (young, mature and senescence) by Arnon method. 4. Effect of HCO₃ concentration on oxygen evolution during photosynthesis in an aquatic plant and to find out the optimum and toxic concentration (either by volume measurement or bubble counting). 5. Measurement of oxygen uptake by respiring tissue (per g/hr.) 6. Determination of the RQ of germinating seeds. 7. Effect of light intensity on oxygen evolution in photosynthesis using Wilmott’ bubble 	8
III	<p>Plant Development, Movements, Dormancy & Responses</p> <ol style="list-style-type: none"> 1. Geotropism and phototropism — Klinostat 2. Hydrotropism - <ol style="list-style-type: none"> a. Measurement of growth — Arc and Liver Auxonometer 3. To study the phenomenon of seed germination (effect of light). 4. To study the induction of amylase activity in germinating grains. 5. Test of seed viability by TTC method. 6. To study the effect of different concentrations of IAA on <i>Avena</i> coleoptile elongation (IAA bioassay) 	8

IV	Techniques for biochemical analysis <ol style="list-style-type: none"> 1. Weighing and Preparation of solutions -percentage, molar & normal solutions, dilution from stock solution etc. 2. Separation of amino acids by paper chromatography. 	8
	<ol style="list-style-type: none"> 3. Detection of organic acids: citric, tartaric, oxalic and malic from laboratory samples., 4. Qualitative Analysis of carbohydrates , 5. Estimation of reducing sugar by anthrone method, 6. Qualitative Analysis of Lipids 7. ,Qualitative analysis of Amino acids and Proteins 8. ,Quantitative Analysis of Nucleic Acids, 9. Analysis of dietary supplements, nutraceuticals & antioxidants 10. Testing of adulterants in food items. 	
V	Genetic material <ol style="list-style-type: none"> 1. Instruments and equipments used in molecular biology. 2. Preparation of LB medium and cultivating E.coli on it. 3. Isolation of Genomic DNA 4. Isolation of DNA from plants 5. Examination of the purity of DNA by agarose gel electrophoresis. 6. Quantification of DNA by UV-spectrophotometer 7. Estimation of DNA by diphenylamine method. 	7
VI	Preparation of models/ charts: <ol style="list-style-type: none"> 1. Study of experiments establishing nucleic acid as genetic material (Avery et al, Griffith's, Hershey & Chase's and Fraenkel & Conrat's experiments)through photographs 2. Numericals based on DNA re-association kinetics (melting profiles and Cot curves) 3. Study of DNA replication through photographs: Modes of replication - Rolling circle, Theta and semi-discontinuous ; Semiconservative model of replication Stahl's experiment); Telomerase assisted end-replication (Messelson and of linear DNA 4. Study of structures of : tRNA (2D and 3D); prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs 5. Study of the following through photographs: Assembly of Spliceosome machinery; Splicing mechanism in group I & group II introns; Ribozymes and Alternative splicing 6. Understanding the regulation of lactose (lac) operon (positive & negative regulation) and tryptophan (trp) operon (Repression and De-repression & Attenuation) through photographs. 7. Understanding the mechanism of RNAi by photographs 	7

VII	Genetic Engineering 1. Isolation of protoplasts. 2. Construction of restriction map of circular and linear DNA from the data provided. 3. Isolation of plasmid DNA. 4. Restriction digestion and gel electrophoresis of plasmid DNA (demonstration/ photograph). 5. Calculate the percentage similarity between different cultivars of a species using RAPD profile. Construct a dendrogram and interpret results. 6. Agarose gel analysis of plasmid DNA 7. Restriction digestion of plasmid DNA -Demonstration of PCR	7
VIII	Applications of Genetic engineering 1. ELISA Test, 2.. Viability tests of cells 3. Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment. 4. Study of steps of genetic engineering for production of Bt cotton, Golden rice, FlavrSavr tomato through photographs.	7

Suggested Readings:

Course Books published in Hindi may be prescribed by the Universities.

1. प्रयोगात्मक वनस्पति विज्ञान भाग 3 लेखक अशोक बेंद्रे तथा अशोक कुमार प्रकाशन रस्तोगी प्रकाशन मेरठ
1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. A Laboratory Manual Of Plant, Physiology, Biochemistry And Ecology ISBN : 9788177544589Edition : 01Year : 2012Author : Akhtar InamPublisher : Agrobios (India)
3. Advanced Methods In Physiology And Biochemistry (pb)ISBN : 9789381191132Edition : 01Year : 2016Author : Padmanaban G , Chandrasekaran CN , Thangavelu AU , Dr. Sivakumar R , Kalimuthu N , Dr. Boominathan P , Dr. Anbarasan P,Agrobios.
4. Methods in Plant Biochemistry and Molecular Biology. 1997. Dashek, WV (ed.). CRC Press.
5. Wilson and Walker .Practical Biochemistry: Principles and Techniques. Cambridge University Press.U.K.
6. Thimmaiah, SR. 2004. Standard Methods of Biochemical Analysis. Kalyani Publishers.
7. Henry, RJ. 1997. Practical Application of Plant Molecular Biology. Chapman & Hall, London

This course can be opted as an elective by the students of following subjects:

Open to all but special for following: B.Sc. Math, B.Sc. Statistics, B.Sc. Nutrition, B.Sc. Biophysics, B.Sc. Biotech, B.Sc. Forestry, B.Sc. Agriculture.

Course prerequisites:

Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry/ Biotech/ /Gardening)

Facilities: Smart and Interactive Class

Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts

Lab requisites: Electrophoresis units, Gelrocker, UV-transilluminator, Vortex Mixer, Shaker, CVT,

HiMedia Biotechnology &Molecular biology Kits/Chemicals, Micropipettes, Elisa reader/Microtitre Reader

Suggested equivalent online courses:

<https://www.edx.org/learn/molecular-biology>
<https://krishikosh.egranth.ac.in/handle/1/5810039999>
<https://www.classcentral.com/course/swayam-genetic-engineering-theory-and-application-14090>
<https://www.coursera.org/courses?query=genetics>
<https://www.coursera.org/courses?query=molecular%20biology>
<https://www.edx.org/learn/genetic-engineering>
<https://www.mooc-list.com/tags/genetic-engineering>
<https://www.classcentral.com/course/edx-molecular-biology-part-1-dna-replication-and-repair-2907>

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25
Other Requisites: All listed under all papers of the course.	
Suggested equivalent online courses: https://ndl.iitkgp.ac.in/ https://asiafoundation.org/what-we-do/books-for-asia?gclid=CjwKCAiA7939BRBMEiw/QhBITSyPnvj3r8yeio-L9f5uTy1a6oEoALCLa9Ebu0pyz858yQZxoC5wkQAvD_BwE http://w http://www.ulib.org/ http://www.tkdl.res.in/ http://www.vigyanprasar.gov.in/digilib Directory of Open Access Repositories (DOAR) http://www.openoar.org Registry of Open Access Repositories (ROAR) http://roar.eprints.org/	

Sunbeam College for Women, Bhagwanpur

B.Sc. Botany V Semester 2025-26 (Dr. Ekta Shukla & Dr. Yashveer Singh)

Course Code: B040503P Course Title: Experiments in Physiology, Biochemistry & Molecular Biology

Reference Books:

