SRIPAT SINGH COLLEGE

(Estd. 1949 Govt. Sponsored)

P.O. Jiaganj, Dist. Murshidabad, West Bengal, PIN–742123

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ACADEMIC CALENDAR

SESSION: July'24-December'24

Stream: Science

Distribution of Courses

List. 1 Academic and Prospectus Committee

Sl.	Members
1.	Dr. Kamal Krishna Sarkar, Chairperson, Principal
2.	Dr. Mitali Tikadar (ex-officio, TCS)
3.	Dr. Sagar Simlandy ((ex-officio, IQAC Coordinator)
4.	Dr. Shibu Paul (Convenor)
5.	Dr. Md. Habib, Member
6.	Dr. Amit Kumar Kundu, Member
7.	Ashok Raj Mahali
8.	Suraiya Yeasmin,
9.	Sabina Yeasmin, Member

Department (HoDs) (Arts Stream)

Sl.	Name of Departments	Names of HODs
1.	Physics	Paban Bitter
2.	Mathematics	Dr. Sudhanshu Kr. Biswas
3.	Chemistry	Dr. Amit Kumar Kundu
4.	Botany	Dr. Suchetana Mukherjee
5.	Zoology	Dr. Sajal Kr. Dey
6.	Molecular Biology and Bio Technology	Dr. Abhishek Basu
7.	Economics	Arunava Kr. Chowdhury
8.	Geography	Dr. Sakti Mandal
9.	Computer Science	Utsab Dutta
10.	Environment Science	Amitava Bhattacharya

Introduction

The Academic Calendar for the Science Stream for all the students of the Ten Science Departments of Sripat Singh College including Physics, Mathematics, Chemistry, Botany, Zoology, Molecular Biology and Bio Technology, Economics, Geography, Computer Science and Environment Science. This Calendar is prepared by the Academic Calendar and Prospectus Committee (List: 1) with the full support and help of all HODs (List:2) of the above-mentioned departments.

DEPARTMENT OF: PHYSICS

SEM-I (Major)

Courses	Courses Title	Topic	No. of Lectures	Teachers
Theory PHY-M-T-1 Marks (Semester End - 40, Internal Assessment -10) Theory: (4 Credits) No. of Lectures – 60	MATHEMATICAL PHYSICS-I	Unit-1-Calculus: a) Recapitulation: b) Second Order Differential equations: Unit-II-Vector Calculus: a) Recapitulation of vectors: b) Vector Differentiation: Unit -III-Vector Integration: Unit-IV-Orthogonal Curvilinear Coordinates: Unit-V-Matrices Unit-VI-Introduction to probability: Unit-VII-Dirac Delta function and its properties:	5 15 6 7 10 4 6 5 2	AKM DPD PB AH AH SB SB SM DPD
PRACTICAL PHY-M-P-1: Marks (Semester End - 20, Internal Assessment – 5) (Lab. Note Book - 05, Viva-Voce-05, Experiment -10) Practical - (2 Credits) No. of Lectures - 60	PHY-M-P-1: MATHEMATICAL PHYSICS-I	Uint-I- a) Introduction and Overview b) Basics of scientific computing c) Errors and error Analysis Unit-II a) Introduction to programming in Python/Fortran/Matlab/C/C++: b) Introduction to plotting graphs with Matplotlib/Gnuplot/Origin/Excel Unit-III a) Programs: b) Random number generation	15 15 30	AH DPD SM

		c) Solution of Algebraic and Transcendental equations by Bisection, Newton Raphson and Secant methods d) Interpolation by Newton Gregory Forward and Backward difference formula, Error estimation of linear interpolation e) Numerical differentiation (Forward and Backward difference formula) and Integration (Trapezoidal and Simpson rules), Monte Carlo method		
Theory PHY-SEC-T-1: Marks (Semester End – 35, Internal Assessment – 10) Internal Assessment [(Class Test/ Assignment/ quiz etc) - 10] Theory: (3 Credits) No. of Lectures - 45	ELECTRICAL CIRCUITS & NETWORK SKILLS	Unit-I- Basic Electricity Principles: Unit-II- Understanding Electrical Circuits: Unit-III- Generators and Transformers: Unit-IV- Electric Motors: Unit-V- Solid-State Devices: Unit-VI- Electrical Protection: Unit-VII- Electrical Wiring:	6 8 4 3 4 3 2	PB PB NH NH NH SM SM

Minor

Courses	Courses Title	Topic	No. of Lectures	Teachers
Theory PHY-MI-T-1: Marks (Semester End - 30, Internal Assessment – 5) Theory – (3 Credits) No. of Lectures - 45	MATHEMATICAL PHYSICS -I	Unit-I-Calculus: Unit-II-Vector Calculus: Unit-III-Vector Integration: Unit-IV-Matrices: Unit-V-Dirac Delta function and its properties:	15 13 10 5 2	NH AH AKM SB SB
Practical PHY-MI-P-1: Marks (Semester End - 10, Internal Assessment – 5) Practical - (1 Credits) No. of Lectures - 30	MATHEMATICAL PHYSICS-I	Unit-I-Introduction to programming in Python/Fortran/Matlab/C/C++: Unit-II-Introduction to plotting graphs with Matplotlib/Gnuplot/Origin/Excel Unit-III-Programs: Unit-IV-Random number generation Unit-V-Solution of Algebraic and Transcendental equations by	5 5 10 4 6	SB NH AH AH AH

		Bisection, Newton Raphson and Secant methods		

Sem-III(Major)

Courses	Courses Title	Topic	No. of Lectures	Teachers
Theory PHS-M-T-3 Marks (Semester End - 40, Internal Assessment – 10) Theory – (4 Credits) No. of Lectures - 60	ELECTRICITY AND MAGNETISM	Unit-I-Electric Field and Electric Potential	16	DPD
		Unit-II- Dielectric Properties of Matter	8	AH
		Unit-III-Magnetic Field	9	SB
		Unit-IV-Magnetic Properties of Matter	3	SM
		Unit-V- Electromagnetic Induction	5	SM
		Unit-VI-Transients	2	SM
		Unit-VII- Electrical Cricuits	4	PB
		Unit-VIII- Network Theorems	4	PB
		Unit-IX- Ballistic Galvanometer	3	PB
Practical PHS-M-P-3: Practical – 20 marks (Lab. Note Book – 05, Viva-Voce-05,Experiment - 10)	ELECTRICITY AND MAGNETISM	. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances and (e) Checking electrical fuses. 2. To study the characteristics of a series(a) RC Circuit. 3. To determine an unknown Low Resistance using Potentiometer. 4. To determine an unknown Low Resistance using Carey Foster's Bridge. 5. To compare capacitances using De' Sauty's bridge. 6. Measurement of field strength B and its variation in a solenoid (determine dB/dx) 7. To verify the Thevenin and Norton theorems. 8. To verify the Superposition, and Maximum power transfer theorems. 9. To determine self inductance of a coil by Anderson's bridge. 10. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.	60	AH+DPD SM+SB

		11. To study the response curve of a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q. 12. Measurement of charge and current sensitivity and CDR of Ballistic Galvanometer 13. Determine a high resistance by leakage method using Ballistic Galvanometer. 14. To determine self-inductance of a coil by Rayleigh's method. 15. To determine the mutual inductance of two coils by Absolute method. 16. To study the characteristics of a series LR Circuit. 17. Measurement of the resistance of a mirror galvanometer by the half deflection method and to determine its figure of merit		
PHY-SEC-T-2: Marks (Semester End – 35, Internal Assessment – 10) Internal Assessment [(Class Test/ Assignment/ quiz etc) - 10] Theory: (3 Credits) No. of Lectures - 45	Renewable Energy and Energy Harvesting	a) Fossil fuels and Alternate Sources of energy b) Solar energy c) Wind energy harvesting d) Ocean Energy e) Geothermal Energy f) Hydro Energy g) Piezoelectric Energy Harvesting Electromagnetic Energy Harvesting	30	AKM+NH

SEM-III(Minor)

Courses	Courses Title	Topic	No. of Lectures	Teachers
Theory PHS-MI-T-3: Marks (Semester End - 30, Internal Assessment – 5) Theory – (3 Credits) No. of Lectures – 45	ELECTRICITY AND MAGNETISM	Unit-I Electrostatics Unit-II Magnetism Unit-III Electromagnetic Induction Unit-IV Maxwells Equation and Electromagnetic wave propagation	22 10 7 6	NH SB AH AKM
Practical PHS-MI-P-03: Practical – 20 marks (Lab. Note Book – 05, Viva-Voce- 05,Experiment - 10) 60 Lectures	ELECTRICITY AND MAGNETISM	Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances and (e) Checking electrical fuses. 2. To study the characteristics of a series(a) RC Circuit. 3. To determine an unknown Low Resistance using Potentiometer.	30	SB+NH

		4. To determine an unknown Low Resistance using Carey Foster's Bridge. 5. To compare capacitances using De' Sauty's bridge. 6. Measurement of field strength B and its variation in a solenoid (determine dB/dx) 7. To verify the Thevenin and Norton theorems. 8. To verify the Superposition, and Maximum power transfer theorems. 9. To determine self inductance of a coil by Anderson's bridge. 10. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width. 11. To study the response curve of a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q. 12. Measurement of charge and current sensitivity and CDR of Ballistic Galvanometer		

SEM-V(CBCS)

Courses	Courses Title	Topic	No. of Lectures	Teachers
PHY-H-CC-T-11: (Credits: Theory-04, Practicals-02) Theory: 60 Lectures F.M. = 75(Theory - 40, Internal Assessment – 15) Internal Assessment: Class Attendance (Theory) – 05, Theory (Class Test/ Assignment/ Tutorial) – 05, Practical (Sessional Viva-voce) - 05]	QUANTUM MECHANICS AND APPLICATIONS	<u>Unit-I</u> a) Time dependent Schrodinger equation: b) Time independent Schrodinger equation- Hamiltonian <u>Unit-II</u> a) General discussion of bound states in an arbitrary potential b) Quantum theory of hydrogen-like atoms: <u>Unit-III</u> a) Atoms in Electric & Magnetic Fields: b) Atoms in External Magnetic Fields <u>Unit-IV</u> a) Many electrons atom	16 22 12 10	SM DPD SB SM

PHY-H-CC-P-11: QUANTUM MECHANICS AND APPLICATIONS Practical – 20 marks (Lab. Note Book – 05, Viva-Voce- 05,Experiment -10)	QUANTUM MECHANICS AND APPLICATIONS	1. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom: 2. Solve the s-wave radial Schrodinger equation for an atom: Laboratory based experiments: 3. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency 4. Study of Zeeman effect: with external magnetic field; Hyperfine splitting 5. To show the tunneling effect in tunnel diode using I-V characteristics. 6. Quantum efficiency of C CD s	60	SM
Theory PHY-H-CC-T-12 (Credits: Theory-04, Practicals-02) Theory: 60 Lectures F.M. = 75(Theory - 40, Internal Assessment – 15) Internal Assessment : Class Attendance (Theory) – 05, Theory (Class Test/ Assignment/ Tutorial) – 05, Practical (Sessional Viva-voce) - 05]	Solid State Physics	Unit-I a) Crystal Structure b) Superconductivity Unit-II a) Elementary Lattice Dynamics b) Ferroelectric Properties of Materials Unit-III a) Magnetic Properties of Matter b) Elementary band theory Unit-IV a) Dielectric Properties of Materials	18 16 18 8	SM NH SB DPD
PHY-H-CC-P-12: Practical – 20 marks (Lab. Note Book – 05, Viva-Voce- 05,Experiment -10)	SOLID STATE PHYSICS	1. Measurement of susceptibility of paramagnetic solution (Quinckf s Tube Method) 2. To measure the Magnetic susceptibility of Solids. 3. To determine the Coupling Coefficient of a Piezoelectric crystal. 4. To measure the Dielectric Constant of a dielectric Materials with frequency	60	DPD+PB

		5. To determine the complex dielectric constant and plasma frequency of metal using Surface Plasmon resonance (SPR) 6. To determine the refractive index of a dielectric layer using SPR 7. To study the PE Hysteresis loop of a Ferroelectric Crystal. 8. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis. 9. To measure the resistivity of a semiconductor (Ge) with temperature by four-probe method (room temperature to 150 °C) and to determine its band gap. 10. To determine the Hall coefficient of a semiconductor sample. 11.To measure the mutual inductance of two coaxial coils at various relative orientations using a ballistic galvanometer. 12.Verification of the inverse cube law for magnetic dipoles (study of the dependence of the field of a magnetic dipole on distance) and determination of the horizontal component of the earth's magnetic field by deflection and oscillation magnetometers.		
PHY-H-DSE-T-01: (Credits: Theory-05, Tutorials-01) Theory: 75 Lectures F.M. = 75 (Theory - 60, Internal Assessment – 15) Internal Assessment [Class Attendance – 05, Class Test/ Assignment/ Tutorial – 10]	CLASSICAL DYNAMICS	<u>Unit-I</u> a) Classical Mechanics of Point Particles b) Electromagnetic radiation <u>Unit-II</u> Special Theory of Relativity	37 38	PB SB+DPD
PHY-H-DSE-T-02: (Credits: Theory-05, Tutorials-01) Theory: 75 Lectures F.M. = 75 (Theory - 60, Internal Assessment – 15) Internal Assessment [Class Attendance – 05, Class Test/ Assignment/ Tutorial – 10]	NUCLEAR AND PARTICLE PHYSICS	<u>Unit-I</u> a) General Properties of Nuclei b) Nuclear Models c) Detector for Nuclear Radiations d) Particle Accelerators <u>Unit-II</u> a) Radioactivity b) Nuclear Reactions	33 28	AH AKM

		c) Nuclear Astrophysics d) Interaction of Nuclear Radiation with matter <u>Unit-III</u> Particle Physics	14	PB

SEM-V(PCC)

Courses	Courses Title	Topic	No. of Lectures	Teachers
PHY-G-DSE-T-01: (Credits: Theory-04, Practicals-02) F.M. = 75 (Theory - 40, Practical – 20, Internal Assessment – 15) Internal Assessment [Class Attendance (Theory) – 05, Theory (Class Test/ Assignment/ Tutorial) – 05, Practical (Sessional Viva-voce) - 05] Theory: 60 Lectures	ELECTRICITY AND MAGNETISM	<u>Unit-I</u> a) Vector Analysis <u>Unit-II</u> a) Electrostatics b) Magnetism <u>Unit-III</u> a) Electromagnetic Induction b) Maxwell's equation and Electromagnetic wave propagation	12 32 16	PB NH AKM
PHY-G-SEC-T-4 (Credits: 02) F.M. = 50 (Theory - 40, Internal Assessment – 10) Internal Assessment [Class Attendance	Basic Instrumentation Skills	<u>Unit-I</u> a) Basic of Measurement: b) Electronic Voltmeter: c) Cathode Ray Oscilloscope: <u>Unit-II</u> a) Signal Generators and Analysis Instruments: b) Impedance Bridges & Q-Meters: c) Digital Instruments: d) Digital Multimeter:	17 13	PB NH

DEPARTMENT OF MATHEMATICS

DISTRIBUTION OF COURSES IN SEMESTER-I: July 2024 - December 2024

MAJOR

Courses	Course title	Topic	No .of lectures (inclusive of Tutorials)	Teacher
Course Code: MATH-M-T-01 Major Course; Credit-6; Full Marks-75	Course Title: Calculus & Analytical Geometry	Unit 1. ● Hyperbolic functions and its derivative, higher order derivatives, Leibnitz rule and its applications to problems of type $eax+b\sin x, eax+bcosx, (ax+b)nsinx, (ax+b)ncosx.$ ● Pedal equations. ● Curvature, radius of curvature, centre of curvature, circle of curvature ● Asymptotes ● Envelopes. ● Singular points, concavity and inflection points. ● Curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves. ● L'Hospital's rule, applications in business, economics and life sciences. Unit 2. ● Reduction formulae, derivations and illustrations of reduction formulae of the type $\int sinnx\ dx, \int cosnxdx, \int tannxdx, \int secnxdx, \int (\log x)ndx, \int sinnxcosmxdx.$ ● Parametric equations, parameterizing a curve, arc length of a curve, arc length of parametric curves, area under a curve, area and volume of surface of revolution, techniques of sketching conics. Unit 3. ● Transformation of coordinate axes, pair of straight line, reflection properties of conics, rotation of axes and second-degree equations, classification of conics using the discriminant, polar equations of conics. ● Straight lines in 3D, sphere, cylindrical surfaces. central conicoids, paraboloids, plane sections of conicoids, generating lines, classification of quadrics, illustrations of graphing standard quadric surfaces like cone, ellipsoid.	25L 16L 30L	PM ARM UA
Course Code: MATH-SEC-T-01 Skill Enhancement Course; Credit-3; Full Marks-45	Course Title: Logic & Boolean Algebra	Unit 1. ● Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contrapositive and inverse propositions and precedence of logical operators. ● Propositional equivalence, Logical equivalences. ● Predicates and quantifiers: Introduction, quantifiers, binding variables and negations. Unit 2. • • Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle. • ● Lattices as ordered sets, lattices as algebraic structures, sublattices, products and homomorphisms. Unit-3 • • Definition, examples and properties of modular and distributive lattices, Boolean algebras, Boolean polynomials, minimal and maximal forms of Boolean polynomials. • ● Quinn-McCluskey method, Karnaugh diagrams, logic gates, switching circuits and applications of switching circuits.	15L 10L 20L	UA SKB SKB