Molecular Biology - Alberts

Gene -Lewin

Molecular Cell Biology -Lodish

Molecular Biology and bioinformatics - Wisdom Publication

Biotechnology -by Promrose

Plant Physiology and Biochemistry-H.S. Srivastava

Botany Practical Volume II- Bendre and Kumar, Rastogi Publication

Biotechnology -by B.D. Singh

Practical Book of V semester -S.Chand Publication

S.No.	Unit	Month	Week	No. of Lab works	Topics/Experiments			
1	I + II	July (27 Days)	3rd	2	Determination of osmotic potential of plant cell sap by plasmolytic method			
					To demonstrate osmosis using potato osmometer.			
			4th	2	To demonstrate the rate of transpiration using Ganong's Potometer			
					To study the structure of stomata (Dicot and Monocot Leaf)			
			5th	2	To study the demonstration of separation of plant pigments			
					To study the the evolution of O ₂ during photosynthesis			
2	I+II+IV	August (24 Days)	1st	2	To study the phenomenon of seed germination under dark & light conditions			
					To study the test of seed viability by TTC methods			
			2nd	2	To measure the growth in plant using Arc Auxanometer			
					Weighing and Preparation of solutions -percentage, molar & normal solutions, dilution from stock solution			
			3rd	2	Separation of amino acids by paper chromatography.			
					Estimation of reducing sugar by anthrone method,/,Quantitative Analysis of Nucleic Acids			
			4th	2	Isolation of Genomic DNA/plant DNA			
					Examination of the purity of DNA by agarose gel electrophoresis.			
			5	2	To demonstrate the comparison of the rate of photosynthesis under different conditions			
					To determine the RQ of germinating seeds (Carbohydrates and Fats),			
			4	III +IV +V	September (22 days)	1st	2	Quantification of DNA by UV-spectrophotometer /Estimation of DNA by diphenylamine method.

					Study of experiments establishing nucleic acid as genetic material (Avery et al, Griffith's, Hershey & Chase's and Fraenkel & Conrat's experiments)through photographs
			2nd	2	Study of DNA replication through photographs: Modes of replication - Rolling circle, Theta and semi-discontinuous; Semiconservative model of replication (Messelson and Stahl's experiment),
			3rd	2	Telomerase assisted end-replication of linear DNA
					Understanding the regulation of lactose (lac) operon (positive & negative regulation)
			4th	2	Understanding the regulation of tryptophan (trp) operon (Repression and De-repression & Attenuation) through photographs.
					Restriction digestion and gel electrophoresis of plasmid DNA (demonstration/ photograph).
			5th	2	Calculate the percentage similarity between different cultivars of a species using RAPD profile. Construct a dendrogram and interpret results.
					Study of methods of gene transfer through photographs: Agrobacterium-mediated gene transfer
5	VI+VII+VIII	October (18 Days)	2nd	2	Study of methods of gene transfer through photographs: direct gene transfer by electroporation, microinjection, microprojectile bombardment.
					Study of steps of genetic engineering for production of Bt cotton, Golden rice, FlavrSavr tomato through photographs.
			3rd	2	LEFT OVER PRACTICALS
					LEFT OVER PRACTICALS
			5th	2	LEFT OVER PRACTICALS
LEFT OVER PRACTICALS					

Semester V, Paper-1
(Theory) Course Title:
Organic Synthesis A

Programme: Degree in Bachelor of Science	Year: Three	Semester: V
Paper-2 Theory	Compulsory	Subject: Chemistry
Course Code: B020501T	Course Title: Organic Synthesis A	
<p>Course outcomes: Hydrocarbons are the principal constituents of petroleum and natural gas. They serve as fuels and lubricants as well as raw materials for the production of plastics, fibers, rubbers, solvents and industrial chemicals. This course will provide a broad foundation in for the synthesis of hydrocarbons. Hydroxy and carbonyl compounds are industrially important compounds. The industries of plastics, fibers, petroleum and rubbers will specially recognize this course. Students will gain an understanding of which are used as solvents and raw material for synthesis of drug and other pharmaceutically important compounds.</p> <ul style="list-style-type: none"> • Synthesis and chemical properties of aliphatic and aromatic hydrocarbons • Synthesis and chemical properties of alcohols, halides carbonyl compounds, carboxylic acids and esters • How to design and synthesize aliphatic and aromatic hydrocarbons. • How to convert aliphatic and aromatic hydrocarbons to other industrially important compounds • Functional group interconversion. 		
Credits: 4	Elective	
Max. Marks: 25+75	Min. Passing Marks:	
Total No. of Lectures-60		
Unit	Topics	No. of Lectures
III	<p>Chemistry of Alkynes Methods of formation of alkynes, Addition to $C\equiv C$, mechanism, reactivity, regioselectivity and stereoselectivity; reactions: hydrogenation, halogenations, hydrohalogenation, hydration, oxymercuration demercuration, hydroboration-oxidation, dissolving metal reduction of alkynes (Birch); reactions of terminal alkynes by exploring its acidity; inter conversion of terminal and non-terminal alkynes.</p>	06
IV	<p>Aromaticity and Chemistry of Arenes Nomenclature of benzene derivatives, MO picture of benzene, Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their Mechanism. Directing effects of the groups. Birch reduction, Methods of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl, naphthalene and anthracene.</p>	10
VII	<p>Chemistry of Ethers and Epoxides: Nomenclature of ethers and methods of their formation, physical properties, Chemical reactions – cleavage and autoxidation, Ziesel's method. Synthesis of epoxides, Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides.</p>	05

VIII	Chemistry of Organic Halides Nomenclature and classes of alkyl halides, methods of formation, chemical reactions, Mechanisms of nucleophilic substitution reactions of alkyl halides, SN2 and SN1 reactions with energy profile	05
	diagrams; Polyhalogen compounds : Chloroform, carbon tetrachloride; Methods of formation of aryl halides, nuclear and side chain reactions; The addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions; Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides, Synthesis and uses of DDT and BHC.	
<p>Suggested Readings:</p> <ol style="list-style-type: none"> Morrison, R. N. & Boyd, R. N. <i>Organic Chemistry</i>, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). Sykes, P. <i>A guidebook to Mechanism in Organic Chemistry</i>, Pearson Education, 2003. Carey, F. A., Giuliano, R. M. <i>Organic Chemistry</i>, Eighth edition, McGraw Hill Education, 2012. Loudon, G. M. <i>Organic Chemistry</i>, Fourth edition, Oxford University Press, 2008. Clayden, J., Greeves, N. & Warren, S. <i>Organic Chemistry</i>, 2nd edition, Oxford University Press, 2012. Graham Solomons, T.W., Fryhle, C. B. <i>Organic Chemistry</i>, John Wiley & Sons, Inc. Smith, J. G. <i>Organic Chemistry</i>, Tata McGraw-Hill Publishing Company Limited. March, J. <i>Advanced Organic Chemistry</i>, Fourth edition, Wiley. \ <p>Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by the University</p> <p>Suggested online links: http://heecontent.upsdc.gov.in/Home.as dx https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm https://nptel.ac.in/courses/104/103/104103071/# https://nptel.ac.in/courses/104/106/104106096/</p>		
<p>This course is compulsory for the students of following subjects: Chemistry in 12th Class</p>		
<p>Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others .</p> <p>Or</p>		
Assessment and presentation of Assignment		(10 marks)
04 Unit tests (Objective): Max marks of each unit test = 10 (average of all 04 unit tests)		(10 marks)
Overall performance throughout the semester (Discipline, participation in different activities)		(05 marks)
<p>Course prerequisites: To study this course, a student must have Passed Sem-I, Theory paper</p>		
<p>Suggested equivalent online courses: </p>		
<p>Further Suggestions: </p>		