Mathematics Minor

Courses	Course title	Topic	No .of lectures (inclusive of Tutorials)	Teacher
MATH-MI-T-01 Minor Course; Credit-4; Full Marks-50	Algebra & Analytical Geometry	Unit 1. ● Complex Numbers: De Moivre's theorem and its applications. Exponential, Sine, Cosine and Logarithm of a complex number. Definition of az. Inverse circular and hyperbolic functions. ● Polynomials: Fundamental theorem of algebra (Statement only). Polynomials with real coefficients, nature of roots of an equation (surd or complex roots occur in pairs). Statement of Descartes's rule of signs and its applications. Relation between roots and coefficients, transformations of equations. Cardan's method of solution of a cubic equation. ● Rank of a matrix: Determination of rank either by considering minors or by the sweep-out process. Consistency and solution of a system of linear equations (not more than 3 variables) by matrix method. ● Equivalence relations and partitions. Functions, composition of functions, invertible functions, one-to-one correspondence and cardinality of a set ● Definition and elementary properties of groups. Concepts of permutation Group, alternating group, finite groups: $S3$, $V4$. The group Zn of integers under addition modulo n. ● Order of an element, order of a group, subgroups and examples of subgroups. Unit 2. ● Transformations of rectangular axes: Translation, rotation and their combinations. Invariants. ● General equation of second degree in x and y: Reduction to canonical forms. Classification of conics. ● Pair of straight lines: Condition that the general equation of 2nd degree in x and y may represent two straight lines. Point of intersection of two intersecting straight lines. Angle between two lines given by ax2+2hxy+by2=0. Equation of bisectors. Equation of two lines joining the origin to the points in which a line meets a conic. ● Polar equation of straight lines and circles. Polar equation of a conic refers to a focus as a pole. Equation of chord joining two points. Equations of tangents and normals. ● Sphere and its tangent planes. Right circular cone.	20L 30L	ARM UA

SEMESTER-III (MAJOR)

Courses	Course title	Topic	No .of lectures (inclusive	Teacher

			of Tutorials)	
Course Code: MATH-M-T-03 Major Course; Credit-6; Full Marks-75	Course Title: Real Analysis-I	Unit 1. • Review of algebraic and order properties of R. • Idea of countable sets, uncountable sets and uncountability of R. Countability of Q. • Bounded above sets, bounded below sets, bounded sets, unbounded sets. Suprema and infima. • Completeness property of R and its equivalent properties. • The Archimedean property, density of rational (and irrational) numbers in R, intervals. • Intervals, ε-neighbourhood of a point in R, interior points, limit points, isolated points, open set, closed set, union and intersection of open and closed sets. Derived set, closure of a set, interior of a set. • Illustrations of Bolzano-Weierstrass theorem for sets.	10L 15L	UA ARM
		Unit 2. • Sequences, bounded sequence, convergent sequence, limit of a sequence, lim inf, lim sup. • Limit theorems. Sandwich theorem. Nested interval theorem • Monotone sequences, monotone convergence theorem. • Subsequences, divergence criteria. Monotone subsequence theorem (statement only). • Bolzano Weierstrass theorem for sequences. • Cauchy sequence, Cauchy's convergence criterion, Cauchy's 1st and 2nd limit theorem	15L	ARM
		Unit 3. • Infinite series, convergence and divergence of infinite series, Cauchy criterion. • Tests for convergence: comparison test, limit comparison test, ratio test: D'Alembert's ratio test, Raabe's test, Cauchy's root test, Gauss test, integral test, Cauchy's condensation test with examples. • Alternating series, Leibnitz test. Absolute and conditional convergence.	15L	ARM
		Unit 4. Limits of functions (ε - δ approach). Sequential criterion for limits. Divergence criteria. Limit theorems, one sided limit. Infinite limits and limits at infinity.		

		Unit 5. ● Continuous functions, neighbourhood property. Sequential criterion for continuity and discontinuity. Algebra of continuous functions. Continuous functions on an interval, ● Bolzano's Theorem, intermediate value theorem. Location of roots theorem, preservation of intervals theorem. ● Uniform continuity, non-uniform continuity criteria, uniform continuity theorem. ● Differentiability of a function at a point and in an interval ● Caratheodory's theorem, ● Algebra of differentiable functions. ● Darboux's theorem ● Rolle's theorem. ● Lagrange's and Cauchy's mean value theorems. ● Taylor's theorem with Lagrange's and Cauchy's forms of remainder. ● Application of Taylor's theorem to convex functions. ● Applications of mean value theorem to inequalities and approximation of polynomials. ● Relative extrema, interior extremum theorem. ● Taylor's series and Maclaurin's series expansions of exponential and trigonometric functions, ● Application of Taylor's theorem to inequalities.	15L	UA
Course Code: MATH-SEC-T-03 Skill Enhancement Course; Credit-3; Full Marks-45	Course Title: Progra-mming in C	Unit 1. ●Brief historical development. Computer generation. Basic structure and elementary ideas of computer systems, operating systems, hardware and software. ● Positional number systems: Binary, octal, decimal, hexadecimal systems. Binary arithmetic. ● BIT, BYTE, WORD. Coding of data -ASCII, EBCDIC, etc.	15L	PM & SKB

		● Algorithms and flow chart: Important features, ideas about complexities of algorithms. Application in simple problems. Unit 2. • Programming language and importance of 'C' programming. ● Constants, variables and data type of 'C'-Program: Character set. Constants and variables data types, expression, assignment statements, declaration. ● Operation and expressions: Arithmetic operators, relational operators, logical operators. ● Decision making and branching: Decision making with if statement, if-else statement, nesting if statement, switch statement, break and continue statement. ● Control statements: While statement, do-while statement, for statement ● Arrays: One-dimension, two-dimensional and multidimensional arrays, declaration of arrays, initialization of one and multi-dimensional arrays . ● User-defined Functions: Definition of functions, scope of variables, return values and their types, function declaration, function call by value, nesting of functions, passing of arrays to functions, recurrence of function. ● Application to simple problems: Evaluation of functional values, solution of quadratic equations with real coefficients, approximate sum of convergent infinite series, sorting of real numbers..	30L	PM &SKB

MINOR, SEM-III

Courses	Course title	Topic	No .of lectures (inclusive of Tutorials)	Teacher
MATH-MI-T-02 Minor Course; Credit-4; Full Marks-50	Course Title: Calculus & Differential Equations	Unit 1. ● Real-valued functions defined on an interval, limit and Continuity of a function. Algebra of limits. Differentiability of a function. ● Successive derivative: Leibnitz's theorem and its application to problems. ● Partial derivatives. Euler's theorem on homogeneous function of two and three variables. ● Curvature, rectilinear asymptotes . ● Indeterminate Forms: L'Hospital's Rule (Statement and Problems only). ● Statement of Rolle's Theorem and its geometrical interpretation. Mean value theorems of Lagrange and Cauchy. Statements of Taylor's and Maclaurin's theorems with Lagrange's and Cauchy's forms of remainders. Taylor's and Maclaurin's infinite series of functions like e^x, sinx, cosx, $(1+x)^n$, log(1+x) with restrictions wherever necessary. ● Application of the principle of maxima and minima for a function of a single variable . Unit 2. ● Reduction formulae, derivations and illustrations of reduction formulae. Unit 3.	20L 5L	ARM SKB

		●First order equations: (i) Exact equations and those reducible to such equations. (ii) Euler's and Bernoulli's equations (Linear). (iii) Clairaut's Equations: General and Singular solutions. ● Second order differential equation: (i) Method of variation of parameters, (ii) Method of undetermined coefficients ●Linear homogeneous equations with constant coefficients, method of variation of parameters, simultaneous differential equations.	20L	ARM

SEMESTER-V (CBCS)

Courses	Course title	Topic	No .of lectures (inclusive of Tutorials)	Teacher
Course: MATH-H-CC-T-11, Core Course; Credit-6; Full Marks-75	Course title: Riemann Integration and Series of Functions	Unit 1. ● Riemann integration: inequalities of upper and lower sums, Darbaux theorem, Riemann conditions of integrability, Riemann sum and definition, Riemann integral through Riemann sums. ● Equivalence of two definitions. Riemann integrability of monotone and continuous functions, properties of the Riemann integral; definition and integrability of piecewise continuous and monotone functions. ● Fundamental theorem of integral calculus. ● 1st and 2nd mean value theorems for integral calculus. Unit 2. ● Improper integration: Type1, Type2. Necessary and sufficient condition for convergence of improper integral in both cases. Cauchy's Criterion. Cauchy's principal value. ● Tests of convergence: Comparison and -test. Absolute and non-absolute convergence and. bel's and Dirichlet's test for convergence on the integral of a product. ● Convergence of Beta and Gamma functions. Relation between Beta and Gamma functions and related problems. Unit 3. ● Pointwise and uniform convergence of sequence of functions. Theorems on continuity, derivability and integrability of the limit function of a sequence of functions. ● Series of functions. Theorems on the continuity and derivability of the sum function of a series of functions; Cauchy criterion for uniform convergence and Weierstrass - Test. ● Power series, radius of convergence, Cauchy Hadamard theorem. Differentiation and integration of power series; bel's theorem; Weierstrass approximation theorem. Unit 4. ● Fourier series: Definition of Fourier coefficients and series, examples of Fourier expansions and summation results for series.	23L 22L 25L 5L	ARM ARM ARM ARM

Course: MATH-H-CC-T-12, Core Course; Credit-6; Full Marks-75	Course title: Mechanics-I	Unit-1: ● Motion in a straight line, motion under attractive and repulsive forces, motion under acceleration due to gravity. ● Simple harmonic motion, horizontal oscillation, composition of two S.H.M.'s, damped harmonic motion, forced oscillation, damped forced oscillation. ● Motion in a resisting medium: Vertical and curvilinear motion in a resisting medium. ● Motion of varying mass: Equations of motion. Unit-2: ● Work, Power and Energy: Definitions. Work done in stretching an elastic string. ● Conservative forces. Conservation of energy. ● Impulse and impulsive forces: Impulse of a force. Impulsive forces. Conservation of linear momentum. ● Collision of elastic bodies: Elasticity. Impact of smooth bodies. Impact on a fixed plane. Direct and oblique impact of two smooth spheres. Loss of kinetic energy. Angle of deflection. Unit-3: ● Motion in a Plane: Velocity and acceleration of a particle moving on a plane in Cartesian and polar coordinates. Motion of a particle moving on a plane refers to a set of rotating rectangular axes. Angular velocity and acceleration. Circular motion. Tangential and normal accelerations. ● Central orbit: Characteristics of central orbits. Areal velocity. Law of force for elliptic, parabolic and hyperbolic orbits. Velocity under central forces. Orbit under radial and transverse accelerations. Stability of nearly circular orbits. ● Planetary motion ewtonian law. Orbit under inverse square law. Kepler's laws of planetary motion. Time of description of an arc of an elliptic, parabolic and hyperbolic orbit. Effect of disturbing forces on the orbit. Artificial satellites: Orbit round the earth. Parking orbits. Escape velocity. Unit-4: ● Degrees of freedom. Moments and products of inertia: Moment of inertia (M.I) and product of inertia (P.I.) of some simple cases. M.I. about a perpendicular axis. Routh's rule. M.I. about parallel axes. M.I. about any straight line. M.I. of a lamina about a straight line in its plane. Momental ellipsoid. Equi-momental systems. ● General equations of motion D' lembert's principle and its application to deduce general equations of motion of a rigid body. Motion of the centre of inertia (C.I.) of a rigid body. Motion relative to C.I. ● Motion about an axis: Rotation of a rigid body about a fixed body. Equation of motion. K.E. of the body rotating about an axis. Compound pendulum and its minimum time of oscillation. 30 ● Motion in two dimensions under finite forces: Equations of motion. K.E. and angular momentum about the origin of a rigid body moving in two dimensions. Two – dimensional of a solid of revolution down a rough inclined plane. Necessary and sufficient conditions for pure rolling.	15L 10L 20L 30L	PM PM PM PM

Course: MATH-H-DSE-T-1B Discipline Specific Elective Course; Credit-6; Full Marks-75	Course title: Partial Differential Equations & Laplace Transforms	Unit 1. ● Derivation of heat equation, wave equation and Laplace equation. ● Classification of second order linear equations. ● Reduction of second order linear equations to canonical forms. Unit 2. [30L] ● The Cauchy problem, Cauchy-Kovalevskaya theorem (Statement only), Cauchy problem of an infinite string. ● Initial boundary value problems. Semi-infinite string with a fixed end, semi-infinite string with a free end. ● Method of separation of variables, solving the vibrating string problem. Solving the heat conduction problem. ● One dimensional diffusion equation and parabolic differential equations. Method of separation of variables. Solving the vibrating string problem and the heat conduction problem. ● Wave equation. Unit 3. □ Laplace Transform (LT) of Elementary functions. Properties of LTs: change of scale theorem, shifting theorem. LTs of derivatives and integrals of functions, derivatives and integrals of LTs. LT of Dirac Delta function, periodic functions. □ Convolution Theorem. Inverse LT. Application of Laplace transforms to solve ordinary and partial differential equations. 32 Graphical Demonstration (Teaching aid) [10L] 1. Solution of Cauchy problem for first order PDE. 2. Finding the characteristics for the first order PDE. 3. Plot the integral surfaces of a given first order PDE with initial data. 4. Solution of wave equation for the following associated conditions: (a) (b) 5. Solution of wave equation for the following associated conditions: (a) (b)	20L 30L 20L 10L	SKB SKB SKB SKB
Course: MATH-H-DSE-T-2A Discipline Specific Elective Course; Credit-6; Full Marks-75	Course title: Number Theory	Unit 1. ● Linear diophantine equation, prime counting function, statement of prime number theorem. ● Goldbach conjecture, linear congruences, complete set of residues. ● Chinese remainder theorem, Fermat's little theorem, Wilson's theorem, Statement of Fermat's Last theorem and their applications. 33 Unit 2. ● Number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet product, the Mobius Inversion formula, the greatest integer function. ● Euler's phi-function, Euler's theorem, reduced set of residues, some properties of Euler's phi-function. Unit 3. [30L] ● Order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots. ● Euler's criterion, the Legendre symbol and its properties, quadratic reciprocity, quadratic congruences with composite moduli. ● Prime number and its properties. ● The arithmetic of , a prime, pseudo prime and Carmichael Numbers, Fermat Numbers, perfect numbers, Mersenne numbers. ● Public key encryption, RSA encryption and decryption, the equation	20L 25L 30L	UA UA UA

SEMESTER-V (PROGRAMME COURSE)

Courses	Course title	Topic	No .of lectures (inclusive of Tutorials)	Teacher
Course: MATH-G-DSE-T-1A Discipline Specific Elective Course; Credit-6; Full Marks-75	Course title: Group Theory & Linear Algebra	Unit 1. ● Definition and examples of groups, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of a group, examples of subgroups including the center of a group. ● Cosets, Index of subgroups, Lagrange's theorem, order of an element. ● Normal subgroups, their definition, examples, and characterizations, Quotient groups. Unit 2: ● Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces. 13 ● Characteristic Polynomial, Eigenvalues and Eigenvectors. ● Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations. ● Dual Space, Dual Basis, Change of basis. ● Matrices in diagonal form. Reduction to diagonal form upto matrices of order 3.	30L 45L	SKB SKB
Course: MATH-G-SEC-T-3A Skill Enhancement Course; Credit-2; Full Marks-50	Course title: Theory of Probability	Unit 1: ● Sample space, probability axioms, real random variables (discrete and continuous). ● Cumulative distribution function, probability mass/density functions. ● Mathematical expectation, moments, moment generating function, characteristic function, discrete distributions: uniform, binomial, Poisson, continuous distributions: uniform, normal, exponential. Unit 2: ● Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions. ● Expectation of function of two random variables, conditional expectations, independent random variables.	13L 12L	PM PM

DEPARTMENT OF CHEMISTRY

B.Sc. (Hons.)

Major

Courses	Course Title	Topic	No. of Lectures (Inclusion of Tutorials)	Teachers
CHEM-MAT-1 [4 credits] [120 Classes] Full Marks: 55 (End Sem. 40+Internal Assessment 15)	Inorganic-1A	• **Atomic Structure** Bohr's model and atomic spectrum of hydrogen, Limitations of Bohr's model and Sommerfeld'smodifications, de Broglie's concept, Heisenberg's uncertainty principle and its significance, Time independent Schrödinger's wave equation (without application and solution detail), Significance of ψ and ψ2, Radial and angular wave functions for hydrogen atom (qualitative idea), radialprobability distribution curves, shapes of s, p, d and f orbitals (qualitative idea), Quantumnumbers and their significance, Pauli's exclusion principle, aufbau principle and limitations, Hund's rules, exchange energy, Electronic configurations of atoms. Elementary idea of microstates.	16L	MH & MM
		• **Periodic Properties** Modern IUPAC periodic table and classification of elements in the table; Effective nuclear chargeand its calculation using Slater's rules; Atomic radii, Ionic radii and Pauling's method fordetermining univalent ionic radii; Electronegativity (Pauling's, Mulliken's and Allred-Rochow'sscale) and its applications, Ionization energy, Electron affinity and factors influencing these properties; Group trends and periodic trends of these properties with reference to s, p and d-block elements, Inert pair effect.	14L	KKS

	Physical -1A	**Kinetic Theory and Gaseous state** *Kinetic Theory of gases: Concept of pressure and temperature; Collision of gas molecules; Collision diameter, Collision number and mean free path; Frequency of binary collisions (similar and different molecules). *Maxwell's distribution of speed and energy: Nature of distribution of velocities, Maxwell's distribution of speeds in one, two and three dimensions; Kinetic energy distribution in one, twoand three dimensions, calculations of average, root mean square and most probable values in each case; Calculation of number of molecules having energy. Principle of equipartition of energy and its application to calculate the classical limit of molar heat capacity of gases. *Real gas and virial equation: Deviation of gases from ideal behavior, compressibility factor; Boyle temperature; Andrew's and Amagat's plots; van-der-Waals equation and its features; its derivation and application in explaining real gas behaviour, other equations of state (Berthelot, Dieterici); Existence of critical state, Critical constants in terms of van-der - Waals constants; Law of corresponding states; virial equation of state; van-der-Waals equation expressed in virial form and significance of second virial coefficient; Intermolecular forces (Debye, Keesom and London interactions; Lennard-Jones potential - elementary idea).. **Chemical Thermodynamics – I** *Zeroth and 1st law of Thermodynamics: Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of	18 L 12L	AR RG

		thermodynamics; Concept of heat, work, internal energy and statement of first law; enthalpy, H: relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases (ideal and van-der-Waals) under isothermal and adiabatic conditions, Joule's experiment and its consequence. * Thermo chemistry: Standard states; Heats of reaction; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications, Laws of thermo chemistry; bond energy, bond dissociation energy and resonance energy from thermo chemical data, Kirchhoff's equations and effect of pressure on enthalpy of reactions		
CHEM-MAP-1 [2 credits = 20] Practical. Major (Practical)	Inorganic-1A &	i) Preparation of primary standard solutions of tartans ii) Estimation of carbonate and hydroxide present together in a mixture iii) Estimation of carbonate and bicarbonate present together in a mixture.	12	MH & AKK
	Physical-1A	i) Determination of pH of unknown solution (buffer), by color matching method. ii) Determination of heat of neutralization of a strong acid by a strong base iii) Determination of heat of solution of oxalic acid from solubility measurement.	12	AR

Semester III

Courses	Course Title	Topic	No. of Lectures (Inclusion of Tutorials)	Teachers
CHEMHT-5 [4 Credit = 40] + Internal Assessment = 15 Full Marks: 55	Physical Chemistry – II	**1. Transport process** *Viscosity: General features of fluid flow (streamline flow and turbulent flow); Newton's equation, viscosity coefficient: Poiseuille's equation; Principle of determination of viscosity coefficient of liquids by falling sphere method; Temperature variation of viscosity of liquids and comparison with that of gases. *Conductance and transport number: Ion conductance: Conductance and measurement of conductance, cell constant, specific conductance and molar conductance: Variation of specific and equivalent conductance with dilution for strong and weak electrolytes; Kohlrausch's law of independent migration of ions; Equivalent and molar conductance at infinite dilution and their determination for strong and weak electrolytes: Debye Hückel theory of Ion atmosphere (qualitative)-asymmetric effect, relaxation effect and electrophoretic effect; Ostwald's dilution law; Ionic mobility: Application of conductance measurement (determination of solubility product and ionic product of water): Conductometric titrations. Transport number. Principles of Hittorf's and Moving-boundary method. **2. Application of Thermodynamics-1** *Partial properties and chemical potential Chemical potential and activity, partial molar quantities, relation between chemical potential and Gibb's free energy and other thermodynamic state functions, variation of chemical potential (μ) with temperature and pressure, Gibbs-Duhem equation, fugacity and	**20L** **20 L**	RG & AR RG & AR

		fugacity coefficient, Variation of thermodynamic functions for systems with variable composition, Equations of states for these systems, Change in G, SH and V during mixing for binary solutions. *Chemical Equilibrium: Thermodynamic conditions for equilibrium, degree of advancement, Van't Hoff's reaction isotherm (deduction from chemical potential), Variation of free energy with degree of advancement, Equilibrium constant and standard Gibbs free energy change, Definitions of KP, Kc and Kx, Van't Hoff's reaction isobar and isochore from different standard states; Shifting of equilibrium due to change in external parameters e.g. temperature and pressure, variation of equilibrium constant with addition to inert gas, Le Chatelier's principle. Nernst's distribution law, Application-(finding out Keq using Nernst distribution law for KI+12=KI, and dimerization of benzene. *Chemical potential and other properties of ideal substances-pure and mixtures Pure ideal gas: Its chemical potential and other thermodynamic functions and their changes during a change of thermodynamic parameters of mixing, Chemical potential of an ideal gas in an ideal gas mixture: Concept of standard states and choice of standard states of ideal gases. *Condensed Phase: Chemical potential of pure solid and pure liquids, Ideal Solution-Definition, Raoult's law, Mixing properties of ideal solutions, chemical potential of a component in an ideal solution; Choice of standard states of solids and liquids **3. Foundation of Quantum Mechanics:**	**20 L**	RG & AR

		*Beginning of Quantum Mechanics Wave-particle duality, light as particles: photoelectric and Compton effects; electrons as waves and the de Broglie hypothesis; Uncertainty relations (without proof) Wave function: Schrodinger time-independent equation, nature of the equation, acceptability conditions imposed on the wave functions and probability interpretations of wave function *Concept of Operators: Elementary concepts of operators, eigenfunctions andeigenvalues, Linear operators, Commutation of operators, commutator anduncertainty relation, Expectation value; Hermitian operator, Postulates ofQuantum Mechanics. *Particle in a box Setting up of Schrodinger equation for one-dimensional box and its solution, Comparison with free particle eigenfunctions and eigenvalues Properties of particle in a box wave functions (normalisation, orthogonality, probability distribution), Expectation values of x, x, p, and p, and their significance in relation to the uncertainty principle; Extension of the problem to two and three dimensions and the concept of degenerate energy levels.		
CHEMHP-5 [2 credits = 20] Practical. Full Marks: 20	Inorganic Chemistry – II [Practical]	i) Study of viscosity of unknown liquid (glycerol, sugar) with respect to water. ii) Determination of partition coefficient for the distribution of I_2 between water and CCl_4	**(20L)**	RG & AR

		iii) Determination of K, for $KI+I_2=KI$, using partition coefficient between water and CCl_4 iv) Conductometric titration of an acid (strong, weak/ monobasic, dibasic) against strong base v) Study of saponification reaction conductometrically vi) Verification of Ostwald's dilution law and determination of Ka of weak acid		
CHEMHT-6 [4 Credit = 40] + Internal Assessment = 15 + CHEMHP-6 [2 credits = 20] Practical. Full Marks: 75	Inorganic Chemistry – II	**1. Chemical Bonding – I:** Ionic Bond: Lattice energy, Born-Lande equation with derivation andimportance of Kapustinskii expression for lattice energy, Born-Haber cycle anditsapplications, Polarising power and polarisability of ions, Fajan's rules and itsapplications, radius ratio rules – its applications and limitations, salvation energyand solubility energetics of dissolution process; Packing in crystals, voids incrystal lattice, packingefficiency, Structure of ionic solids: rock salt, zinc blende,wurtzite, fluorite, antifluorite, perovskite and layer lattice. Qualitative idea aboutstoichiometric and non-stoichiometric crystal defects. **2. Chemical Bonding – II** directional properties of covalent bond, Concept of Equivalent and non equivalent Hybridization and shapes of simple molecules and ions (examples from main groups), Stereochemically non-rigid molecules – Berry'spseudorotation, Resonance and Dipole moments of inorganic molecules and ions,VSEPR theory and Bent's rule and their applications; M.O. Theory (elementarypictorial approach), concept of bond order, MO diagram of homo-nucleardiatomics (1_{st} and 2_{nd} period elements), hetero-nuclear diatomics (HF, CO, NO,NO^+ and CN^-) and triatomics (H_2O and BeH_2). Electron sea model and elementary idea about band theory, classification of inorganic solids andtheirconduction properties according to band theory; Hydrogen bonding:	(22L) (28L)	MH KKS

		classifications, its effect on the properties of compounds and its importance inbiological systems, vander Waal's forces. **3. Metal extraction and purification: Basic Metallurgy** Idea about ores and minerals, operations involved in metallurgy, Flow chart diagram for the extraction of pure Ti, Ni and U(including reactions) from their important ores and their uses.	(10L)	AKK
	Inorganic Chemistry – II [Practical]	i) Estimation of Fe(II) and Fe(III) in a given mixture using K2Cr2O7 solution ii) Estimation of Fe(III) and Cu(II) in a given mixture using K2Cr2O7 solution iii) Estimation of Cr(VI) and Mn(II) in a given mixture using K2Cr2O7 solution iv) Estimation of Fe(III) and Cr(VI) in a given mixture using K2Cr2O7 solution v) Estimation of Fe(II) and Mn(II) in a given mixture using KMnO4 solution vi) Estimation of Fe(III) and Ca(II) in a given mixture using KMnO4 solution		MH+AKK
CHEMHT-7 [4 Credit = 40] + Internal Assessment = 15 + CHEMHP-7 [2 credits = 20] Practical. Full Marks: 75	Organic Chemistry – III	**1. Chemistry of alkenes and alkynes:** **Addition to C=C:** mechanism (with evidence wherever applicable), reactivity, regioselectivity(Markownikoff and antiMarkownikoffadditions) and stereoselectivity; reactions: hydrogenation, halogenations, iodolactonisation,hydrohalogenation, hydration, oxymercurationdemercuration, hydroboration-oxidation,epoxidation, syn and antihydroxylation,ozonolysis, addition of singlet and triplet carbenes;electrophilic addition to diene (conjugated dienes and allene); radicaladdition: HBr addition; mechanism of allylic and benzylic bromination incompetition with brominations across C=C; use of NBS; dissolving metalreduction of alkenes; interconversion of E - and Z - alkenes; contrathermodynamic	(16L)	MM

		isomerization of internal alkenes. **Addition to C≡C (in comparison to C=C):** mechanism, reactivity,regioselectivity (Markownikoff and anti-Markownikoff addition) and 21Prepared byUGBOS (Chemistry)stereoselectivity; reactions: hydrogenation, halogenations, hydrohalogenation, hydration, oxymercuration-demercuration, hydroboration-oxidation, dissolving metal reduction of alkynes (Birch); reactions of terminal alkynes by exploring its acidity; interconversion ofterminal and non-terminal alkynes. 1. Aromatic Substitution: Electrophilic aromatic substitution: **Electrophilic aromatic substitution**: Mechanisms and evidences in favourof it; orientation and reactivity; reactions: nitration, nitrosation,sulfonation, halogenation, Friedel-Crafts reaction; one-carbon electrophiles(reactions: chloromethylation, Gatterman-Koch, Gatterman, Houben-Hoesch, Vilsmeier-Haack, Reimer-Tiemann, Kolbe-Schmidt); Ipsosubstitituion **Nucleophilic aromatic substitution:** addition-elimination mechanism and evidences in favour of it; SNArmechanism; cine substitution (benzynemechanism), structure of benzyne. 2. Carbonyl and Related Compounds: **Addition to C=O:** structure, reactivity and preparation of carbonylcompounds; mechanism (with evidence), reactivity, equilibrium andkinetic control; Burgi-Dunitz trajectory in nucleophilic additions;formation of hydrates, cyanohydrins and bisulphite adduct; nucleophilicaddition-elimination reactions with alcohols, thiols and nitrogen- based nucleophiles; reactions: benzoin condensation, Cannizzaro and Tischenkoreactions, reactions with	(8L) (30L)	MM MM

		ylides: Wittig and CoreyChaykovsky reaction;Rupe rearrangement, oxidations and reductions: Clemmensen, Wolff-Kishner, LiAlH4, NaBH4, MPV, Oppenauer, Bouveault-Blanc, acyloincondensation; oxidation of alcohols with PDC and PCC; periodic acid andlead tetraacetate oxidation of 1,2-diols. Exploitation of acidity of α-H of C=O: formation of enols and enolates; kinetic and thermodynamic enolates; reactions (mechanism with evidence):halogenation of carbonyl compounds under acidic and basic conditions,Hell-Volhard-Zelinsky (H. V. Z.) reaction, nitrosation, SeO_2 (Riley)oxidation; condensations (mechanism with evidence): Aldol, Knoevenagel,Claisen-Schmidt, Claisen ester including Dieckmann, Stobbe; Mannichreaction, Perkin reaction, Favorskii rearrangement; alkylation of active methylene compounds; preparation and synthetic applications of diethyl malonate and ethyl acetoacetate; specific enol equivalents (lithium enolates, enamines, aza-enolates and silyl enol ethers) in connection with alkylation, acylation and aldol type reaction. **Elementary ideas** of Green Chemistry: Twelve (12) principles of greenchemistry; planning of green synthesis; common organic reactions and their counterparts: reactions: Aldol, Friedel-Crafts, Michael, Knoevenagel, Cannizzaro, benzoin condensation and Dieckmann condensation. **Nucleophilic addition to α,β-unsaturated carbonylsystem:** general principle and mechanism (with evidence); direct and conjugate addition,addition of enolates (Michael reaction), Stetter reaction, Robinsonannulations.		

	Organic Chemistry – III [Practical]	3. Organometallics: Grignard reagent; Organolithiums; Gilman cuprates: preparation and reactions (mechanism with evidence); addition of Grignard and organolithium to carbonyl compounds; substitution on -COX; directedortho metalation of arenes using organolithiums, conjugate addition byGilman cuprates; Corey-House synthesis; abnormal behavior of Grignardreagents; comparison of reactivity among Grignard, organolithiums andorganocopper reagents; Reformatsky reaction; Blaise reaction; concept ofumpolung and base-nucleophile dichotomy in case of organometallicreagents. **Qualitative Analysis of Single Solid Organic Compounds:** 1. Detection of special elements (N, S, Cl, Br) by Lassaigne's test 2. Solubility and classification (solvents: H_2O, 5% HCl, 5% NaOH and 5%$NaHCO_3$) 3. Detection of the following functional groups by systematic chemical tests: 4. Aromatic amino (Ar-NH_2), aromatic nitro (Ar-NO_2), amido (-$CONH_2$,including imide), phenolic hydroxyl (Ph–OH), carboxylic acid (-COOH),carbonyl (-CHO and >C=O); only one test for each functional group is to be reported. 5. Melting point of the given compound 6. Preparation, purification and melting point determination of a crystallinederivative of the given compound 7. Identification of the compound through literature survey.Each student, during laboratory session, is required to carry out qualitative chemical tests for all the special elements and the functional groups	(6L)	MM MM

		withrelevant derivatisation in known and unknown (at least six) organic compounds		

Semester v

Courses	Course Title	Topic	No. of Lectures (Inclusion of Tutorials)	Teachers
CHEMHT-11 [4 Credit = 40] + Internal Assessment = 15 + CHEMHP-6 [2 credits = 20] Practical. Full Marks: 75	Inorganic Chemistry – IV	**1. Coordination Chemistry – II :** Structure and bonding of coordination compounds on the basis of V.B.Theory and its limitations. Elementary idea about CFT, splitting of $d_n$configuration inML_4 to ML_6 and ML_8 systems, factors affecting , measurement of spectrochemical series of ligands, CFSE in weak and strong fields, OSSE, Highspin and low spin complexes, spin isomerism, tetragonal distortion, Jahn Tellertheorem and applications, achievements and limitations of CFT, nephelauxetic effect, stabilisation of unusually high and low oxidation states of 3d serieselements, MOT (elementary idea), σ and π bonding in octahedral complexes (apictorial approach). Colour and electronic spectra of complexes: selection rules for electronic transitions, d-d transition, charge transfer transition (qualitative33Prepared byUGBOS (Chemistry) idea), L-S coupling and R-S ground state term for atomic no. up to 30, qualitative ORGEL diagram for $3d^1 – 3d^9$ ions with appropriate symbols for theenergy levels.	(28L)	KKS

		2. Magnetochemistry: Classification of magnetic substances, Origin of para magnetic moments, temperature dependence of para magnetism – Curie and Curie-Weiss law, TIP,magnetic susceptibility and its measurement (Gouy method), diamagneticcorrection, effective magnetic moment, spin only moment for 3d metals, Orbitalcontribution to magnetic moment, spin-orbit coupling, quenching of orbitalcontribution, Sub-normal magnetic moments and antiferromagnetic interactions (elementary idea with examples). **3. Chemistry of d- and f-block elements:** **d-block elements:** Characteristic properties, Comparison among the elements of3d series with reference to electronic configuration, oxidation states and E_0values; General comparison between 3d, 4d and 5d series elements in term ofelectronic configuration, oxidation states, atomization energy, magneticproperties and coordination chemistry. **f-block elements**: Comparison between d and f-block elements; Electronicconfiguration, oxidation states, variation of magnetic properties (Ln^{3+}), atomicand ionic(3+) radii of lanthanoids; consequences of lanthanide contraction,separation of lanthanides by ion exchange and solvent extraction methods;comparison between lanthanoids and actinoids. **4. Reaction Kinetics and Mechanism:** Introduction to inorganic reaction mechanisms, substitution reactions in squareplanar complexes; *trans*-effect - theories and applications; lability and inertnessin octahedral complexes towards substitution reactions. Elementary concept of*cis*-effect.	(12L) (12L) (8L)	MH MH MH