Lecture Plan
Academic session 2025-2026
Class– B.Sc. – V Semester

\Teacher Name: Dr. Chhaya Pandey

Course Code: B020501T

Course Title: Organic Synthesis A Paper I

Month	Unit	Week	No. of Planned Lecture	TOPIC
July	III	5th	1	Methods of formation of alkynes Addition to $C\equiv C$, mechanism, reactivity, regioselectivity and stereoselectivity ;reactions :hydrogenation ,halogenations, hydrohalogenation
August	III & IV	1st	Zero	---
		2nd	1	oxymercuration demercuration, hydroboration-oxidation, dissolving metal reduction of alkynes(Birch).
		3rd	2	Reactions of terminal alkynes by exploring its acidity; inter conversion of terminal and non-terminal alkynes.
		4th	1	Nomenclature of benzene derivatives, MO picture of benzene, Aromaticity: Hückel's rule, aromatic character of arenes,
		5th	1	Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their Mechanism.Directing effects of the groups. Birch reduction,
September	VII	1st	2	Methods of formation and chemical reactions of naphthalene and anthracene
		2nd	1	Nomenclature of ethers and methods of their formation, physical properties,
		3rd	2	Chemical reactions – cleavage and autoxidation, Ziesel's method. Synthesis of epoxides, Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening of epoxides.
		4th	1	orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides.
		5th	zero	
October	VIII	1st	Zero	---
		2nd	1	Nomenclature and classes of alkyl halides, methods of formation, chemical reactions, Mechanisms of nucleophilic substitution reactions of alkyl halides, SN_2 and SN_1 reactions with energy profile diagram.
		3rd	1	Polyhalogen compounds : Chloroform, carbon tetrachloride; Methods of formation of aryl halides, nuclear and side chain reactions.
		4th	Zero	
		5th	2	The addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions; Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides, Synthesis and uses of DDT and BHC.

Paper-2

Course Title: Rearrangements and Chemistry of Group Elements

Programme: Degree in Bachelor of Science	Year: Three	Semester: V
Paper-2 Theory	Elective	Subject: Chemistry
Course Code: B020502T	Course Title: Rearrangements and Chemistry of Group Elements	
<p>Course outcomes: This paper provides detailed knowledge of synthesis of various class of organic compounds and functional groups inter conversion. Organic synthesis is the most important branch of organic chemistry which provides jobs in production & QC departments related to chemicals, drugs, medicines, FMCG etc. industries.</p> <ul style="list-style-type: none">• It relates and gives an analytical aptitude for synthesizing various industrially important compounds.• This paper also provides a detailed knowledge on the elements present in our surroundings, their occurrence in nature. Their position in periodic table, their physical and chemical properties as well as their extraction. This paper also gives detailed understanding of the s, p, d and f block elements and their characteristics.		
Credits : 4	Elective	
Max. Marks: 25+75	Min. Passing Marks:	
Total No. of Lectures- = 60		
II	Catalysis General principles and properties of catalysts, homogenous catalysis (catalytic steps and examples) and heterogenous catalysis (catalytic steps and examples) and their industrial applications, Deactivation or regeneration of catalysts. Phase transfer catalysts, application of zeolites as catalysts. Enzyme catalysis; Michaelis-Menten equation, Lineweaver-Burk plot, turn-over number.	8
V	Chemistry of Lanthanides Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, ceric ammonium sulphate and its analytical uses.	4
VI	Chemistry of Actinides Electronic configuration, oxidation states and magnetic properties, chemistry of separation of Np, Pu and Am from U.	4
VII	Metal Carbonyls Metal carbonyls: 18-electron rule, preparation, structure and nature of bonding in the mononuclear and dinuclear carbonyls.	6

VIII	<p>Bioinorganic Chemistry</p> <p>Essential and trace elements in biological processes, metalloporphyrins with special reference to hemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Ca^{2+}. Nitrogen fixation.</p>	6
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Suggested Readings:

1. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Sykes, P. *A guidebook to Mechanism in Organic Chemistry*, Pearson Education, 2003.
3. Carey, F. A., Giuliano, R. M. *Organic Chemistry*, Eighth edition, McGraw Hill Education, 2012.
4. Loudon, G. M. *Organic Chemistry*, Fourth edition, Oxford University Press, 2008.
5. Clayden, J., Greeves, N. & Warren, S. *Organic Chemistry*, 2nd edition, Oxford University Press, 2012.
6. Graham Solomons, T.W., Fryhle, C. B. *Organic Chemistry*, John Wiley & Sons, Inc.

7. Smith, J. G. *Organic Chemistry*, Tata McGraw-Hill Publishing Company Limited.
8. March, J. *Advanced Organic Chemistry*, Fourth edition, Wiley.
9. Lee, J.D. Concise Inorganic Chemistry, Pearson Education 2010
10. Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles of Structure and Reactivity, Pearson Education 2006
11. Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970
12. Shriver, D.D. & P. Atkins, *Inorganic Chemistry 2nd Ed.*, Oxford University Press, 1994.
13. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications 1962.
14. Francis, P. G. Mathematics for Chemists, Springer, 1984
15. Prakash Satya, Tuli G.D., Basu S.K., Madan R.D., Advanced inorganic Chemistry, S.Chand publishing.

Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by the University

Suggested online links:

<http://heecontent.upsdc.gov.in/Home.aspx>

<https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm>

<https://nptel.ac.in/courses/104/103/104103071/#>

<https://swayam.gov.in/>

Lecture Plan

Academic session 2025-2026

Class– B.Sc. – V Semester

Teacher Name: Dr. Chhaya Pandey

Course Code: B020502T

Course Title: Rearrangements and Chemistry of Group Elements Paper 2

Month	Unit	Week	No. of Planned Lecture	TOPIC
July	V	4th	1	Chemistry of Lanthanides Electronic structure lanthanide contraction, complex formation.
August	VI & VII	1st	Zero	.
		2nd	1	Ceric ammonium sulphate and its analytical uses. Chemistry of Actinides Electronic configuration, oxidation states magnetic properties
		3rd	1	Chemistry of separation of Np, Pu and Am
		4th	2	Metal carbonyls Definition ,preparation and properties. 18-electron rule preparation
		5th	2	.Structure and nature of bonding in the mononuclear and dinuclear carbonyl
September	II	1st	Zero	
		2nd	1	Catalysis General principles and properties of catalysts, homogenous catalysis (catalytic steps and examples)
		3rd	1	Heterogenous catalysis (catalytic steps and examples) and their industrial applications,
		4th	2	Deactivation or regeneration of catalysts. Phase transfer catalysts, application of zeolites as catalysts.
		5th	Zero	----
October	II & VIII	2nd	2	Enzyme catalysis; Michaelis-Menten equation, Lineweaver-Burk plot, turn-over number.
		3rd	2	Essential and trace elements in biological processes, metalloporphyrins with special reference to heamoglobin and myoglobin.
		5th	2	Biological role of alkali and alkaline earth metal ions with specialreference to Ca^{2+} . Nitrogen fixation.

Semester V, Paper-3
(Practical) Course Title:
Qualitative Analysis

Programme: Degree in Bachelor of Science	Year: Three	Semester: V
Practical paper-3		Subject: Chemistry
Course Code: B020503P	Course Title: Qualitative Analysis	
Course outcomes: Upon completion of this course the students will have the knowledge and skills to: understand the laboratory methods and tests related to inorganic mixtures and organic compounds.		
<ul style="list-style-type: none"> • Identification of acidic and basic radicals in inorganic mixtures • Separation of organic compounds from mixture • Elemental analysis in organic compounds • Identification of functional group in organic compounds • Identification of organic compound 		
Credits: 2		Elective
Max. Marks: 25+75		Min. Passing Marks:
Practical		60 h
Unit	Topics	No of lectures
I	Inorganic Qualitative Analysis Semi micro Analysis – cation analysis, separation and identification of ions from Groups I, II, III, IV, V and VI, Anion analysis. Mixture containing 6 radicals-2 +4 or 4+ or 3+3	16
II	Elemental analysis and identification of functional groups Detection of extra elements (N, S and halogens) and functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines, amides, nitro and anilide) in simple organic compounds.	14
III	Separation of Organic Mixture Analysis of an organic mixture containing two solid components using water, NaHCO ₃ , NaOH for separation and preparation of suitable derivatives	18
IV	Identification of organic compounds Identification of an organic compound through the functional group analysis, determination of melting point and preparation of suitable derivatives.	12

Suggested Readings:

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.
5. Harris, D.C. *Exploring Chemical Analysis*, 9th Ed. New York, W.H. Freeman, 2016.
6. Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age International Publisher, 2009.

Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by the University

Suggestive digital platforms web links

4. <https://www.labster.com/chemistry-virtual-labs/>
5. <https://www.vlab.co.in/broad-area-chemical-sciences>
1. <http://chemcollective.org/vlabs>

This course can be opted as an elective by the students of following subjects: Chemistry in 12th Class

Suggested Continuous Evaluation Methods:

Viva voce	(10 marks)
Mock test	(10 marks)
Overall performance	(05marks)

Chemistry Practical PLAN

Academic session 2025-2026

Class– B.Sc. – V Semester

Teachers Name: Dr. Chhaya Pandey & Dr. Arun Kumar Upadhyay

Course Code: B020503P

Course Title: Qualitative

Analysis

Month	Unit	Week	No. of Planned Lecture	TOPIC
July	III	5th	2	Inorganic Qualitative Analysis Semi micro Analysis – cation analysis, separation and identification of ions from Groups I, II, III, IV, V and VI, Anion analysis. Mixture containing 6 radicals-2 +4 or 4+ or 3+3
August	III & IV	1st	2	Inorganic Qualitative Analysis Semi micro Analysis – cation analysis, separation and identification of ions from Groups I, II, III, IV, V and VI, Anion analysis. Mixture containing 6 radicals-2 +4 or 4+ or 3+3
		2nd	4	Inorganic Qualitative Analysis Semi micro Analysis – cation analysis, separation and identification of ions from Groups I, II, III, IV, V and VI, Anion analysis. Mixture containing 6 radicals-2 +4 or 4+ or 3+3
		3rd	4	Inorganic Qualitative Analysis Semi micro Analysis – cation analysis, separation and identification of ions from Groups I, II, III, IV, V and VI, Anion analysis. Mixture containing 6 radicals-2 +4 or 4+ or 3+3
		4th	4	Inorganic Qualitative Analysis Semi micro Analysis – cation analysis, separation and identification of ions from Groups I, II, III, IV, V and VI, Anion analysis. Mixture containing 6 radicals-2 +4 or 4+ or 3+3
		5th	4	Elemental analysis and identification of functional groups Detection of extra elements (N, S and halogens) and functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines, amides, nitro and anilide) in simple organic compounds.
September	VII	1st	2	Elemental analysis and identification of functional groups Detection of extra elements (N, S and halogens) and functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines, amides, nitro and anilide) in simple organic compounds.
		2nd	4	Elemental analysis and identification of functional groups Detection of extra elements (N, S and halogens) and functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines, amides, nitro and anilide) in simple organic compounds.

		3rd	4	Elemental analysis and identification of functional groups Detection of extra elements (N, S and halogens) and functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines, amides, nitro and anilide) in simple organic compounds.
		4th	4	Elemental analysis and identification of functional groups Detection of extra elements (N, S and halogens) and functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines, amides, nitro and anilide) in simple organic compounds.
		5th	4	Separation of Organic Mixture Analysis of an organic mixture containing two solid components using water, NaHCO ₃ , NaOH for separation and preparation of suitable derivatives
October	VIII	1st	Zero	---
		2nd	4	Separation of Organic Mixture Analysis of an organic mixture containing two solid components using water, NaHCO ₃ , NaOH for separation and preparation of suitable derivatives
		3rd	4	Identification of organic compounds Identification of an organic compound through the functional group analysis, determination of melting point and preparation of suitable derivatives.
		4th	2	Identification of organic compounds Identification of an organic compound through the functional group analysis, determination of melting point and preparation of suitable derivatives.
		5th	4	Identification of organic compounds Identification of an organic compound through the functional group analysis, determination of melting point and preparation of suitable derivatives.

Signature of HOD with date & seal

B.Sc. Third year
DETAILED SYLLABUS FOR
Degree in Bachelor of Science

Programme/Class: Degree	Year: Third	Semester: Fifth
Subject: ZOOLOGY		
Course Code: BS2450501T	Course Title: Diversity of Non-Chordates and Economic Zoology	
Course outcomes: The student at the completion of the course will be able to: The student at the completion of the course will be able to: <ul style="list-style-type: none"> • demonstrate comprehensive identification abilities of non-chordate diversity • explain structural and functional diversity of non-chordate • explain evolutionary relationship amongst non-chordate groups • Get employment in different applied sectors • Students can start their own business i.e. self employments. • Enable students to take up research in Biological Science 		
Credits: 4	Core: Compulsory	
Max. Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0		
Unit	Topic	Total No. of Lectures (60)
I	Basics of Animal Classification <ul style="list-style-type: none"> • Classification up to phylum, Systematics and Taxonomy. Codes of Zoological nomenclature 	6
II	Protozoa to Coelenterate <ul style="list-style-type: none"> • Protozoa – Paramecium (Morphology and Reproduction) • Porifera – Sycon (Canal System) • Coelenterata – Obelia (Morphology and Reproduction); coral reef diversity and conservation 	8
III	Ctenophora to Nematelminthes <ul style="list-style-type: none"> • Ctenophora - Salient features • Platyhelminthes - Taenia (Tape worm) (Morphology and Reproduction) • Nematelminthes – Ascaris lumbricoides (Morphology and Reproduction) 	8
IV	Annelida Metamerism in annelida <ul style="list-style-type: none"> • Annelida – Hirudinaria (Leech) (Morphology and Reproduction) 	8
V	Arthropoda <ul style="list-style-type: none"> • Arthropoda – Palaemon (Prawn) (Morphology, Appendages, Nervous System and Reproduction) • Vision in insects, metamorphosis in Lepidopteran insects. 	8
VI	Mollusca to Hemichordata <ul style="list-style-type: none"> • Mollusca – Pila (Morphology, Shell, Respiration, Nervous System and Reproduction) 	8

	<ul style="list-style-type: none"> • Modification of foot, Nervous system and torsion in Gastropoda • Echinodermata –Pentaceros (Morphology and Water Vascular System) 	
VII	Vectors and pests Life cycle and their control of following pests: Gundhi bug, Sugarcane leafhopper, Rodents. Termites and Mosquitoes and their control	8
VIII	Economic Zoology- Animal breeding and culture: Sericulture, Apiculture, Lac-culture, Vermiculture	7

Suggested Readings:

1. Barnes et al (2009). The Invertebrates: A synthesis. Wiley Backwell 17
2. Hunter: Life of Invertebrates (1979, Collier Macmillan)
3. Marshall: Parker & Haswell Text Book of Zoology, Vol. I (7th ed 1972, Macmillan)
4. Moore: An Introduction to the Invertebrates (2001, Cambridge University Press)
5. Brusca and Brusca (2016) Invertebrates. Sinauer
6. Jan Pechenik (2014) Biology of the invertebrates. McGraw Hill
7. Neilsen (2012). Animal Evolution: Interrelationships amongst living Phyla. Oxford
8. Parasitology- Chatterjee
9. Parasitology- Chakraborty
10. Thoms C. Chung. General Parasitology. Hardcourt Brace and Co. Ltd. Asia, New Delhi.
11. Gerard D. Schmidt and Larry S Roberts. Foundations of Parasitology. McGraw Hill.
12. Bisht. D.S., Apiculture, ICAR Publication.
13. Singh S., Beekeeping in India, Indian council of Agricultural Research, New Delhi.
14. Jhingran. V.G. Fish and fisheries in India.,
15. Khanna. S.S, An introduction to fishes
16. Boyd. C.E. & Tucker. C.S, Pond aquaculture water quality management,
17. Biswas. K.P, Fish and prawn diseases,
18. Pedigo, L.P. (2002). Entomology and Pest Management, Prentice Hall.
19. Lee, Earthworm Ecology
20. Stevenson, Biology of Earthworms
21. Destructive and Useful Insects by C. L. Metcalf
22. Sericulture for Rural Development : Hanumappa (1978), Himalaya Publication,
23. Sericulture in India Sarkar, D.C. (1988), CSB, Bangalore. Course Books published in Hindi may be prescribed by the Universities and Colleges

This course can be opted as an elective by the students of following subjects:

The eligibility for this paper is 10+2 with Biology as one of the subject

Suggested Continuous Evaluation Methods:

Class Test: 10 Marks

Written Assignment/Presentation/Project / Term Papers/Seminar: 15Marks

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions:

Sunbeam College for Women, Bhagwanpur, Varanasi

B.Sc. V Semester (Session: 2025-26)

Diversity of Non Chordates and Economic Zoology (B050501T) Paper I Theory

Dr. Madhumita Srivastava

Reference Books: 1. Diversity of Non Chordates and Economic Zoology by Kotpal & Tyagi
2. A Text Book of Zoology Invertebrates by R.L. Kotpal
3. Text Book of Invertebrates by E.L. Jordan

Sl. No.	Unit	Month	Week	No. of Lectures (39)	Topics
1			3rd	2	Unit I- Protozoa to Coelenterate Protozoa – Paramecium (Morphology and Reproduction) Porifera – Sycon (Canal System)
	I & II	July	4th	3	Coelenterata – Obelia (Morphology and Reproduction) Unit- II- Ctenophora to Nemathelminthes Ctenophora - Salient features Platyhelminthes - Taenia (Morphology and Reproduction)
			5th	2	Nemathelminthes –Ascaris lumbricoides - (Morphology and Reproduction)
2	III & IV	August	1st	2	Unit III- Annelida Annelida –Hirudinaria (Leech) - Morphology
			2nd	2	Hirudinaria- Morphology contd.
			3rd	2	Hirudinaria- Reproduction
			4th	3	Unit IV- Arthropoda Palaemon - Morphology, Appendages
			5th	3	Palaemon contd.- Nervous System and Reproduction
5	V & VI	September	1st	3	Unit V- Mollusca to Echinodermata Mollusca – Pila- Morphology, Shell Respiration, Nervous system and Reproduction
			2nd	3	Echinodermata- Pentaceros- Morphology and Water Vascular system Unit VI- Vectors and Pests Life cycle and control of following pests: Gundhi bug
			3rd	2	Sugarcane leafhopper Rodents
			4th	3	Termites Mosquitoes and their control
			5th	0	
6	VII & VIII	October	1st	1	Unit- VII Economic Zoology-1 Animal breeding and culture: Pisciculture
			2nd	3	Pisciculture contd.
			3rd	2	Unit VIII Economic Zoology- 2 Sericulture Apiculture
			4th	1	Lac culture
			5th	2	Vermiculture

B.Sc. Third year
DETAILED SYLLABUS FOR
Degree in Bachelor of Science

Programme/Class: Degree	Year: Third	Semester: Fifth
Subject: ZOOLOGY		
Course Code: B050502T	Course Title: Diversity of Chordates and Comparative Anatomy	
Course outcomes: The student at the completion of the course will be able to:		
<ul style="list-style-type: none"> • Demonstrate comprehensive identification abilities of chordate diversity • Explain structural and functional diversity of chordates • Explain evolutionary relationship amongst chordates • Take up research in biological sciences. 		
Credits:4		Core Compulsory/Elective
Max. Marks: 25+75		Min. Passing Marks: as per rules
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0		
Unit	Topic	Total No. of Lectures (60)
I	Origin of Chordates & Hemichordata <ul style="list-style-type: none"> • Origin of Chordates. Classification of Phylum Chordata upto the class. • Hemichordata: General characteristics, classification and detailed study of Balanoglossus (Habit and Habitat, Morphology, Anatomy, Physiology and Development). 	6
II	Cephalochordata and Urochordata <ul style="list-style-type: none"> • Cephalochordata : General characteristics, classification and detailed study of Branchiostoma (Amphioxus) (Habit and Habitat, Morphology, Anatomy, Physiology). • Urochordata : General characteristics, classification and detailed study of Herdmania(Habit and Habitat, Morphology, Anatomy, Physiology and Post Embryonic Development). 	6
III	Classification and General Characteristics of Vertebrates <ul style="list-style-type: none"> • General characters and Classification of different classes of vertebrates (Pisces, Amphibia, Reptilia, Aves, Mammalia) up to the order with examples. • Poisonous and Non Poisonous Snakes and biting mechanism. • Neoteny and Paedogenesis • Migration in birds • Dentition in Mammals 	8
IV	Comparative Anatomy and Physiology of Vertebrates <ul style="list-style-type: none"> • Integumentary System Structure, functions and derivatives of integument • Skeletal System Overview of axial and appendicular skeleton, Jaw suspensorium, Visceral arches 	8
V	<ul style="list-style-type: none"> • Digestive System Alimentary canal and associated glands, dentition	8
VI	<ul style="list-style-type: none"> • Respiratory System Skin, gills, lungs and air sacs; Accessory respiratory organs	8

VII	<ul style="list-style-type: none"> • Circulatory System General plan of circulation, evolution of heart and aortic arches • Urinogenital System Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri 	8
VIII	<ul style="list-style-type: none"> • Nervous System <p>Comparative account of brain Autonomic nervous system, Spinal cord, Cranial nerves in mammals Sense Organs .</p> <p>Classification of receptors Brief account of visual and auditory receptors in man</p>	8

Suggested Readings:

1. Harvey et al: The Vertebrate Life (2006)
2. Colbert et al: Colbert's Evolution of the Vertebrates: A history of the backboned animals through time (5th ed 2002, Wiley - Liss)
3. Hildebrand: Analysis of Vertebrate Structure (4th ed 1995, John Wiley)
4. Kenneth V. Kardong (2015) Vertebrates: Comparative Anatomy, Function, Evolution McGraw Hill
5. McFarland et al: Vertebrate Life(1979, Macmillan Publishing)
6. Parker and Haswell: TextBook of Zoology, Vol. II (1978, ELBS)
7. Romer and Parsons: The Vertebrate Body (6th ed 1986, CBS Publishing Japan)
8. Young: The Life of vertebrates (3rd ed 2006, ELBS/Oxford)
9. Weichert C.K and William Presch (1970). Elements of Chordate Anatomy, Tata McGraw Hills Co

Suggested Continuous Evaluation Methods:

Class Test: 10 Marks

Written Assignment/Presentation/Project / Research orientation assignment/ quiz/Seminar: 15

Sunbeam College for Women, Bhagwanpur, Varanasi

B.Sc. V Semester (Session 2025-26)

Course Code: B050502T

Course Title: Diversity of Chordates and Comparative Anatomy

Teacher- Dr. Priti Srivastava

Suggested Readings:

1. Harvey et al: The Vertebrate Life (2006)
2. Colbert et al: Colbert's Evolution of the Vertebrates: A history of the backboned animals through time (5th ed 2002, Wiley - Liss)
3. Hildebrand: Analysis of Vertebrate Structure (4th ed 1995, John Wiley)
4. Kenneth V. Kardong (2015) Vertebrates: Comparative Anatomy, Function, Evolution McGraw Hill
5. McFarland et al: Vertebrate Life(1979, Macmillan Publishing)
6. Parker and Haswell: TextBook of Zoology, Vol. II (1978, ELBS)
7. Romer and Parsons: The Vertebrate Body (6th ed 1986, CBS Publishing Japan)
8. Young: The Life of vertebrates (3rd ed 2006, ELBS/Oxford)
9. Weichert C.K and William Presch (1970). Elements of Chordate Anatomy, Tata McGraw Hills

S. No.	Unit	Month	Week	No. of lectures	Topics
1	I & II	July	2nd	2	Origin of Chordates & Hemichordata, Origin of Chordates. Classification of Phylum Chordata upto the class
			3rd	4	Hemichordata: General characteristics, classification and detailed study of Balanoglossus(Habit and Habitat, Morphology, Anatomy, Physiology and Development
			4th	2	Urochordata : General characteristics, classification and detailed study of Herdmania(Habit and Habitat, Morphology, Anatomy, Physiology and Post Embryonic Development
2	II & III	August	1st	2	Cephalochordata : General characteristics, classification and detailed study of Branchiostoma (Amphioxus) (Habit and Habitat, Morphology, Anatomy, Physiology).
			2nd	3	General characters and Classification of different classes of vertebrates (Pisces)
			3rd	2	General characters and Classification of different classes of vertebrates (, Amphibia); Neoteny and Paedogenesis
			4th	4	General characters and Classification of different classes of vertebrates (Reptilia, Aves); Poisonous and Non Poisonous Snakes and biting mechanism.
			5th	1	General characters and Classification of different classes of vertebrates (Aves)
3	III, IV & V	September	1st	3	General characters and Classification of different classes of vertebrates (Aves); Migration in birds
			2nd	4	General characters and Classification of different classes of vertebrates (Mammalia) upto the order with examples; Dentition in Mammals
			3rd	4	Comparative Anatomy and Physiology of Vertebrates Integumentary System; Structure, functions and derivatives of integument
			4th	4	Skeletal System Overview of axial and appendicular skeleton, Jaw suspensorium,Visceral arches
			5th		
4	VI, VII & VIII	October	1st		
			2nd	4	Digestive System Alimentary canal and associated glands, dentition
			3rd	3	Respiratory System Skin, gills, lungs and air sacs; Accessory respiratory organs
			4th	2	Circulatory System General plan of circulation, evolution of heart and aortic arches
			5th	2	Urinogenital System-Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri

Programme/Class: Degree	Year: Third	Semester: Fifth
Subject: ZOOLOGY		
Course Code: B050503P	Course Title: Lab on Virtual Dissection, Anatomy, Economic Zoology and Parasitology	
Course outcomes: The student at the completion of the course will be able to: <ul style="list-style-type: none"> • demonstrate comprehensive identification abilities of chordate and non- chordates diversity • explain structural and functional diversity of chordates and non- chordates • explain evolutionary relationship amongst chordates and non- chordates • Generate self employment • Enable students to take up research in biological sciences. 		
Credits: 2	Core: Compulsory	
Max. Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4		
Unit	Topic	Total No. of Lectures (60)
I	Study of animal specimens of various animal phyla. 1.To prepare permanent stained slide of septal nephridia of earthworm. 2.To take out the nerve ring of earthworm. 3.To take out hastate plate from Palaemon.	15
II	1.Study of animal specimens of various animal phyla 2. Study on use and ethical handling of model organisms (Mice, rats, rabbit and pig). 3. To prepare stained/unstained slide of placoid scales. 4. Comparative study of bones of different vertebrates. 5. Comparative study of histological slides of different tissues of vertebrates. 6. Design and construction of aquaria and its accessories	15
III	1.Permanent Preparation of: Euglena, Paramecium 2. Study of prepared slides/specimens of Entamoeba, Giardia, Leishmania, Trypanosoma, Plasmodium, Fasciola, Cotugnia, Taenia, Rallietina, Polystoma Schistosoma, Echinococcus, Enterobius, Ascaris and Ancylostoma 3. Permanent Preparation of Cimex (bed bug)/ Pediculus (Louse), Haematopinus (cattle louse), fresh water annelids, arthropods; and soil arthropods. 4. Larval stages of helminths and arthropods. 5. Permanent mount of wings, mouth parts and developmental stages of mosquito and house fly. Permanent preparation of ticks/ mites, abdominal gills of aquatic insects viz. Chironomus larva, dragonfly and mayfly nymphs, preparation of antenna of housefly. 6. Identification of pests. 7. Life history of silkworm, honeybee and lac insect. 8. Slides of plant nematodes. 9. Dissections: through multimedia / models Cockroach : Central nervous system	15
IV	9. Project Report/ model chart making on Aqua culture & aquarium biology- Exotic and Endemic species of Aquarium Fishes Types of Aquaria (Salinity, Temperature, Species Selection & Location) 1. Aquarium Setup and Accessories. 11. Dissections: through multimedia / models Wallago: Afferent and efferent branchial vessels, Cranial nerves, Weberian ossicles 11. Aquarium preparation	15

Virtual Labs (Suggestive sites) https://www.vlab.co.in https://zoologysan.blogspot.com www.vlab.iitb.ac.in/vlab https://www.vlab.co.in https://zoologysan.blogspot.com www.vlab.iitb.ac.in/vlab www.onlinelabs.in www.powershow.com https://vlab.amrita.edu https://sites.dartmouth.edu	
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Suggested Readings:

1. Harvey et al: The Vertebrate Life (2006)
2. Colbert et al: Colbert’s Evolution of the Vertebrates: A history of the backboned animals through time (5th ed 2002, Wiley - Liss)
3. Hildebrand: Analysis of Vertebrate Structure (4th ed 1995, John Wiley)
4. Kenneth V. Kardong (2015) Vertebrates: Comparative Anatomy, Function, Evolution McGraw Hill
5. McFarland et al: Vertebrate Life (1979, Macmillan Publishing)
6. Parker and Haswell: TextBook of Zoology, Vol. II (1978, ELBS)
7. Romer and Parsons: The Vertebrate Body (6th ed 1986, CBS Publishing Japan)
8. Young: The Life of vertebrates (3rd ed 2006, ELBS/Oxford)
9. Barnes et al (2009). The Invertebrates: A synthesis. Wiley Backwell 17
10. Marshall: Parker & Haswell Text Book of Zoology, Vol. I (7th ed 1972, Macmillan)
11. Moore: An Introduction to the Invertebrates (2001, Cambridge University Press)
12. Brusca and Brusca (2016) Invertebrates. Sinauer
13. Jan Pechenik (2014) Biology of the invertebrates. McGraw Hill
14. Boradale, L.A. and Potts, E.A. (1961). Invertebrates: A Manual for the use of Students. Asia Publishing Home
15. Robert Leo Smith Ecology and field biology Harper and Row publisher
16. Handbook of Practical Sericulture :Ullal, S.R. and Narasimhanna, M.N. (1987), Central Silk Board Publication, Bangalore.
17. Prost, P. J. (1962). Apiculture. Oxford and IBH, New Delhi.
18. Bisht. D.S., Apiculture, ICAR Publication.
19. Singh S., Beekeeping in India, Indian council of Agricultural Research, New Delhi.
20. Ullal S.R. and Narasimhanna, M.N. Handbook of Practical Sericulture: CSB, Bangalore
21. Jolly. M. S. Appropriate Sericultural Techniques; Ed., Director, CSR & TI, Mysore.
22. Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub. Co
23. Santanam, B. et al, A manual of freshwater aquaculture
24. Boyd. C.E. & Tucker. C.S, Pond aquaculture water quality management
25. Pedigo, L.P. (2002). Entomology and Pest Management, Prentice Hall.
26. Ranganathan L.S, Vermicomposting technology- soil health to human health