	Inorganic Chemistry – IV[Practical]	A. Quantitative: i) Estimation of available chlorine in bleaching powder using iodometry ii) Estimation of available oxygen in pyrolusite using permanganometry iii) Estimation of Cu in brass using iodometry iv) Estimation of Fe in cement using permanganometry v) Estimation of chloride gravimetrically vi) Estimation of Ni(II) using DMG gravimetrically B. Experiment : i) Paper chromatographic separation of Ni(II) and Co(II) ii) Measurement of 10Dq by spectrophotometric method iii) Preparation of $Mn(acac)_3$ and determination of its λmax colorimetrically		MH+AKK
CHEMHT-12 [4 Credit = 40] + Internal Assessment = 15 + Full Marks: 55	Physical Chemistry – IV	**1. Molecular Spectroscopy:** Interaction of electromagnetic radiation with molecules and various types ofspectra; Born-Oppenheimer approximation *Rotation spectroscopy: Selection rules, intensities of spectral lines, determinationof bond lengths of diatomic and linear triatomic molecules, isotopic substitution. *Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies; Diatomic vibrating rotator, P, Q, R branches *Raman spectroscopy:	**(24 L)**	RG & AR

		Qualitative treatment of Rotational Raman effect; Vibrational Raman spectra, Stokes and anti-Stokes lines *NMR & ESR spectroscopy: NMR spectroscopy: Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra. ESR spectroscopy: Its principle, ESR of simple radicals. **2. Photochemistry:** *Lambert-Beer's law: Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients;Laws of photochemistry, Stark-Einstein law of photochemical equivalence quantum yield, actinometry, examples of low and high quantum yields. *Photochemical Processes: Potential energy curves (diatomic molecules), Frank-Condon principle and vibrational structure of electronic spectra; Bond dissociation and principle of determination of dissociation energy (ground state);Decay of excited states by radiative and non-radiative paths; Pre-dissociation; Fluorescence and phosphorescence, Jablonskii diagram. *Rate of Photochemical processes: Photochemical equilibrium and the differential rate of photochemical reactions, Photostationary state; HI decomposition, H_2+Br_2reaction, dimerisation of anthracene; photosensitised reactions, quenching; Roleof photochemical reactions in biochemical processes, photostationary states, chemiluminescence. **3. Surface Phenomenon:** *Surface tension and energy: Surface tension, surface energy, excess pressure, capillary rise and surface tension; Work of cohesion and adhesion, spreading of liquid over	**(24 L)** **(24 L)**	AR RG & AR

		other surface; Vapour pressure over curved surface; Temperature dependence of surface tension. *Adsorption: Physical and chemical adsorption; Freundlich and Langmuir adsorption isotherms; multilayer adsorption and BET isotherm (no derivationrequired); Gibbs adsorption isotherm and surface excess; Heterogenous catalysis (single reactant); Zero order and fractional order reactions. *Colloids: Lyophobic and lyophilic sols, Origin of charge and stability of lyophobic colloids, coagulation and Schultz-Hardy rule, Zeta potential and Stern double layer (qualitative idea), Tyndall effect; Electro-kinetic phenomena (qualitative idea only); Determination of Avogadro number by Perrin's method; Stability of colloids and zeta potential; Micelle formation.		
CHEMHP-6 [2 credits = 20] Practical. Full Marks: 20	Physical Chemistry – IV[Practical]	i. Determination of surface tension of a liquid using Stalagmometer. ii. Determination of CMC from surface tension measurements. iii. Verification of Beer and Lambert's Law for KMnO4and K2Cr2O7solution. iv. Study of kinetics of K2S2O8+ KI reaction, spectrophotometrically. v. Determination of pH of unknown buffer, spectrophotometrically. vi. Spectrophotometric determination of CMC.		RG & AR

CHEMHTDSE-1B [4 Credit = 40] + Internal Assessment = 15 + CHEMHTDSE-1B [2 credits = 20] Practical. Full Marks: 75	Inorganic Materials of Industrial Importance	**1. Silicate Industries** **1. Silicate Industries (9L)** i) Glass: Glassy state and its properties, classification (silicate and non-silicateglasses). Manufacture and processing of glass. Composition and properties of thefollowing types of glasses: Soda lime glass, lead glass, armoured glass, safetyglass, borosilicate glass, fluorosilicate, coloured glass,photosensitive glass. ii) Ceramics: Important clays and feldspar, ceramic, their types and manufacture.High technology ceramics and their applications, superconducting andsemiconducting oxides, fullerenes carbon nanotubes and carbon fibre. iii) Cements: Classification of cement, ingredients and their role, Manufacture ofcement and the setting process, quick setting cements. **2. Fertilizers** Different types of fertilizers. Manufacture of the following fertilizers: Urea,ammonium nitrate, calcium ammonium nitrate, ammonium phosphates;polyphosphate, superphosphate, compound and mixed fertilizers, potassiumchloride, potassium sulphate. **3. Surface Coatings** Objectives of coatings surfaces, preliminary treatment of surface, classificationof surface coatings. Paints and pigments-formulation, composition and relatedproperties. Pigments, toners and laker pigments, Fillers, Thinners, Enamels,emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendlypaint, Plastic paint), Water and Oil paints, additives, Metallic coatings(electrolytic and electroless), **4. Batteries** Primary and secondary batteries, battery components and their role,	(9L) (9L) (9L)	AKK

	Inorganic Materials of Industrial Importance Practical	Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery. Fuel cells, Solar cell and polymer cell. **5. Alloys** Classification of alloys, ferrous and non-ferrous alloys, Specific properties ofelements in alloys. Manufacture of Steel (removal of silicondecarbonization,demanganization, desulphurization dephosphorisation).. Composition andproperties of different types of steels. **6. Catalysis** General principles and properties of catalysts, homogenous catalysis (catalyticsteps 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. **7. Chemical explosives** Origin of explosive properties in organic compounds, preparation and explosiveproperties of lead azide, PETN, cyclonite (RDX). Introduction to rocketpropellants. **List of Practical** 1. Determination of free acidity in ammonium sulphate fertilizer. 2. Estimation of Calcium in Calcium ammonium nitrate fertilizer. 3. Estimation of phosphoric acid in superphosphate fertilizer. 4. Electroless metallic coatings on ceramic and plastic material. 5. Determination of composition of dolomite (by complexometric titration). 6. Analysis of (Cu, Ni); (Cu, Zn) in alloy or synthetic samples. 7. Analysis of Cement. 8. Preparation of pigment (zinc oxide).	(9L) (9L) (6L)	

CHEMHTDSE-2C [4 Credit = 40] + Internal Assessment = 15 + CHEMHTDSE-2C [2 credits = 20] Practical. Full Marks: 75	Green Chemistry	**1. Introduction to Green Chemistry:** What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry **2. Principles of Green Chemistry and Designing a Chemical synthesis:** Twelve principles of Green Chemistry with their explanations andexamples and special emphasis on the following: Designing a Green Synthesis using these principles; Prevention of Waste/byproducts; maximum incorporation of the materials used in the processinto the final products, Atom Economy, calculation of atom economy oftherearrangement, addition,substitution and elimination reactions.Prevention/ minimization of hazardous/ toxic products reducing toxicity.risk = (function) hazard × exposure; waste or pollution preventionhierarchy. Green solvents– supercritical fluids, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent, PEG, solventless processes, immobilized solvents and how to compare greenness of solvents. Energy requirements for reactions – alternative sources of energy: use of microwaves and ultrasonic energy. Selection of starting materials; avoidance of unnecessary derivatization –careful use of blocking/protecting groups. Use of catalytic reagents (wherever possible) in preference to43Prepared byUGBOS (Chemistry) stoichiometric reagents; catalysis and green chemistry, comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis.	(4L) (26L)	MM

		Prevention of chemical accidents designing greener processes, inherentsafer design, principle of ISD "What you don't have cannot harm you",greener alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) andFlixiborough accident (safer route tocyclohexanol) subdivision of ISD, minimization, simplification, substitution, moderation and limitation.Strengthening/ development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes. **3. Examples of Green Synthesis/ Reactions and some real-world cases** Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis) Microwave assisted reactions in water: Hofmann Elimination, methylbenzoate to benzoic acid, oxidation of toluene and alcohols; microwaveassisted reactions in organic solvents Diels-Alder reaction andDecarboxylation reactionUltrasound assisted reactions: sonochemical Simmons-Smith Reaction(Ultrasonic alternative to Iodine)Surfactants for carbon dioxide – replacing smog producing and ozonedepleting solvents with CO_2 for precision cleaning and dry cleaning of garments.Designing of Environmentally safe marine antifoulant.Right fit pigment: synthetic azopigments to replace toxic organic andinorganic pigments.An efficient, green synthesis of a compostable and widely applicableplastic (poly lactic acid) made from corn. Healthier Fats and oil by Green Chemistry: Enzymatic Inter	(26L)	MM

		esterificationfor production of no Trans-Fats and OilsDevelopment of Fully Recyclable Carpet: Cradle to Cradle Carpeting **4. Future Trends in Green Chemistry:** Oxidation reagents and catalysts; Biomimetic, multifunctional reagents;Combinatorial green chemistry; Proliferation of solventless reactions; co crystal controlled solid state synthesis (C2S3); Green chemistry insustainable development. **Safer starting materials:**	(4L)	
	Green Chemistry Practical	Preparation andcharacterization of nanoparticles of gold using tea leaves. **Using renewable resources:** Preparation of biodiesel from vegetable/ waste cooking oil. **Avoiding waste:** Principle of atom economy. Use of molecular model kit to stimulate the reaction to investigate how theatom economy can illustrate Green Chemistry. Preparation of propene by two methods can be studied a. Triethylamine ion + OH^- → propene + trimethylpropene + water 1-propanol b. H_2SO_4 Propene + waterother types of reactions, like addition, elimination, substitution andrearrangement should also be studied for the calculation of atom economy.Principle of atom economy. **Use of enzymes as catalysts:**		MM

		Benzoin condensation using Thiamine cation (anchored enzyme) as a catalyst instead of cyanide. **Alternative Green solvents:** Extraction of D-limonene from orange peel using liquid CO_2 prepared from dry ice. Mechanochemical solvent free synthesis of azomethines **Alternative sources of energy**: Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II).Photoreduction of benzophenone to benzopinacol in the presence of sunlight.		
		Inorganic Materials of Industrial Importance **List of Practicals** 1. Determination of free acidity in ammonium sulphate fertilizer. 2. Estimation of Calcium in Calcium ammonium nitrate fertilizer. 3. Estimation of phosphoric acid in superphosphate fertilizer. 4. Electroless metallic coatings on ceramic and plastic material. 5. Determination of composition of dolomite (by complexometric titration). 6. Analysis of (Cu, Ni); (Cu, Zn) in alloy or synthetic samples. 7. Analysis of Cement. 8. Preparation of pigment (zinc oxide).		MH+AKK

Department of Chemistry
B.Sc. (General)

MINOR

Courses	Course Title	Topic	No. of Lectures (Inclusion of Tutorials)	Teachers
CHEMGT-1 [3 credits] [47 L] Full Marks: 35 (End Sem. 25+Internal Assessment 10)	**Course Title: Inorganic-1 & Organic-1**	**Inorganic Chemistry –I** 1. **Atomic Structure** Bohr's theory for hydrogen atom (simple mathematical treatment), atomic spectra of hydrogen and Bohr's model, Sommerfeld's model, quantum numbers and their significance, Pauli's exclusion principle, Hund's rule, electronic configuration of many-electron atoms, Aufbau principle and its limitations. **2. Chemical Periodicity** Classification of elements on the basis of electronic configuration: general characteristics of s-, p-, d- and f-block elements. Positions of hydrogen and noble gases in the periodic table. Atomic and ionic radii, ionization potential, electron affinity, and electronegativity; periodic and group wise variation of above properties in respect of s- and p- block elements. 3. **Acids and bases** Brönsted–Lowry concept, conjugate acids and bases, relative strengths of acids and bases, effects of substituent and solvent, differentiating and levelling solvents. Lewis acid-base concept, classification of Lewis acids and bases, Lux-Flood concept and solvent system concept. Hard and soft acids and bases (HSAB concept), applications of HSAB process. **4. Redox reactions** Balancing of equations by oxidation number and ion-electron method, Standard electrode potential, formal potential, redox indicator and redox titrations.	**6L** **6L** **8LL** **4L**	**MM** RG MH AKK

		Organic Chemistry – I 1.**Fundamentals of Organic Chemistry** Electronic displacements: Inductive effect, resonance and hyperconjugation; cleavage of bonds: homolytic and heterolytic; structure of organic molecules on the basis of VBT; nucleophiles and electrophiles; reactive intermediates: carbocations, carbanions and free radicals 2. Stereochemistry Different types of isomerism; geometrical and optical isomerism; concept of chirality and optical activity (up to two carbon atoms); asymmetric carbon atom; elements of symmetry (plane and centre); interconversion of Fischer and Newman representations; enantiomerism and diastereomerism, meso compounds; threo and erythro, D and L, cis and trans nomenclature; CIP Rules: R/S (upto 2 chiral carbon atoms) and E/Z nomenclature. **Nucleophilic Substitution and Elimination Reactions**: Nucleophilic substitutions: SN1 and SN2 reactions; eliminations: E1 and E2 reactions (elementary mechanistic aspects); Saytzeff and Hofmann eliminations; elimination vs substitution. Aliphatic Hydrocarbons: Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structures. Alkanes (up to 5 Carbons). Preparation: catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: mechanism for free radical substitution: halogenation. Alkenes: (up to 5 Carbons). Preparation: elimination reactions: dehydration of alcohols and dehydrohalogenation of alkyl halides; cis alkenes (partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alkaline KMnO4) and trans-addition (bromine) with mechanism, addition of HX [Markownikoff's (with mechanism) and anti-Markownikoff's addition],	**4** **8L** **4L** **5L** **5L**	MM AR AKK AKK RG

		hydration, ozonolysis, oxymercuration-demercuration and hydroboration-oxidation reaction. Alkynes: (up to 5 Carbons). Preparation: acetylene from CaC2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal dihalides. Reactions: formation of metal acetylides, addition of bromine and alkaline KMnO4, ozonolysis and oxidation with hot alkaline KMnO4.		
CHEM-MIP-1A (Minor-1) [F.M. = 15]	**Inorganic-1**	Practical: 1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture. 2. Estimation of oxalic acid by titrating it with KMnO4. 3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO4. 4. Estimation of Fe (II) ions by titrating it with K2Cr2O7. 5. Estimation of Cu (II) ions iodometrically using Na2S2O3.	**4L**	**AKK**
	Organic Chemistry – I	Qualitative Analysis of Single Solid Organic Compound(s) 1. Detection of special elements (N, Cl, and S) in organic compounds. 2. Solubility and Classification (solvents: H2O, dil. HCl, dil. NaOH, dil. NaHCO3) **3.** 3. Detection of functional groups: Aromatic-NO2, Aromatic-NH2, -COOH, carbonyl (no distinction of –CHO and >C=O needed), -OH (phenolic) in solid organic compounds. Experiments 1 to 3 with unknown (at least 6) solid samples containing not more than two of the above type of functional groups should be done.	**4L**	**MM**

Semester III

Courses	Course Title	Topic	No. of Lectures (Inclusion of Tutorials)	Teachers
CHEMGT-3 [4 credits] [60 Classes] Full Marks: 55 (End Sem. 40+Internal Assessment 15)	Physical Chemistry – II	1. Chemical Energetics a. Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics; Concept of heat, work, internal energy and statement of first law; enthalpy, H; relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases b. Standard states; Heats of reaction; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; Laws of thermochemistry; bond energy, bond dissociation energy and resonance energy from thermochemical data, Kirchhoff's equations and effect of pressure on enthalpy of reactions; Adiabatic flame temperature; explosion temperature c. Statement of the second law of thermodynamics; Concept of heat reservoirs and heat engines; Carnot cycle; Physical concept of Entropy; Carnot engine, refrigerator and efficiency; Entropy change of systems and surroundings for various processes and transformations; Auxiliary state functions (G and A) and Criteria for spontaneity and equilibrium. 2. Chemical Equilibrium: Thermodynamic conditions for equilibrium, degree of advancement; Variation of free energy with degree of advancement; Equilibrium constant and standard Gibbs free energy change; Definitions of KP, KC and KX and relation among them; van't Hoff's reaction isotherm, isobar and isochore from different standard states; Shifting of equilibrium due to change in external parameters e.g. temperature and pressure;	12L 9L	**AR** **RG** **AKK**

		variation of equilibrium constant with addition to inert gas; Le Chatelier's principle 3. Ionic Equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water; Ionization of weak acids and bases, pH scale, common ion effect; Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts; Buffer solutions; Solubility and solubility product of sparingly soluble salts – applications of solubility product principle		
	Organic Chemistry – II	1. Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structures. 1. Aromatic Hydrocarbons Benzene: Preparation: from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. Reactions: electrophilic substitution (general mechanism); nitration (with mechanism), halogenations (chlorination and bromination), sulphonation and Friedel-Craft's reaction (alkylation and acylation) (up to 4 carbons on benzene); side chain oxidation of alkyl benzenes (up to 4 carbons on benzene). 2. Organometallic Compounds Introduction; Grignard reagents: Preparations (from alkyl and aryl halide); concept of umpolung; Reformatsky reaction. 3. Aryl Halides Preparation: (chloro-, bromo- and iodobenzene): from phenol, Sandmeyer reactions. Reactions (Chlorobenzene): nucleophilic aromatic	**9L** **7L** **4L**	AKK MM AKK

		substitution (replacement by –OH group) and effect of nitro substituent (activated nucleophilic substitution). 4. Alcohols, Phenols and Ethers a. Alcohols: (up to 5 Carbons). Preparation: 1°-, 2°- and 3°-alcohols: using Grignard reagent, reduction of aldehydes, ketones, carboxylic acid and esters; Reactions: With sodium, HX (Lucas test), oxidation (alkaline KMnO4, acidic dichromate, concentrated HNO3); Oppenauer oxidation; b. Diols: Preparation (with OsO4); pinacol- pinacolone rearrangement (with mechanism) (with symmetrical diols only). c. Phenols: Preparation: cumene hydroperoxide method, from diazonium salts; acidic nature of 62 Prepared by UGBOS (Chemistry) phenols; Reactions: electrophilic substitution: nitration and halogenations; Reimer-Tiemann reaction, Houben–Hoesch condensation, Schotten–Baumann reaction, Fries rearrangement and Claisen rearrangement. d. Ethers: Preparation: Williamson's ether synthesis; Reaction: cleavage of ethers with HI. 5. Carbonyl Compounds Aldehydes and Ketones (aliphatic and aromatic): (Formaldehye, acetaldehyde, acetone and benzaldehyde): Preparation: from acid chlorides, from nitriles and from Grignard reagents; general properties of aldehydes and ketones; Reactions: with HCN, ROH, NaHSO3, NH2-G derivatives and with Tollens' and Fehling's reagents; iodoform test; aldol condensation (with	**8L** **4**	RG AKK

		mechanism); Cannizzaro reaction (with mechanism), Wittig reaction, benzoin condensation; Clemmensen reduction, Wolff-Kishner reduction and Meerwein-Pondorff-Verley (MPV) reduction.		
CHEMGP-3 [2 credits = 20] Practical. GE (Practical)	Physical Chemistry – II	Thermochemistry 1. Determination of heat capacity of calorimeter for different volumes 2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide 3. Determination of enthalpy of ionization of acetic acid 4. Determination of enthalpy of hydration of copper sulphate Ionic Equilibria 1. Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH meter and compare it with the indicator method 2. Preparation of buffer solutions and find the pH of an unknown buffer solution by colour matching method (using following buffers) a. Sodium acetate-acetic acid b. Ammonium chloride-ammonium hydroxide 3. Study of the solubility of benzoic acid in water.		AR
	Organic Chemistry – II	Organic Chemistry – II Identification of a pure organic compound 1. Solid compounds: oxalic acid, tartaric acid, succinic acid, resorcinol, urea, glucose, benzoic acid and salicylic acid. 2. Liquid Compounds: methyl alcohol, ethyl alcohol, acetone, aniline, dimethylaniline, benzaldehyde, chloroform and nitrobenzene		**MM**

Semester – V

Courses	Course Title	Topic	No. of Lectures (Inclusion of Tutorials)	Teachers
CHEMGTDSE-1 [4 credits] [60 Classes] Full Marks: 55 (End Sem. 40+Internal Assessment 15)	**Analytical and Environmental Chemistry**	1. Chemical Analysis a) Gravimetric analysis: solubility product and common ion effect; requirements of gravimetry; gravimetric estimation of chloride, sulphate, lead, barium, nickel, copper and zinc. b) Volumetric analysis: primary and secondary standard substances; principles of acid-base, oxidation –reduction and complexometric titrations; indicators: acid-base, redox and metal ion; principles of estimation of mixtures: NaHCO3 and Na2CO3 (by acidimetry); iron, copper, manganese and chromium (by redox titration); zinc, aluminum, calcium and magnesium (bycomplexometric EDTA titration). c) Chromatography: Chromatographic methods of analysis: column chromatography and thin layer chromatography. 2. Environmental Chemistry a) The Atmosphere: composition and structure of the atmosphere; troposphere, stratosphere, mesosphere and thermosphere; ozone layer and its role; major	**14L** 16L	MH AKK

		air pollutants: CO, SO2, NOx and particulate matters – their origin and harmful effects; problem of ozone layer depletion; green house effect; acid rain and photochemical smog; air pollution episodes: air quality standard; air pollution control measures: cyclone collector, electrostatic precipitator, catalytic converter. b) The Hydrosphere: environmental role of water, natural water sources, water treatment for industrial, domestic and laboratory uses; water pollutants; action of soaps and detergents, phosphates, industrial effluents, agricultural runoff, domestic wastes; thermal pollution, radioactive pollution and their effects on animal and plant life; water pollution episodes: water pollution control measures : waste water treatment; chemical treatment and microbial treatment; water quality standards: DO, BOD, COD, TDS and hardness parameters; desalination of sea water : reverse osmosis, electrodialysis. c) The Lithosphere: water and air in soil, waste matters and pollutants in soil, waste classification, treatment and disposal; soil pollution and control measures.		
		1. Error Analysis and Computer Applications a) Error analysis: accuracy and precision of quantitative analysis, determinate, indeterminate,	**12L**	AKK

	Analytical Industrial Chemistry	systematic and random errors; methods of least squares and standard deviations. b) Computer applications: general introduction to computers, different components of a computer; hardware and software; input and output devices; binary numbers and arithmetic; introduction to computer languages; programming and operating systems. 2. Industrial Chemistry a) Fuels: classification of fuel; heating values; origin of coal, carbonization of coal, coal gas, producer gas, water gas, coal based chemicals; origin and composition of petroleum, petroleum refining, cracking, knocking, octane number, antiknock compounds, kerosene, liquefied petroleum gas (LPG), liquefied natural gas (LNG); petrochemicals (C1 to C3 compounds and their uses). b) Fertilizers: manufacture of ammonia and ammonium salts, urea, superphosphate, biofertilizers. c) Glass and ceramics: definition and manufacture of glasses, optical glass and coloured glass; clay and feldspar, glazing and vitrification, glazed porcelein, enamel. d) Cement: portland cement: composition and setting of cement, white cement.	**18L**	AR MH
CHEMGPDSE-1 [2 credits = 20]	**Analytical and Environmental Chemistry**	1. To find the total hardness of water by EDTA titration.	**5L**	AR

Practical. PCC (Practical)		2. To find the pH of an unknown solution by comparing color of a series of HCl solutions + 1 drop of methyl orange, and a similar series of NaOH solutions + 1 drop of phenolphthalein. 3. To determine the rate constant for the acid catalysed hydrolysis of an ester. 4. Determination of the strength of the H_2O_2 sample. 5. To determine the solubility of a sparingly soluble salt, e.g. KHTa (one bottle)		
	Analytical and Industrial Chemistry	1. Titration of Na_2CO_3 and $NaHCO_3$ mixture vs HCl using phenolphthalein and methyl orange indicators. 2. Titration of HCl and CH_3COOH mixture vs NaOH using two different indicators to find the concentration. 3. Estimation of available oxygen in pyrolusite	**4L**	**AKK**

DEPARTMENT OF BOTANY

Syllabus Distribution July,24-December,24

SEMESTER-1(NEP) 2024

Course Code	Course Title	Name of the Course	Course Content	Assigned Teacher	No. of Lectures (inclusive of Tutorials)
BOT-MJ-CC-T-01	ORIGIN , LIFE PROCESSES & DIVERSITY OF PLANT GROUPS	MAJOR (THEORY)	Unit 1: Origin of Life What is life? Theories of origin of life; role of water in life process; origin of land plants.	DR	12
			Unit 2: Microbes Viruses- Discovery, general structure; economic importance; Bacteria- Discovery, general characteristicsand cell structure; economic importance.	RI	6
			Unit 3: Algae General characteristics; salient features of Cyanophyceae, Chlorophyceae, Charophyceae, Phaeophyceae,Rhodophyceae and Bacillariophyceae; ecology and distribution of algae; economic importance of algae	DR	8
			Unit 4: Fungi Introduction – General characteristics, salient features of Myxomycota, Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina; fungi- nutrition and reproduction; ecology and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza; Lichens- general account.	SM	7
			Unit 5: Introduction to Archegoniate Unifying features of archegoniates; transition to land habit; alternation of generations	RI	7
			Unit 6: Bryophytes General characteristics, salient features of Hepaticopsida, Anthocerotopsida and Bryopsida.	RI	7

			Adaptation to land habitat, adaptation to land habitat; Ecological and economic importance of Bryophytes.		
			Unit 7: Pteridophytes General characteristics, salient features of Psilophyta, Lycophyta, Sphenophyta and Filicophyta; Ecological and economical importance.	SM	7
			Unit 8: Gymnosperms General characteristics; salient features of Cycadophyta, Coniferophyta and Gnetophyta.; Ecological and economic importance.	DR	7
			Unit 9: Angiosperms Floral characteristics, affinity with Gymnosperms; Herbarium; Botanical Garden.	BC	10
BOT-MJ--CC-P-01	Origin , Life Processes & Diversity of Plant groups	Major (Practical)	Bacterial forms : Coccus, Bacillus, Spirillum, Vibrio Algae : *Nostoc, Lyngbya, Spirogyra, Oedogonium* Fungi : *Rhizopus* (Vegetative structure with sporangium/ zygospore) , *Aspergillus*(vegetative structure with conidia), *Ascobolus* (Fruit body, L.S of *Ascobolus* fruit body), *Agaricus* (Fruit body, L.S of gills). Bryophytes: *Riccia,* (Entire thallus, T.S of thallus showing sporophyte), *Marchantia* (V.S of archegoniophore & antheridiophore, sporophyte), *Funaria,* (Plant body, L.S of capsule). Pteridophytes*: Lycopodium* (Plant body, L.S of strobilus), *Pteris,*(T.S of leaflet). Gymnosperms: Megasporophyll and microsporophyll of *Cycas*, external morphology of *Pinus* female cone; L.S of male and female cone of *Pinus*. Angiosperms : *Polyanthes tuberosa, Crysopogon aciculatus, Tridax procumbens, Oldenlandia corymbosa, Solanum nigrum*	Three practical groups each conducted by SM, RI, DR	60
BOT-SEC-T-01	A. BIOFERTILIZERS	Theory	Unit 1: General account about the microbes used as biofertilizer - *Rhizobium* - isolation. identification, mass multiplication, carrier-based inoculants, Actinorhizal symbiosis	DR	4
			Unit 2: *Azospirillum*: isolation and mass multiplication - carrier based inoculants, associative effect of different microorganisms.	RI	8

			Azotobacter: classification, characteristics - crop response to *Azotobacter* inoculum, maintenance and mass multiplication.		
			Unit 3: Cyanobacteria (blue green algae), *Azolla* and *Anabaena azollae* association, nitrogen fixation, factors affecting growth, blue green algae and Azolla in rice cultivation.	RI	4
			Unit 4: Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield - colonization of AM - isolation and inoculum production of AM, and its influence on growth and yield of crop plants.	SM	8
			Unit 5: Organic farming - Green manuring and organic fertilizers, recycling of biodegradable municipal, agricultural and industrial wastes - bio compost making methods, types and method of vermicomposting- field application.	SM	6
BOT-SEC-P-01-A		Practical	1. Isolation of *Rhizobium* from leguminous root nodule 2. Isolation of *Azotobacter*, *Azospirillum* 3. Isolation of BGA from water and soil samples 4. Production of *Azolla* in trays 5. Study of different types of mycorrhizal association from permanent slides/photographs 6. Visit to areas where organic farming, bio composting, vermicomposting is practiced	SM, RI, DR	30
BOT-MI-CC-T-01	BIODIVERSITY OF MICROBES, ALGAE, FUNGI AND BRYOPHYTES	MINOR (THEORY)	Unit 1: Microbes Virus- General structure, replication (general account), DNA virus (T-phage); Lytic and Lysogenic cycle, RNA virus (TMV); Economic importance; Bacteria- General characteristics and cell structure; Reproduction- conjugation, transformation and transduction; Economic importance.	BC	10
			Unit 2: Algae General characteristics: reproduction; Classification of	SP	12

			algae by Fritsch (1935); Economic importance of algae.		
			Unit 3: Fungi Introduction: General characteristics, cell wall composition, reproduction and classification (Alexopoulos, Mims and Blackwell 1996); Symbiotic associations- Lichens: General account; Mycorrhiza: ectomycorrhiza and endomycorrhiza.	SP	12
			Unit 4: Bryophyte General characteristics; adaptations to land habit; classification following Smith G.M. (1955); Economic importance of bryophytes with special mention of *Sphagnum*	SY	10
BOT–MI-CC-P-01		MINOR (PRACTICAL)	**1.** EMs/Models of viruses -T-Phage and TMV. **2.** Types of Bacteria - from temporary/permanent slides/photographs. **3.** Gram staining. **4.** Algae- (Study from permanent slides/ permanent slide/preserved specimen) -*Nostoc, Oedogonium, Chlamydomonas* and *Fucus* **5.** Fungi- (Study from permanent slides/ permanent slide/preserved specimen)- *Rhizopus* and *Penicillium*, *Agaricus* (Section of gills) . **6.** Lichens: Study of growth forms of Lichens (crustose, foliose and fruticose). **7.** Mycorrhiza: ectomycorrhiza and endomycorrhiza (Photographs). **8.** Bryophyte-(Study from permanent slides/ permanent slide/preserved specimen)- *Marchantia* (morphology of thallus, VS of antheridiophore, archegoniophore) , *Funaria (*morphology, LS of capsule).	UNIT 1-3: BC UNIT 4-5: SP UNIT 6-8: SY	

SEMESTER-3 (NEP)

MAJOR

COURSE CODE	COURSE TITLE	COURSE CONTENT	TEACHER ASSIGNED	No. of Lectures (inclusive of Tutorials)
BOT-MJ-CC-T-03 (THEORY)	PHYCOLOGY AND LICHENS	Unit 1: Relevance of studying algae	RI	7
		Unit 2: Cyanophyceae (Blue-Green Algae)	RI	3
		Unit 3: Chlorophyceae (Green Algae)	RI	6
		Unit 4: Xanthophyceae (Yellow-Green Algae)	DR	3
		Unit 5: Bacillariophyceae	DR	3
		Unit 6: Phaeophyceae (Brown Algae)	DR	3
		Unit 7: Rhodophyceae (Red Algae)	SM	3
		Unit 8: Algal Biotechnology	SM	8
		Unit 9- Lichen	SM	4
BOT-MJ-CC-P-03 (PRACTICAL)		1. Study of vegetative and reproductive structures of *Nostoc*, *Oedogonium*, *Chara*, *Vaucheria, Ectocarpus, and Polysiphonia* through temporary preparations, *Fucus, Chlamydomonas, Coleochateae* through preserved specimens and permanent slides and *Prochloron* through electron micrographs.	RI, DR	
		2. Study of lichen forms- Photographs/preserved specimens	SM	
BOT-SEC-T-03	MUSHROOM CULTURE	Unit 1: Introduction	SM	6
		Unit 2: Cultivation Technology:	RI	8
		Unit 3: Storage and nutrition:	DR	6
		Unit 4: Food Preparation:	DR	5
BOT-SEC-P-03 (PRACTICAL)		Aseptic inoculation technique.	RI	5
		Demonstration of spawning technique, bed preparation	SM	5

MINOR

COURSE CODE	COURSE TITLE	COURSE CONTENT	TEACHER ASSIGNED	
BOT-MI-CC-T-02(THEORY)	VASCULAR PLANTS, MORPHOLOGY & TAXONOMY	Unit 1: Pteridophytes	SY	2
		Unit 2: Gymnosperms	SP	8
		Unit 3: Morphology of Angiosperms	BC	4
		Unit 4: Introduction to angiosperm taxonomy	BC	2

BOT-MI-CC-P-02(PRACTICAL)	OF ANGIOSPERMS	Unit 1: *Lycopodium*- morphology, WM of strobilus, (temporary slides), LS of strobilus (permanent slide). *Selaginella*- morphology, WM of strobilus, WM of microsporophyll and megasporophyll (temporary slides), LS of strobilus (permanent slide). *Pteris*- morphology, TS of leaflet.	SY	25
		Unit 2: Megasporophyll of *Cycas* (from preserved specimen); pollen grain of *Pinus* (from permanent slide).	SP	
		Unit 3: Study of vegetative and floral characters of the following families of the available genera distributed locally according to Bentham and Hooker's system of classification: Dicotyledon: Fabaceae (*sensu stricto*); Malvaceae; Solanaceae; Lamiaceae; Asteraceae. Spot identification (Scientific name and Family) of common wild plants from families included in theory syllabus. Field visits (2 local) and submission of properly preserved herbarium specimens of at least 15 common wild plants with herbarium label, proper field record and field notes. The herbarium specimens should be submitted during end term examination.	BC	
UG-BOT-G-SEC-T-01 (Theory)	Biofertilizers	Unit 1: General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, and carrier-based inoculants, Actinorrhizal symbiosis. Unit 2:	SP	30

		Azospirillum: isolation and mass multiplication – carrier-based inoculants, associative effect of different microorganisms. Azotobacter: classification, characteristics – crop response to Azotobacter inoculum, maintenance and mass multiplication. Unit 3: Cyanobacteria (blue green algae), Azolla and Anabaena azollae association, nitrogen fixation, factors affecting growth, blue green algae and Azolla in rice cultivation. Unit 4: Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of AM – isolation and inoculum production of AM, and its influence on growth and yield of crop plants. Unit 5: Organic farming – green manuring and organic fertilizers, recycling of biodegradable municipal, agricultural and industrial wastes – biocompost making methods, types and method of vermicomposting – field application.		