Suggested Continuous Evaluation Methods:
Class Test: 10 Marks
Written Assignment/Presentation/Project / Research orientation assignment/ quiz/Seminar: 15

Course Code: (B050503P) Course Title: Lab on Virtual Dissection, Anatomy, Economic Zoology and Parasitology

Teacher- Dr. Priti Srivastava

Suggested Readings:

1. Harvey et al: The Vertebrate Life (2006)
2. Colbert et al: Colbert's Evolution of the Vertebrates: A history of the backboned animals through time (5th ed 2002, Wiley - Liss)
3. Hildebrand: Analysis of Vertebrate Structure (4th ed 1995, John Wiley)
4. Kenneth V. Kardong (2015) Vertebrates: Comparative Anatomy, Function, Evolution McGraw Hill
5. McFarland et al: Vertebrate Life (1979, Macmillan Publishing)
6. Parker and Haswell: TextBook of Zoology, Vol. II (1978, ELBS)
7. Romer and Parsons: The Vertebrate Body (6th ed 1986, CBS Publishing Japan)
8. Young: The Life of vertebrates (3rd ed 2006, ELBS/Oxford)
9. Barnes et al (2009). The Invertebrates: A synthesis. Wiley Backwell 17
10. Marshall: Parker & Haswell Text Book of Zoology, Vol. I (7th ed 1972, Macmillan)
11. Moore: An Introduction to the Invertebrates (2001, Cambridge University Press)
12. Brusca and Brusca (2016) Invertebrates. Sinauer
13. Jan Pechenik (2014) Biology of the invertebrates. McGraw Hill
14. Boradale, L.A. and Potts, E.A. (1961). Invertebrates: A Manual for the use of Students. Asia Publishing Home
15. Robert Leo Smith Ecology and field biology Harper and Row publisher
16. Handbook of Practical Sericulture :Ullal, S.R. and Narasimhanna, M.N. (1987), Central Silk Board Publication, Bangalore.
17. Prost, P. J. (1962). Apiculture. Oxford and IBH, New Delhi.
18. Bisht. D.S., Apiculture, ICAR Publication.
19. Singh S., Beekeeping in India, Indian council of Agricultural Research, New Delhi.
20. Ullal S.R. and Narasimhanna, M.N. Handbook of Practical Sericulture: CSB, Bangalore
21. Jolly. M. S. Appropriate Sericultural Techniques; Ed., Director, CSR & TI, Mysore.
22. Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub. Co.
23. Santanam, B. et al, A manual of freshwater aquaculture
24. Boyd. C.E. & Tucker. C.S, Pond aquaculture water quality management
25. Pedigo, L.P. (2002). Entomology and Pest Management, Prentice Hall.
26. Ranganathan L.S, Vermicomposting technology- soil health to human health

S. No.	Unit	Month	Week	No. of lectures	Topics
2	I & II	July	3rd	2	Study of animal specimens and slides of Hemichordata
			4th	2	Study the slides and specimen of urochordata
			5th	2	Study the slide and specimen of cephalochordata.
3	II	August	1st	0	
			2nd	2	Study of animal specimens of various animal phyla (Pisces)
			3rd	2	Study of animal specimens of various animal phyla (amphibia and reptile)
			4th	2	Study of animal specimens of various animal phyla (Aves and Mammal)
			5th	2	Study on use and ethical handling of model organisms (Mice, rats, rabbit and pig).
4	II	September	1st	2	To prepare stained/unstained slide of placoid scales
			2nd	2	Comparative study of histological slides of different tissues of vertebrates.
			3rd	0	
			4th	2	Comparative study of bones of different vertebrates (cranium, axial skeleton & appendicular)
			5th	0	
5	IV	october	1st	0	
			2nd	2	To dissect and display Afferent and efferent branchial vessels of Wallago
			2nd	2	To dissect and display Cranial nerves, Weberian ossicles of wallago
			3rd	0	
			4th	2	Study of an aquatic ecosystem, its biotic components and food chain.

B.Sc. V Semester (Session: 2025-26)

Lab on Virtual Dissection, Anatomy, Economic Zoology and Parasitology (B050503P)

Practical - Dr. Madhumita Srivastava

Reference Books:

1. A Manual of Practical Zoology Invertebrates by P.S. Verma

2. Modern Practical Zoology by Yadav and Varshney

3. Practical Zoology by S.S. Lal

Sl. No.	Unit	Month	Week	No. of Lectures (64)	Topics
1	I	July	3rd	3	Study of animal specimens of various animal phyla. Project work
			4th	5	To prepare permanent stained slide of septal nephridia of earthworm To take out hastate plate from Palaemon. Project work
			5th	2	To take out the nerve ring of earthworm.
2	III	August	1st	3	Permanent Preparation of: Euglena, Paramecium Project work
			2nd	3	Study of prepared slides/specimens of Entamoeba, Giardia, Leishmania, Trypanosoma, Plasmodium Project work
			3rd	3	Study of prepared slides/specimens of Fasciola, Cotugnia, Taenia, Rallietina, Polystoma, Schistosoma, Echinococcus, Enterobius, Ascaris and Ancylostoma Project work
			4th	5	Permanent Preparation of Cimex (bed bug)/ Pediculus (Louse), Haematopinus (cattle louse) Project work
			5th	5	Permanent Preparation of fresh water annelids, arthropods; and soil arthropods. Project work
5	III	September	1st	4	Larval stages of helminths. Project work
			2nd	5	Larval stages of arthropods. Project work
			3rd	5	Permanent mount of wings, mouth parts and developmental stages of mosquito and house fly. Project work
			4th	5	Permanent preparation of ticks/ mites, abdominal gills of aquatic insects viz. Chironomus larva, dragonfly and mayfly nymphs, preparation of antenna of housefly. Project work
			5th	0	
6	III	October	1st	2	Identification of pests.
			2nd	5	Life history of silkworm, honeybee and lac insect. Project work
			3rd	3	Slides of plant nematodes. Project work
			4th	3	Cockroach : Central nervous system (Dissection) Project work
			5th	3	Project Report/ model chart making.

Co-curricular course: Semester-5

Course Title: Analytic Ability and Digital Awareness

Programme/Class: Bachelor of Science		Year: Third	Semester: Fifth
Subject: <u>Co-Curricular Course</u>			
Course Code: Z050501		Course Title: Analytic Ability and Digital Awareness	
Course outcomes (Analytic Ability):			
CO 1: Familiarize with analogy, number system, set theory and its applications, number system and puzzles. CO 2: To understand the basics of Syllogism, figure problems, critical and analytical reasoning. CO 3: Familiarize with word processing application and worksheet . CO 4: To understand the basics of web surfing and cyber security.			
Credits: 2		Co-Curricular	
Max. Marks: 25+75		Min. Passing Marks:	
Total No. of Lectures-Tutorials-Practical (in hours per week): 2-0-0			
Unit	Topic		No. of Lectures
I	Alphabet test, Analogy, Arithmetic Reasoning, Blood relations, Coding and Decoding, Inequalities, Logical Venn diagram, Seating Arrangements, Puzzles and Missing numbers		6L+2T+0P
II	Syllogism, Pattern completion and figure series, Embedded Figure and counting of figures, Cube & Dice, Paper cutting and folding, Data sufficiency, Course of Action, Critical Reasoning, Analytical and decision making		5L+2T+0P
III	Computer Basics: Block diagram of Digital Computer, Classification of Computers, Memory System, Primary storage, Auxiliary memory, Cache memory, Computer Software (System/Application Software), MS Word Basics: The word screen, Getting to word documents, typing and Revising text, Finding and Replacing, Editing and Proofing tools, Formatting text characters, Formatting Paragraph, Document templates., Page set up, tables, Mail Merge, Macros, protecting documents, printing a document.		2T+3P+3P
	MS-Excel Introduction, Worksheet basics, Creating worksheet, Heading information, Data & Text, Date & Time, Alphanumeric values, Saving & quitting worksheet, Opening and moving around in an existing worksheet, Toolbars and Menus, Excel shortcut and function keys, Working with single and multiple workbook, Working with formulae & cell referencing, Auto sum, coping formulae, Absolute & relative addressing, Worksheet with ranges, Formatting of worksheet, Previewing & Printing worksheet, Graphs and charts, Database, Creating and using macros, Multiple worksheets- concepts Introduction of Open Source Applications: LibreOffice, OpenOffice and Google Docs etc.		
IV	Web Surfing: An Overview: working of Internet, Browsing the Internet, E-Mail, Components of E-Mail, Address Book, Troubleshooting in E-Mail, Browsers: Netscape Navigator, Microsoft Internet Explorer, Google Chrome, Mozilla Firefox, Tor, Search Engines lik Google, DuckDuckGo etc, Visiting web sites: Downloading. Cyber Security: Introduction to Information System, Type of information system, CIA model of Information Characteristics, Introduction to Information Security, Need of Information Security, Cyber Security, phishing, spamming, fake news, general issues related to cyber security, Business need, Ethical and Professional issues of security.		3P+ 4T
Suggested Readings:			
1. Sharma, A., "How to prepare for Data Interpretation and Logical Reasoning for the CAT" McGraw Hill Education Pvt. Ltd., New Delhi, India, 2011, Ed. 5, ISBN 978 2007 070 481 2. Aggarwal, R.S., "A Modern Approach to Verbal and Non-verbal Reasoning" S. ChandPublishers New Delhi, India, 2010, ISBN 10: 8121905516 3. Madan , Sushila, Introduction to Essential tools, Jain Book Agency, New Delhi/India, 2009, 5 th ed.. 4. Goel, Anita, Computer Fundamentals, Pearson Education, India, 2012 5. Michael E. Whitman and Herbert J. Mattord, "Principles of Information Security," Sixth Edition, Cengage Learning, 2017			
Note: Course Books published in Hindi may be prescribed by the Universities.			
This course can be opted as an elective by the students of following subjects: "Co-Curricular"			

Suggested Continuous Evaluation Methods: **Max. Marks: 25**

1. Assessment Type: Class Tests (Max. Marks 14)

Suggested Usage:

Include all types of questions-essay, short answer, objective; Design to test all levels of domain; Exam Blue Print be prepared to ensure inclusion of all types & levels of questions and proper sampling of content; Marking Criteria made known to students; Teacher should provide written feedback selectively and discuss answers in the class; Only Role/Code numbers , not names be written to avoid bias in marking; Display of model answer copies.

After Completion of Unit I and Unit II, a first class test of max. marks of 7 shall be conducted.

After Completion of Unit III and IV, a second class test of max. marks of 7 shall be conducted.

If any student does not appear in any one or both class test, a makeup test shall be conducted of max. marks of 5 instead of total 14 marks.

2. Assessment Type: Quizzes/ Objective Tests / Recognition Type (such as MCQs; True or False; Matching; Classifying) /Recall Type -Filling Blanks; One word / PhraseAnswers (Max Marks: 5)

Suggested Usage: Teachers be trained in construction, advantages, disadvantages and precautions while preparing different types of objective items; Go beyond factual information to High Order Thinking (HOT) Skills. It shall be “End of the class quiz”.

3. Assessment Type: Assignments (Max Marks: 4)

Suggested Usage: Some class assignments shall be given to students at the end of each Unit. Note making techniques be taught to students; Not just direct questions from notes, but application analysis and synthesis of that knowledge.

4. Assessment Type: Group Discussion (Max. marks: 2)

Course prerequisites:None

Suggested equivalent online courses:

Further Suggestions: None

Sunbeam College for Women, Bhagwanpur, Varanasi

B.Com. Second Year

B. Sc. Fifth Semester

Co-curricular Course

Analytic Ability and Digital Awareness (Course Code: Z050501)

References:

1. Sharma, A., "How to prepare for Data Interpretation and Logical Reasoning for the CAT" McGraw Hill Education Pvt. Ltd., New Delhi
2. Aggarwal, R.S., "A Modern Approach to Verbal and Non-verbal Reasoning" S. Chand Publishers New Delhi
3. Basics of Computer by Dilip Jain
4. Goel, Anita, Computer Fundamentals, Pearson Education
5. Michael E. Whitman and Herbert J. Mattord, "Principles of Information Security," Sixth Edition, Cengage Learning

S. No.	Unit	Month	Week	No. of Lectures	Topics
1	I	July	3rd	2	Alphabet test , Analogy
			4th	2	Arithmetic reasoning, Blood relation
			5th	2	Coding and decoding, Inequalities
2	II	August	1st	2	Logical Venn diagram
			2nd	2	Seating Arrangements, Puzzles and missing numbers
			3rd	2	Syllogisms, Pattern completion and Figure Series
			4th	2	Embeded Figure and counting of figures, Cube and Dice
3	III	September	5th	2	Paper cutting and folding, Data Sufficiency, Course of Action
			1st	2	Critical Reasoning, Analytical and decision making
			2nd	2	Computer Basics: Block diagram of Digital Computer, Classification of Computers, Memory System, Primary storage, Auxiliary memory, Cache memory, Computer Software (System/Application Software)
			3rd	2	MS Word Basics: The word screen, Getting to word documents, typing and Revising text, Finding and replacing, Editing and proofing tools, Formatting Text characters , Mail merge, Protecting a document, Printing a document
4	IV	October	4th	2	MS-Excel: Introduction, Worksheet basics, Creating worksheet, Heading information, Data & Text, Date & Time, Alphanumeric values, Saving & quitting worksheet, Opening and moving around in an existing worksheet, Toolbars and Menus, Excel shortcut and function keys, Working with single and multiple workbook
			2nd	2	Working with formulae & cell referencing, Auto sum, coping formulae, Absolute & relative addressing, Worksheet with ranges, Formatting of worksheet, Previewing & Printing worksheet, Graphs and charts, Database, Creating and using macros, Multiple worksheets-concepts
			3rd	2	Introduction of Open Source Applications: LibreOffice, OpenOffice and Google Docs etc.
			4th	2	Web Surfing: An Overview: working of Internet, Browsing the Internet, E-Mail, Components of E-Mail, Address Book, Troubleshooting in E-Mail, Browsers: Netscape Navigator, Microsoft Internet Explorer, Google Chrome, Mozilla Firefox, Tor, Search Engines lik Google, DuckDuckGo etc, Visiting web sites: Downloading.
			5th	2	Cyber Security: Introduction to Information System, Type of information system, CIA model of Information Characteristics, Introduction to Information Security, Need of Information Security, Cyber Security, phishing, spamming, fake news, general issues related to cyber security, Business need, Ethical and Professional issues of security.