SEMESTER-5 (CBCS)

HONOURS

COURSE CODE	COURSE TITLE	COURSE CONTENT	TEACHER ASSIGNED	No. of Lectures (inclusive of Tutorials)
UG-H-BOT-CC-T-11	Plant Physiology	Unit 1: Plant-water relations Water in plant life, diffusion, osmosis, imbibitions, water potential and its components; Water absorption by roots, aquaporins, pathways of water movement, symplast, apoplast, transmembrane pathways, root pressure; Ascent of sap-cohesion-tension theory; Transpiration, factors affecting transpiration, antitranspirants, mechanism of stomatal movement, Guttation	RI	10
		Unit 2: Mineral nutrition Essential and beneficial elements, macro and micronutrients; Techniques used in nutritional studies and use of nutrient solutions; Criteria of essentiality, Roles of essential elements; Mineral deficiency symptoms.	DR	6
		Unit 3: Nutrient Uptake Soil as a nutrient reservoir; Transport of ions across cell membrane, passive absorption, electrochemical gradient,	RI	8

		facilitated diffusion, active absorption, role of ATP, carrier systems, proton ATPase pump and ion flux, uniport, co-transport, symport, antiport.		
		Unit 4: Translocation in the phloem Pathways of translocation, experimental evidence, Phloem sap, P-protein; Mass flow and Pressure-Flow Model; Phloem loading and unloading; Source-sink relationship.	DR	8
		Unit 5: Plant growth regulators Auxins - Discovery, chemical nature (natural and synthetic), biosynthesis of IAA, bioassay and physiological roles of auxins; Gibberellin, Cytokinin, Abscisic acid and Ethylene - Discovery, chemical nature (natural and synthetic), bioassay and physiological roles; Brassinosteroids and Jasmonic acid-Discovery, chemical nature (natural and synthetic) and physiological roles	SM	12
		Unit 6: Physiology of flowering Classification of plants based on photoperiod responses, critical day length, concept of night length monitoring; Perception of flowering stimulus; Florigen concept; role of Flowering Locus T; Vernalization-Role of cold temperature in flowering.	SM	6
		Unit 7: Phytochrome, crytochromes and phototropins Discovery, chemical nature, role in photomorphogenesis, low energy responses (LER) and high irradiance responses (HIR), mode of action.	SM	6
		Unit 8: Seed dormancy Types, factors causing dormancy, breaking down and significance of seed dormancy.	RI	4
- UG-H-BOT-CC-P-11 (Practical)		1. Determination of osmotic potential of plant cell sap by plasmolytic method.	SM	10
		2. Determination of water potential of given tissue (potato tuber) by weighing method.	SM	10
		3. Determination of stomatal frequency and loss of water per stoma per hour.	RI	10
		4. Effect of humidity and light on the rate of transpiration in excised twig/ leaf.	RI	10
		5. Comparison of imbibitions of water by starchy, proteinaceous and fatty seeds.	DR	10
		6. Comparison of germination frequency of two crop seeds and effect of light and dark thereon.	DR	10
UG-H-BOT-CC-T-12 (Theory)	Plant Metabolism	Unit 1: Concept of metabolism Introduction, anabolic and catabolic pathways; Regulation of metabolism; Role of regulatory enzymes (allosteric, covalent modulation and Isozymes).	DR	6
		Unit 2: Carbon assimilation Historical background; Photosynthetic pigments, role of photosynthetic pigments (chlorophylls and accessory	SM	14

		pigments), antenna molecules and reaction centres; Photochemical reactions, photosynthetic electron transport, PSI, PSII, Q cycle; CO2 reduction: Calvin cycle, photorespiration, C4 pathways; Crassulacean acid metabolism; Factors affecting CO2 reduction.		
		Unit 3: Carbohydrate metabolism Synthesis and catabolism of sucrose and starch.	DR	2
		Unit 4: Carbon Oxidation Glycolysis, fate of pyruvate, regulation of glycolysis, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate; TCA cycle, amphibolic role, anaplerotic reactions, regulation of the cycle; Mitochondrial electron transport, oxidative phosphorylation; Cyanide-resistant respiration; Factors affecting respiration.	SM	10
		Unit 5: ATP-Synthesis Mechanism of ATP synthesis; Substrate level phosphorylation: chemiosmotic mechanism (oxidative and photophosphorylation); ATP synthase, Boyers conformational model, Racker's experiment; Role of uncouplers.	SM	8
		Unit 6: Lipid metabolism Synthesis and breakdown of triglycerides; β-oxidation of fatty acids; Glyoxylate cycle; Gluconeogenesis.	DR	8
		Unit 7: Nitrogen metabolism Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes); Physiology and biochemistry of nitrogen fixation; Ammonia assimilation and transamination.	RI	8
		Unit 8: Mechanisms of signal transduction Receptor-ligand interactions; Second messenger concept, Role of Calcium calmodulin.	RI	4
UG-H-BOT-CC-P-12 (PRACTICAL)		Detection: 1. Determination of rate of photosynthesis under varying HCO3 concentration in an aquatic plant and to find out the optimum and toxic condition.	RI	20
		2. Determination of effect of promoter and inhibitor on the rate of aerobic respiration using Ganong's Respiroscope	RI	
		3. Determination of the rate of respiration of different plant parts using Ganong's Respiroscope.	RI	
		4. Determination of RQ of germinating seeds.	DR	10
		5. Estimation of nitrogen/ amino acid by formal titration method (for any amino acid).	DR	

		6. Estimation of glucose by Benedict's quantitative reagent	SM	20
		7. Estimation of catalase activity in plant samples	SM	
		8. Estimation of urease activity in plant samples.	SM	
		9. Colorimetric estimation of protein by Folin phenol reagent.	DR	10
		Demonstration Experiment 1. Chemical separation of photosynthetic pigments.	DR	
UG-H-BOT-DSE-T-01 (THEORY)	A. Analytical Techniques in Plant Science	Unit 1: Imaging and related techniques Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Use of fluorochromes: (a) Flow cytometry (FACS); (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting; Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.	DR	15
		Unit 2: Cell fractionation Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, CsCl2 gradient, analytical centrifugation, ultracentrifugation, marker enzymes.	SY	8
		Unit 3: Radioisotopes Use in biological research, auto-radiography, pulse chase experiment	SY	4
		Unit 4: Spectrophotometry Principle and its application in biological research.	SY	4
		Unit 5: Chromatography Principle; Paper chromatography; Column chromatography, Thin Layer Chromatography (TLC), Gas Liquid Chromatography (GLC), High Performance Liquid Chromatography (HPLC), Ion-exchange chromatography; Molecular sieve chromatography; Affinity chromatography.	DR	8
		Unit 6: Characterization of proteins and nucleic acids Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: Agarose Gel Electrophoresis, Polyacrylamide Gel Electrophoresis (PAGE), Sodium Dodecyl Sulfate Polyacrylamide Gel Electrophoresis (SDSPAGE)	RI	6
		Unit 7: Biostatistics Statistics, data, population, samples, parameters; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit.	DR	15

UG-H-BOT-DSE-P-01 (PRACTICAL)		1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.	RI	10
		2. Separation of amino acids by paper chromatography.	RI	10
		3. Demonstration of pigment separation by column chromatography	SM	10
		4. Estimation of protein concentration through Lowry's methods.	DR	10
		5. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH)	DR	10
		6. Preparation of permanent slides by double staining method (Helianthus stem, Nerium leaf, Maize root).	SM, DR	10
UG-H-BOT-DSE-T-02 (THEORY)	Plant Breeding and Biometry	Unit 1: Plant breeding Introduction and objectives. Breeding systems: modes of reproduction in crop plants. Important achievements and undesirable consequences of plant breeding.	SY	10
		Unit 2: Methods of crop improvement Introduction: Centres of origin and domestication of crop plants, plant genetic resources; Acclimatization; Selection methods: For self pollinated, cross pollinated and vegetatively propagated plants; Hybridization: For self, cross and vegetatively propagated plants – Procedure, advantages and limitations.	SM	10
		Unit 3: Quantitative inheritance Concept, mechanism, examples of inheritance of Kernel colour in wheat, Skin colour in human beings. Monogenic vs polygenic inheritance	DR	10
		Unit 4: Inbreeding depression and heterosis History, genetic basis of inbreeding depression and heterosis; Applications	BC	10
		Unit 5: Crop improvement and breeding Role of mutations; Polyploidy; Distant hybridization and role of biotechnology in crop improvement	DR	10
		Unit 6: Biometry Terms and Definition– sample and population, quantitative and qualitative variables, random sampling, frequency distribution, arithmetic mean, mode and median; Measurement of dispersion –standard deviation, coefficient of variation and standard error; Test of significance – Null Hypothesis, X2 -test of goodness of fit, probability; Measurement of gene frequency (Hardy Weinberg hypothesis)	RI	10
- UG-H-BOT-DSE-P-02 (PRACTICAL)		1. Hybridization technique (anthesis, emasculation, pollination) (Demonstration).	RI	20

		2. Differential pollen stainability following aceto-carmine technique.	RI	
		3. Analysis of statistical data: Calculation of mean, mode, median, standard deviation and standard error	DR	10
		4. Determination of goodness of fit in normal and modified mono -and dihybrid ratios by Chi-square analysis and comment on the nature of inheritance.	SM	20
		5. Calculation of correlation coefficient values and finding out the probability	DR	10

PCC

COURSE CODE	COURSE TITLE	COURSE CONTENT	TEACHER ASSIGNED	
UG-BOT-G-DSE-T-01	A. Analytical Techniques in Plant Sciences	Unit 1: Imaging and related techniques Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Use of fluorochromes: (a) Flow cytometry (FACS); (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting; Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.	SY	60
		Unit 2: Cell fractionation Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, CsCl2 gradient, analytical centrifugation, ultracentrifugation, marker enzymes.		
		Unit 3: Radioisotopes Use in biological research, auto-radiography, pulse chase experiment		
		Unit 4: Spectrophotometry Principle and its application in biological research.		
		Unit 5: Chromatography Principle; Paper chromatography; Column chromatography, Thin Layer Chromatography (TLC), Gas Liquid Chromatography (GLC), High Performance Liquid Chromatography (HPLC), Ion-exchange chromatography; Molecular sieve chromatography; Affinity chromatography.	SY	
		Unit 6: Characterization of proteins and nucleic acids Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: Agarose Gel Electrophoresis, Polyacrylamide Gel Electrophoresis (PAGE), Sodium Dodecyl Sulfate Polyacrylamide Gel Electrophoresis (SDSPAGE)		
		Unit 7: Biostatistics		

		Statistics, data, population, samples, parameters; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit.		
UG-BOT-G-DSE-P-01		1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.	BC, SY, SM	25
		2. Separation of amino acids by paper chromatography.		
		3. Demonstration of pigment separation by column chromatography		
		4. Estimation of protein concentration through Lowry's methods.		
		5. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH)		
		6. Preparation of permanent slides by double staining method (Helianthus stem, Nerium leaf, Maize root).		
UG-BOT-G-SEC-T-03 (Theory)	A. Herbal Technology	Unit 1: Herbal medicines History and scope: definition of medical terms, role of medicinal plants in Siddha systems of medicine; cultivation, harvesting, processing, storage, marketing and utilization of medicinal plants. Unit 2: Pharmacognosy Systematic position and medicinal uses of the following herbs in curing various ailments: Tulsi, Ginger, Fenugreek, Indian Goose berry and Ashoka. Unit 3: Phytochemistry Active principles and methods of their testing: identification and utilization of the medicinal herbs- Catharanthus roseus (cardiotonic), Withania somnifera (drugs acting on nervous system), Clerodendrum phlomoides (anti-rheumatic) and Centella asiatica (memory booster). Unit 4: Analytical pharmacognosy Drug adulteration: types, methods of drug evaluation; Biological testing of herbal drug: phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds). Unit 5: Medicinal plant banks Micro propagation of important species (Withania somnifera, neem and tulsi- herbal foods, future of pharmacognosy).	SP	30

DEPARTMENT OF: ZOOLOGY

SEMESTER-I MAJOR (NEP)

Courses	Course Title	Topic	No. of Lectures (inclusive of Tutorials)	Teachers
ZOO-MJ-T-101 [4 credits] [4 Classes PW] Full Marks: 55 (End Sem. 40+Internal Assessment 10+Attendance in Classes 05)	Taxonomy and Introduction to Non-chordates	Module 1: Basics of Animal Classification	5	HGT
		Module 2: Protista	5	AB
		Module 3: Porifera	5	AB
		Module 4: Cnidaria	5	SD
		Module 5: Ctenophora	5	SB
		Module 6: Platyhelminthes	5	AB
		Module 7: Aschelminthes	5	SB
		Module 8: Annelida	5	SB
		Module 9: Arthropoda	5	SH
		Module 10: Onychophora	5	DM
		Module 11: Mollusca	5	HGT
		Module 12: Echinodermata	5	SD
		Module 13: Hemichordata	5	HGT
ZOO-MJ-P-101 [2 credits] [4 Classes PW] Full Marks: 20 (End Sem. 20)	Taxonomy and Introduction to Non-chordates Lab	Identification (upto subclass)	60	HGT AB UG SD SB
ZOO-SEC-1 [3 credits] [3 Classes PW] Full Marks: 45 (End Sem. 35+Field Study 10)	Introduction to Sericulture	Module 1: Introduction	9	SD
		Module 2: Biology of Silkworm	9	HGT
		Module 3: Rearing of Silkworms	9	SH
		Module 4: Pests and Diseases	9	AB
		Module 5: Entrepreneurship in Sericulture	14	SH UG

MINOR

Courses	Subject/ Course Title	Topic	No. of Lectures (inclusive of Tutorials)	Teachers
ZOO-MI-T-101 [3 credits] [3 Classes PW] Full Marks: 35 (End Sem. 25+Internal Assessment 10)	Basic idea of animal diversity and taxonomy	Module 1: Basics of Animal Classification	3	DM
		Module 2: Protista	3	SB
		Module 3: Porifera	3	DM
		Module 4: Cnidaria	3	DM
		Module 5: Platyhelminthes	3	SH
		Module 6: Nematoda	3	AB
		Module 7: Annelida	3	SB
		Module 8: Arthropoda	3	SH
		Module 9: Mollusca	3	AB
		Module 10: Echinodermata	3	SB
		Module 11: Protochordata	3	SH
		Module 12: Pisces	3	DM
		Module 13: Amphibia	3	SH
		Module 14: Reptilia	3	AB
		Module 15: Aves	3	SB
		Module 16: Mammalia	3	AB

ZOO-MI-P-101 [1 credit] [2 Classes PW] Full Marks: 15 (End Sem. 15)	Basic idea of animal diversity and taxonomy Lab	1. Identification 2. Pecten from Fowl head 3. Dissection of brain and pituitary of Rohu/Catla/Mrigal 4. Identification and significanceof adult Fasciola hepatica, and Ascaris lumbricoides	30 2 2 2	UG & DM

DEPARTMENT OF: ZOOLOGY

SEMESTER-III: MAJOR

Courses	Course Title	Topic	No. of Lectures(inclusive of Tutorials)	Teachers
ZOO-MJ-T-301 [4 credits] [4 Classes PW] Full Marks: 55 (End Sem. 40+Internal Assessment 10+Attendance in Classes 05)	Ecology and Wildlife Biology	Module 1: Introduction to Ecology Module 2: Ecosystem Module 3: Community Module 4: Population Module 5: Conservation biology	12 12 12 12 12	SH HGT SD AB SB DM
ZOO-MJ-P-301 [2 credits] [4 Classes PW] Full Marks: 20 (End Sem. 20)	Ecology and Wildlife Biology Lab	1. Study of life tables and plotting of survivorship curves. 2. Setting quadrate, pitfall/light traps and recording results from collections therein: determination of population density, faunal abundance, species richness, importance value index, and calculation of Shannon-Weiner diversity index from the results. 3. Study of aquatic ecosystem. 4. Observation and description (Original photograph, systematic position, character and habitat description in LNB) of local wild flora, birds, butterflies, mammals (any 2 groups) 5. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary OR Study visit to a marine ecosystem.	10 10 10	SH HGT SD AB SB DM UG
ZOO-SEC-3 [3 credits] [3 Classes PW] Full Marks: 45 (End Sem. 35+Internal assessment 10)	Statistical and Computational Biology	Module 1: Introduction to Biostatistics Module 2: Testing of Hypotheses Module 3: Correlations and Regression Module 4: Introduction to Bioinformatics Module 5: Basic concept of data retrieval and sequence alignment	10 10 10 10 10	HGT SD SH AB SB DM

MINOR

Courses	Course Title	Topic	No. of Lectures (inclusive of Tutorials)	Teachers
ZOO-MI-T-301 [3 credits] [3 Classes PW] Full Marks: 35 (End Sem. 25+Internal Assessment 10	Comparative anatomy and Developmental Biology	Module 1: Integumentary System Module 2: Skeletal System Module 3: Digestive System Module 4: Circulatory System Module 5: Respiratory System Module 6: Urinogenital System	6 6 6 6 6 6	HGT HGT SB SH SD DM

		Module 7: Nervous System Module 8: Sense Organs Module 9: Developmental Biology	6 6 6	SD AB SH
ZOO-MI-P-301 [1 credit] [2 Classes PW] Full Marks: 15 (End Sem. 15)	Comparative anatomy and Developmental Biology Lab	1. Study of placoid, cycloid and ctenoid scales 2. Study of disarticulated skeleton of Toad/Pigeon/Guineapig. 3. Demonstration of Carapace and plastron of turtle OR Identification of mammalian skulls. 4. Dissection of Tilapia/carp: Circulatory system/urinogenital system; brain/pituitary. 5. Study of whole mounts of developmental stages of chick through permanent slides: 24, 48, 72, and 96 hours of incubation.	3 10 2 10 5	HGT SB SH SD DM SD AB UG

SEMESTER-V (CBCS)

Courses	Course Title	Topic	No. of Lectures (inclusive of Tutorials)	Teachers
ZOOL-H-CC-T-11 [4 credits] Full Marks:55 (End Sem. 40+Internal Assessment 10+Attendance in Classes 05	Molecular Biology	Unit 1: Nucleic Acids Unit 2: DNA Replication Unit 3: Transcription Unit 4: Translation Unit 5: Post Transcriptional Modifications and Processing of Eukaryotic RNA Unit 6: Gene Regulation Unit 7: DNA Repair Mechanisms Unit 8: Molecular Techniques	6 6 8 8 8 8 8 8	SB DM SH SB DM AB SD HGT
ZOOL-H-CC-P-11 [2 credits] Full Marks: 20 (End Sem 20)	Molecular Biology Lab	1. Demonstration of polytene and lamp brush chromosome 2. Isolation and quantification of genomic DNA 3. Agarose gel electrophoresis for DNA	10 10 10	UG HGT SD SB DM
ZOOL-H-CC-T-12 [4 Credits] Full Marks:55 (End Sem 40+Internal assesment10+ Attendance in classes 05)	Principles of Genetics	Unit 1: Mendelian Genetics and its Extension Unit 2: Linkage, Crossing Over and Chromosomal Mapping Unit 3: Mutations Unit 4: Sex Determination Unit 5: Extra-chromosomal Inheritance Unit 6: Recombination in Bacteria and Viruses Unit 7: Transposable Genetic Elements	8 10 8 8 10 8 8	HGT SD SH SD DM AB SB
ZOOL-H-CC-P-12	Principles of Genetics Lab	1. Chi-square analyses. 2. Preparation of linkage maps. 3. Identification of chromosomal aberration	7 9	UG HGT SD

[2 Credits] (End Sem 20)		4. Pedigree analysis	7 7	SB DM
ZOOL-H-DSE-T-01 [4 Credits] Full Marks:55 (End Sem 40+Internal Assessment 10+ Attendance in classes 05)	Fish and Fisheries	Unit 1: Introduction and Classification Unit 2: Morphology and Physiology Unit 3: Fisheries Unit 4: Aquaculture Unit 5: Fish in research	12 12 12 12 12	SH AB HGT SD DM
ZOOL-H-DSE-P-01 [2 Credits] Full Marks:20(End Sem 20)	Fish and Fisheries Lab	1. Morphometric and meristic characters of fishes. 2.Identification 3. Study of different types of scales 4.Study of crafts and gears used in Fisheries 5. Study of air breathing organs. 6. Project Report on a visit to any fish farm	4 6 4 4 4 4 4	UG HGT SD SH AB DM SB
ZOOL-H-DSE-T-03 [4 Credits] Full Marks:55 (End Sem 40+Internal Assessment 10+Attendance in classes 05)	Wildlife conservation and Management	Unit 1: Introduction to Wild Life Unit 2: Evaluation and management of wild life Unit 3: Management of habitats Unit 4: Population estimation Unit 5: Aims and objectives of wildlife conservation Unit 6: Management planning of wild life in protected areas Unit 7: Man and Wildlife Unit 8: Protected areas	7 8 8 8 8 7 7 7	AB DM SH SD AB HGT SH SB
ZOOL-H-DSE-P-03 [2 Credits] Full Marks:20 (End Sem 20)	Wildlife conservation and Management Lab	1.Identification 2. Demonstration of basic equipment needed in wildlife study. 3.Familiarization and study of animal evidences in the field 4. Monitoring for estimation of faunal abundance and diversity in locality	7 7 7 10	DM UG SB HGT SD

PROGRAMME COURSE (PCC)

Courses	Course Title	Topic	No. of Lectures	Teacher
ZOOL-G-DSE-T-01 [4 Credits] Full Marks:55 (End Sem 40+Internal Assessment 10+ Attendance in classes 05)	Fish and Fisheries	Unit 1: Introduction and Classification Unit 2: Morphology and Physiology Unit 3: Fisheries Unit 4: Aquaculture Unit 5: Fish in research	12 12 12 12 12	SH AB HGT SD DM
ZOOL-G-DSE-P-01 [2 Credits] Full Marks:20(End Sem 20)	Fish and Fisheries Lab	1. Morphometric and meristic characters of fishes. 2.Identification 3. Study of different types of scales 4.Study of crafts and gears used in Fisheries 5. Study of air breathing organs. 6. Project Report on a visit to any fish farm	4 6 4 4 4 4	UG SH SD

ZOOL-G-SEC-03 [2 Credits] Full Marks:50 (End Sem 40 + Internal assessment 10)	Sericulture	Unit 1: Introduction Unit 2: Biology of Silkworm Unit 3: Rearing of Silkworms Unit 4: Pests and Diseases Unit 5: Entrepreneurship in Sericulture	6 6 6 6 6	HGT SD SH SH SH

DEPARTMENT OF MOLECULAR BIOLOGY AND BIOTECHNOLOGY

JULY2024-DECEMBER 2024

SEMESTER-I (NEP):

Courses	Course title	Topic	No .of lectures (inclusive of Tutorials)	Teacher
Course category:MBBT-M-T-1.(The) 4-credit Full marks :55 (Theory 40+Internal Assessment 10+Attendence 05)	BIOCHEMESTRY AND METABOLISM	*UNIT-1:Water, buffer, and acid-base chemistry: Physical and chemical properties of water, Weak interactions in aqueous systems, Basis of acidity and basicity, Ionization of water, weak acids and weak bases, Equilibrium constant, Dissociation constant and the pH scale, Ionic product of water, Buffers – systems that resist pH changes Chromatography: Principles and Applications in protein purification *UNIT-2:Structure classification and properties of Amino acids, Peptide bond, Conformation of peptide bonds, Backbone torsion angles, Ramachandran plot, Forces stabilizing protein structure, Different Level of structural organization of proteins Strategies of protein purification. Carbohydrates: Structure, Function and properties of Monosaccharides,Disaccharidesand Polysaccharides (glycogen, starch, cellulose). *UNIT-3:Lipids: Structure and functions – Classification, nomenclature, and properties of fatty acids, essential fatty acids. Triglycerides, Membrane lipids: Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Archaebacterial ether lipids, Prostaglandins, Cholesterol. Nucleic acids: Structure and functions: Physical & chemical properties of Nucleic acids, purines &pyrimidines, Nucleosides & Nucleotides, *UNIT-4:Carbohydrates Metabolism (Reactions and regulations): Glycolysis, Fate of pyruvate under aerobic and anaerobic conditions, TCA cycle, Gluconeogenesis, Glycogenolysis, glycogen synthesis, Pentose phosphate pathway. Fatty acid metabolism (Reactions and regulations): Synthesis and ß-oxidation of fatty acids.	10 20 10	BB+SB BB+MB MB+SB

			20	MB+SB
Course category:MBBT-M-P-1.(Pract) 2-credit Full marks:20	BIOCHEMESTRY AND METABOLISM (PRACT)	1. Examination of physical properties of biomolecules – colour, odour, texture. 2. Preparation of normal, molar, and gm% solutions. 3. Qualitative tests for Carbohydrates, proteins, and lipids. 4. Operation of pH meter. 5. Preparation of buffers. 6. Separation of Amino acids and plant pigments by Paper chromatography. 7. Separation of Amino acids and plant pigments by Thin Layer chromatography		BB
Course category:MBBT-SEC-T-1.(The) 4-credit Full marks :55 (Theory 40+Internal Assesment 10+Attendence 05)	ENZYMOLOGY	*UNIT-1:Enzymes: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric &oligomeric enzymes, activation energy and transition state, enzyme activity and enzyme Unit, Enzyme substrate complex: Two substrate reactions (Random, ordered and ping-pong mechanism) Enzyme inhibition: types of inhibition, Lineweaver-Burk plots, suicide inhibitor. Zymogens and their activation (Proteases and Prothrombin)Role of: NAD+, NADP+, FMN/FAD, coenzymes A, Thiamine pyrophosphate, Pyridoxalphosphate, lipoic-acid, Biotin vitamin B12, Tetrahydrofolate and metallic ions *UNIT-2:Allosteric enzymes with special reference to phosphofructokinase, kinetics of allosteric enzymes. Isoenzymes– multiple forms of enzymes. Ribozymes. Multifunctional enzyme. Immobilized enzyme and their comparison with soluble enzymes, Application of Immobilized and soluble enzyme in health and industry. Methods for protein sequencing. Brief overview of the methods for analysis of secondary and tertiary structures of enzymes.	15 15	MB+SB AB+DM
Course category:MBBT-SEC-P-1.(Pract) 2-credit Full marks:20	ENZYMOLOGY (DEMONSTRATION PRACTICAL)	1. Demonstration of the digestion of starch by amylase. 2. Investigation of the effect of temperature on enzyme activity. 3. Demonstration of the action of lipase. 4. Demonstration of Enzyme/Cell Immobilization. 5. Demonstration of Isolation and purification of enzymes. 6. Demonstration of Protein sequencing techniques.		BB

DEPARTMENT OF MOLECULAR BIOLOGY AND BIOTECHNOLOGY

SEMESTER-III (NEP)

Courses	Course title	Topic	No .of lectures (inclusive of Tutorials)	Teacher
Course category: MBBT M T 3/ P 3 (The) 4-credit Full marks :55 (Theory 40+Internal Assesment 10+Attendence 05)	GENETICS	*Unit-1: Introduction: Historical developments in the field of genetics. Cell Cycle: Mitosis and Meiosis: Control points in cell-cycle progression in yeast. Role of meiosis in life cycles of organisms. Mendelian genetics: Mendel's experimental design, monohybrid, di-hybrid and tri hybrid crosses, Law of segregation & Principle of independent assortment. *UNIT-2: Non allelic interactions: Interaction producing new phenotype complementary genes, epistasis (dominant & recessive), duplicate genes and inhibitory genes. Chromosome and genomic organization: Eukaryotic nuclear genome nucleotide sequence composition –unique & repetitive DNA, satellite DNA Structure and characteristics of bacterial and eukaryotic chromosome, chromosome morphology, concept of euchromatin and heterochromatin *UNIT-3: Chromosome and gene mutations, Sex determination and sex linkage: Mechanisms of sex determination, Environmental factors and sex determination, Barr bodies, dosage compensation, genic balance theory, Fragile-Xsyndrome and chromosome, sex influenced dominance, sex limited gene expression, sex linked inheritance. *UNIT-4: Genetic linkage, crossing over and chromosome mapping: Linkage and Recombination of genes in a chromosome crossing over Extra chromosomal inheritance: Rules of extra nuclear inheritance, maternal effects, maternal linheritance, cytoplasmic inheritance, organelle heredity, genomic imprinting. *UNIT-5: Chromosomal aberration- number and structure, deletion, duplication, inversion. Associated diseases and Evolutionary. Significance; Cytogenetics of human disorder, Turner syndrome, Klinefelter syndrome, Down syndrome, copy number variation and human diseases, gene dosage, dosage compensation	10 15 15 10 10	AB MB DM DM MB

Course category:CCR5.(Pract) 4-credit Full marks :20	GENETICS (PRACTICAL)	1. Permanent and temporary mount of mitosis. 2. Permanent and temporary mount of meiosis. 3. Mendelian deviations in dihybrid crosses 4. Demonstration of - Barr Body – 5. Translocation study in Rhoeo. 5. Karyotyping with the help of photographs		AB+DM

Courses	Course title	Topic	No .of lectures (inclusive of Tutorials)	Teacher
Course category:MBSEC 101.(The) 2-credit Full marks :55 (Theory 40+Internal Assesment 10+Attendence 05	BIOFERTILIZERS	*UNIT-1:General account about the microbes used as biofertilizer – Rhizobium isolation,identification, mass multiplication, carrier based inoculants, Actinorrhizalsymbiosis.Azospirillum: isolation and mass multiplication – carrier based inoculant, associative effect of,different,microorganisms.Azotobacter: classification, characteristics – crop response to Azotobacterinoculum,maintenance and mass. *UNIT-2:Mycorrhizal association- types of mycorrhizal association, taxonomy, occurrence anddistribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation andinoculum production of VAM, and its influence on growth and yield of crop plants.Organic farming – Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost Application based capacity building through educational tours or virtual/ hands on demonstration of principles and concepts with respect to the following: 1. Preparation and sterilization of Media Jensen's medium, Pikovskaya's agar, Aleksandrow agar 2. Isolation of Nitrogen fixing, Phosphate & Potassium solubilizing bacteria from soil 3. Preparation of Biofertilizer using Plant Growth Pro moting Bacteria and Vermicompost 4. Visit to an Organic Farm or Biogas Plant SUGGESTED READING	15 15 15	SB AB SB +AB

DEPARTMENT OF: MOLECULAR BIOLOGY AND BIOTECHNOLOGY

SEMESTER-V (CBCS):

Courses	Course title	Topic	No .of lectures (inclusive of Tutorials)	Teacher

Course category:CCR11.(The) 4-credit Full marks :55 (Theory 40+Internal Assessment 10+Attendence 05)	BIOPROCESS TECHNOLOGY	*UNIT-1: Introduction to bioprocess technology. Range of bioprocess technology and its chronological Development . Basic principle components of fermentation technology. Types of microbial culture and its growth kinetics– Batch, Fed batch and Continuous culture. *UNIT-2: Design of bioprocess vessels- Significance of Impeller, Baffles, Sparger; Types of culture/production Vessels - Airlift; Cyclone Column; Packed Tower and their application in production processes. Principles of upstream processing – Media preparation, Inoculums development and sterilization. *UNIT-3: Introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting KLa. Bioprocess measurement and control system with special reference to computer aided process Control *UNIT-4: Introduction to downstream processing, product recovery and purification. Effluent treatment. Microbial production of ethanol, amylase, lactic acid and Single Cell Proteins.	10 20 15 15	SB SB MB MB

Course category:CCR11 (Pract) 2-credit Full marks :20	BIOPROCESS TECHNOLOGY(PRACT)	1. Bacterial growth curve. 2. Calculation of thermal death point (TDP) of a microbial sample. 3. Production and analysis of ethanol. 4. Production and analysis of amylase. 5. Production and analysis of lactic acid.		SB+MB
Course category: CCR12.(The) 4-credit Full marks :55 (Theory 40+Internal Assessment 10+Attendence 05)	RECOMBINANT DNA TECHNOLOGY	*UNIT-1: Molecular tools and applications- restriction enzymes, ligases, polymerases, alkaline phosphatase. Gene Recombination and Gene transfer: Transformation, Episomes, Plasmids and other cloning vectors (Bacteriophage-derived vectors, artificial chromosomes), Microinjection, Electroporation, Ultrasonication, Principle and applications of Polymerase chain reaction (PCR), primer-design, and RT- (Reverse transcription) PCR. *UNIT-2: Restriction and modification system, restriction mapping. Southern and Northern hybridization. Preparation and comparison of Genomic and cDNA library, screening of recombinants, *UNIT-3: Random and site-directed mutagenesis: Primer extension and PCR based methods of site directed mutagenesis, Random mutagenesis, Gene shuffling, production of chimeric proteins, Protein *UNIT-4: Genetic engineering in plants: Use of Agrobacterium tumefaciens and A. rhizogenes, Ti plasmids, Strategies for gene transfer to plant cells,	15 20 10 15	DM AB AB DM

Course category:CCR12 (Pract) 2-credit Full marks :20	RECOMBINANT DNA TECHNOLOGY(PRACT)	1. Isolation of chromosomal DNA from plant cells 2. Isolation of chromosomal DNA from E. coli 3. Qualitative and quantitative analysis of DNA using spectrophotometer 4. Plasmid DNA isolation 5. Restriction digestion of DNA		AB+DM
Course category DSE1.(The) 4-credit Full marks :55 (Theory 40+Internal Assesment 10+Attendence 05)	ANIMAL BIOTECHNOLOGY	*UNIT-1:Gene transfer methods in Animals – Microinjection, Embryonic Stem cell, gene transfer, Retrovirus & Gene transfer. *UNIT-2:Introduction to transgenesis. Transgenic Animals – Mice, Cow, Pig, Sheep, Goat, Bird, Insect. Animal diseases need help of Biotechnology – Foot-and mouth disease, Coccidiosis, Trypanosomiasis, Theileriosis. *UNIT-3:Animal propagation – Artificial insemination, Animal Clones. Conservation Biology – Embryo transfer techniques. Introduction to Stem Cell Technology and its applications *UNIT-4:Genetic modification in Medicine - gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems & ethics.	10 10 20 20	DM DM DM AB

Course category:DSE1(Pract) 2-credit Full marks :20	ANIMAL BIOTECHNOLOGY(PRACT)	1. Sterilization techniques: Theory and Practical: Glass ware sterilization, Media sterilization, Laboratory sterilization 2. Sources of contamination and decontamination measures. 3. Preparation of Hanks Balanced salt solution 4. Preparation of Minimal Essential Growth medium 5. Isolation of lymphocytes for culturing		AB+DM
Course category DSE2.(The) 4-credit Full marks :55 (Theory 40+Internal Assesment 10+Attendence 05)	PLANT BIOTECHNOLOGY	*UNIT-1:History of plant tissue culture, concept on differentiation, dedifferentiation and redifferentiation. Types of culture: Seed, Embryo, Callus, Organs, Cell and Protoplast culture. *UNIT-2:In vitro haploid production Androgenic methods: Anther culture, Microspore culture andogenesis Sgnificance and use of haploids, Ploidy level and chromosome doubling, diplodization, Gynogenic haploids, factors effecting gynogenesis, chromosome elimination *UNIT-3:Protoplast Isolation and fusion Methods of protoplast isolation, Protoplast development, Somatic hybridization, identifiation and selection of hybrid cells, Cybrids, Potential of somatic hybridization limitations. *UNIT-4:lant Growth Promoting bacteria. Nitrogen fixation, Nitrogenase, Hydrogenase, Nodulation, Biocontrol of pathogens, Growth promotion by free-living bacteria.	15 20 15 10	SB SB MB MB
Course category:DSE2 (Pract) 2-credit Full marks :20	PLANT BIOTECHNOLOGY(PRACT)	1. Preparation of simple growth nutrient (knop's medium), full strength, half strength, solid and liquid. 2. Preparation of complex nutrient medium (Murashige & Skoog's medium) 3. Selection, Prune, sterilize and prepare an explant for culture. 4. Significance of growth hormones in culture medium. 5. To demonstrate various stages of Micropropagation.		BB+MB+SB

DEPARTMENT OF ECONOMICS

July,24-December,24

SEMESTER- 1

Course	Course title	Topic	No of Lectures	Teachers
MAJOR (MAC 1)	Introductory Microeconomics	Unit 1: Exploring the subject matter of Economics Unit 2: Supply and Demand: How Markets Work	12 20	SKD SKD

		Unit 3: Consumer Theory Unit 4: Production and Costs	20 20	SKD SKD
MINOR (MIC 11)	Principles of Microeconomics	Unit 1: Introduction Unit 2: Consumer Theory Unit 3: Production and Cost: Unit 4: Perfect Competition	12 15 15 06	SKD SKD AKC AKC

COURSE	COURSE TITLE	TOPIC	NO OF LECTURES	*TEACHERS*
SEC-1 –	Basic Mathematics –	Unit 1: Basic Concepts of Functions Unit 2: Limits and Continuity of Functions Unit 3: Derivatives Unit 4: Integrals of functions of one variable Unit 5: Matrix and Determinants	4 6 14 6 6	AKC AKC AKC AKC AKC

DEPARTMENT OF ECONOMICS

SEMESTER- III

Course	Course title	Topic	No of Lectures	Teachers
MAJOR (MAC 3)	Mathematical Economics	Unit 1: Application of Matrix Algebra Unit 2: Functions of Several Variables Unit 3: Multivariable Optimization Unit 4: Differential Equation	06 12 12 10	AKC SKD AKC SKD
MINOR (MIC 21)	Principles of Macroeconomics	Unit 1: Introduction Unit 2: National Income Accounting Unit 3: Determination of National Income	06 16 16	SKD AKC AKC

		Unit 4: Money in Modern Economy Unit 5: Unemployment	06 06	SKD SKD

COURSE	COURSE TITLE	TOPIC	NO OF LECTURES	*TEACHERS*
SEC-3 –	Computer Application in Economics	Unit 1: Introduction Unit 2: MS Excel for Data Analysis Unit 3: Excel Formulas & Functions Unit 4: Descriptive Statistics using Excel Unit 5: Data Visualization in Excel	07 08 10 10 07	AKC SKD AKC SKD AKC

DEPARTMENT OF ECONOMICS

Syllabus Distribution from July-December, 2024

SEMESTER- V (CBCS)

COURSE	COURSE TITLE	TOPIC	NO OF LECTURES	TEACHERS
ECON-H-CC-T-11	International Economics	1. Basics of trade theory 2. Technology and Trade (Ricardian Model) 3. Factor Endowment & Trade (Heckscher-Ohlin-Samuelson Model) 4. Trade Policy 5. Balance of Payments & Exchange Rate	06 06 08 06 10	AKC AKC AKC AKC AKC
ECON-H-CC-T-12	Public Economics	1. Nature and Scope of Public Economics 2. Theory of Public Good 3. Taxation	05 06	SKD SKD

		4. Public Expenditure and Public Debt	08 08	SKD SKD
ECON-H-DSE-T-1A	Economic Development and Policy in India - I	1. Issues in Growth, Development and Sustainability 2. Factors in Development 3. Population and Economic Development 4. Employment 5. Indian Development Experience	04 04 05 03 03	SKD SKD SKD SKD SKD
ECON-H-DSE-T-2A	Public Finance	1. Overview of Fiscal Functions, Tools of Normative Analysis, Pareto Efficiency, Equity and the Social Welfare 2. Market Failure, Public Good and Externalities 3. Elementary Theories of Product and Factor Taxation (Excess Burden and Incidence) Issues from Indian Public Finance 1. Current Issues of India's Tax System 2. Working of Monetary and Fiscal Policies 3. Analysis of Budget and Deficits 4. Fiscal Federalism in India 5. State and Local Finances	04 05 03 02 03 04 03 03	AKC AKC AKC SKD SKD SKD SKD SKD
• ECON—G-DSE-T-1A	Economic Development and Policy in India - I	1. Issues in Growth, Development and Sustainability 2. Factors in Development 3. Population and Economic Development 4. Employment	03 02 03 02	SKD SKD AKC AKC

		5. Indian Development Experience	03	AKC
ECON—G-GE-T-1	Introductory Microeconomics	1. Exploring the subject matter of Economics	02	SKD
		2. Supply and Demand: How Markets Work, Markets and Welfare	06	AKC
		3. The Households	05	SKD
		4. The Firm and Perfect Market Structure	05	AKC
		5. Imperfect Market Structure	06	AKC
		6. Input Markets	04	SKD
ECON—G-SEC-T-03	Statistical Tools for Data Analysis – II	1. Bivariate frequency distribution. Correlation and regression. Rank correlation.	06	AKC
		2. Basics of index numbers: price and quantity index numbers.	06	AKC

Department of Geography

Semester –I (Major-1):

NEP -2020 (SESSION 2024-2025)

Course	Course title	Topic	No. of Lectures	Teachers
	GEOTECTONICS AND GEOMORPHOLOGY	UNIT I: GEOTECTONICS		
		1. Earth's tectonic and structural evolution with reference to geological time scale	07	SM
		2. Earth's crust and interior: Internal structure with reference to seismological evidences	06	BC
		3. Theories of Isostasy: Airy and Pratt		
		4. Continental drift theory: Evidences and criticism; Concept of Sea Floor Spreading and Palaeomagnetism	04 08	SM SPM
		5. Plate Tectonics: Mechanism and resultant landforms; Earthquakes and Vulcanicity	08	SPM
		6. Folds and Faults: Origin and classification	06	SPM
		UNIT II: GEOMORPHOLOGY		
		1. Fundamental principles of Geomorphology	04	SM
		2. Degradation processes: Weathering, Mass wasting and resultant landforms	08	BC
		3. Theories of landscape evolution: Davis, Penck and Hack	06	SM
		4. Slope development: Theories of King and Wood	06	BC
		5. Development of river network and landforms on uniclinal and folded structures	06	AD
		6. Processes and landforms: Fluvial, Glacial, Aeolian and Coastal	12	AD

Semester –I SEC-P-1:
NEP -2020 (SESSION 2024-2025)

Course	Course title	Topic	No. of Lectures	Teachers
Skill Enhancement Course (SEC) PAPER: I (Practical) CODE: GEOG-SEC-P-1 FULL MARKS: 45, Semester End Exam-35 Internal Assessment-05(Assignment)+ 05(attendance)=10	Basics of Computer and Computer Applications	1. Basics of computer and its operation	04	SPM
		2. Numbering Systems - Binary Arithmetic	04	SPM
		3. Preparation of Annotated diagrams and its interpretation: Line graph, Bar and Pie diagrams, Histogram and Scatter diagrams	08	AD
		4. Data Computation, Storing and Formatting in Spreadsheets: Computation of Rank, Mean, Median, Mode, Standard Deviation, Moving Averages, Derivation of Correlation, Coefficient of Variation, Regression	12	SM
		5. Internet Surfing: Generation and Extraction of Information	06	BC

Semester –III (Major-3)

NEP -2020 (SESSION 2024-2025)

Course	Course title	Topic	No. of Lectures	Teachers
Major PAPER: III (Theory) COURSE CODE: GEOG-M-T-3 FULL MARKS: 75 Semester End Exam-60 Internal Assessment-10 (test exam)+ 5(attendance)=15	COURSE TITLE: FUNDAMENTALS OF REMOTE SENSING, GIS AND GNSS	UNIT I: FUNDAMENTALS OF REMOTE SENSING 1. Definition and stages of remote sensing; EMR and its spectral ranges 2. Remote sensing platforms, satellites and sensors 3. Sensor resolutions and their applications with reference to IRS and LANDSAT missions 4. Concept of FCC; Principles of image interpretation (visual and digital) 5. Aerial Photographs: types, geometry and photo interpretation keys 6. Applications of remote sensing in managing agriculture, water and forest resources; Monitoring urban growth and environmental degradation	 04 04 06 04 04 08	 SM SM SM SM AD AD
		UNIT II: FUNDAMENTALS OF GIS AND GNSS 1. Definition, components and applications of GIS 2. GIS data structures types: spatial and non-spatial, raster and vector 3. Principles of preparing attribute tables, data manipulation and overlay analysis 4. Principles and significance of buffer preparation 5. Basic concept of GPS 6. Principles of GNSS positioning and waypoint collection; GIS- GNSS integration	 08 04 04 04 06 04	 SPM SPM SPM SPM BC BC

Semester –III Skill Enhancement Course (SEC -P-3)

Course	Course title	Topic	No. of Lectures	Teachers
Skill Enhancement Course (SEC) PAPER: III (Practical) CODE: GEOG-SEC-P-3 Total Marks: 45 Credits: 3 Course Evaluation: Semester End Examination (25+10* = 35 Marks) and Internal Assessment (10 Marks) *Laboratory Note Book + Viva-voce: 5+5 = 10	APPLICATIONS OF REMOTE SENSING AND GIS	1. Acquisition procedure of free geospatial data from NRSC /Bhoonidhi and USGS	06	SM
		2. Georeferencing of maps and images; Digitisation of features: Point, Line and Polygon	04	SM
		3. Data attachment and preparation of thematic map (bargraph, pie-chart and choropleth); Overlay analysis	08	SPM
		4. Preparation of FCC using IRS LISS-III/IV and/or LANDSAT (ETM+) data; Image enhancement	08	SPM
		5. Preparation of LULC map by Supervised Image Classification (Maximum Likelihood) using IRS LISS-III/IV or LANDSAT (ETM+) data	06	AD

Semester -V

Core Course (CC) CBCS

Course	Course title	Topic	No. of Lectures	Teachers
CORE COURSE 11 GEO/H/CC/T/11: (Theory): FULL MARKS: 75 Semester End Exam-40 Practical-20 Internal Assessment-10 (test exam)+ 5(attendance) =15	Research Methodology and Field Work	Unit-I: Research Methodology 1. Research in Geography: Meaning, types and significance 2. Significance of literature review and formulation of research design 3. Defining research problem, objectives and hypothesis; Research materials and methods 4. Structure of research report: Title, Acknowledgement, Abstract and Key-words, Introduction, Literature Survey, Methodology, Result and Discussion, Conclusion including Recommendations and Suggestions, References and Bibliography (APA) Unit-II: Fieldwork 1. Fieldwork in Geographical studies – Role and significance; Selection of study area and objectives; Pre-field preparations; Ethics of fieldwork 2. Field techniques and tools: Observation (participant, nonparticipant), questionnaires (open, closed, structured, non-structured); Interview with special reference to focused group discussions 3. Field techniques and tools: Landscape survey using transects and quadrants, relevant constructing sketches, diagrams, photographs and video recording 4. Designing a field report – Aims and Objectives, Methodology, Analysis, Interpretation and Writing the report GEO/H/CC/P/11: (Practical): Research Methodology and Field Work	04 04 04 08 06 06 04 04	BC BC BC BC AD AD AD AD AD & BC

Semester -V: July, 2024-December, 2024

Core Course (CC) CBCS

Course	Course title	Topic	No. of Lectures	Teachers
CORECOURSE 12 GEO/H/CC/T/12 FULL MARKS: 75 Semester End Exam-40 Practical-20 Internal Assessment-10 (test exam)+5(attendance)=15	Remote Sensing and GIS	Unit-I: Remote Sensing 1. Definition and stages of Remote Sensing (RS); Platforms and Sensors 2. Sensor resolutions and their applications with reference to IRS and LANDSAT missions, image referencing schemes and data acquisition 3. Aerial Photographs: Types, Geometry and photo interpretation keys; Concept of FCC 4. Principles of Image interpretation (Visual and Digital) Unit-II: Geographical Information Systems and Global Navigation Satellite System 1. GIS data structures: types (spatial and non - spatial), raster and vector 2. Principles of preparing attributes tables, data manipulation and overlay analysis 3. Principles of GNSS positioning and waypoint collection; Transferring of waypoints to GIS. GEO/H/CC/P/12: (Practical) 1. Georeferencing of map 2. Digitisation of features: Point, Line and Polygon 3. Data attachment overlay and preparation of thematic map (bargraph, pie-chart and choropleth) 4. Preparation of FCC using IRS LISS-III and/or LANDSAT (ETM+) data 5. Preparation of LULC map by Supervised Image Classification (Maximum Likelihood) using IRS LISS-III or LANDSAT (ETM+) data	04 04 04 04 04 04 02 04 06 06 04	SPM SPM SPM SPM SM SM SM SM SM SPM SPM

Semester -V

DSE (Discipline Specific Elective)

CBCS

Course	Course title	Topic	No. of Lectures	Teachers
DISCIPLINE SPECIFIC ELECTIVE 01 GEO/H/DSE/T/01/ A: (Theory): FULL MARKS: 75 Semester End Exam-60 Internal Assessment- 10 (test exam) +5(attendance)=15	Urban Geography	Unit-I 1. Urban Geography: Nature, Scope, Approaches and recent trends 2. Theories of Urban Morphology: Concentric Zone Theory, Sector Theory and Multiple Nuclei Theory 3. Concept of Hierarchy; Christaller's Central Place Theory 4. Rank Size Rule; The Law of the Primate City 5. Patterns of urbanisation in developed and developing countries Unit-II 1. Ecological process of urban growth 2. City Region: Concept, Structure and Characteristics 3. Patterns and trends of urbanization in India 4. Case studies of Delhi, Kolkata with reference to Land use and Urban issues (housing, slum) 5. Urban renewal programme JNNURM	 04 06 04 04 04 02 04 02 04 04	 SM SPM SPM SM SM SM SM SPM SPM SPM

Semester -V

CBCS

Course	Course title	Topic	No. of Lectures	Teachers
DISCIPLINE SPECIFIC ELECTIVE 02 (GEO/H/DSE/T/02 /A: (Theory) FULL MARKS: 75 Semester End Exam-60 Internal Assessment-10 (test exam) +5(attendance)=15	Population Geography	Unit -1 1. Development of Population Geography as a field of specialization; Relation between population geography and demography; Sources of population data with special reference to India (Census, Vital statistics and NSS) 2. World patterns determinants of population distribution and growth; Concept of optimum population 3. Demographic Transition Model; Theories of population growth: Malthusian and Marxian theory 4. Population distribution, density and growth profile in India Unit- 2 1. Population Composition and Characteristics: Age-Sex Pyramid; Female-Male Ratio 2. Determinate measures of Fertility and Mortality 3. Population Composition of India: Rural and Urban, Occupational Structure as per Census of India 4. Migration: Theories, Causes and Types 5. Concept of Human Development Index 6. Population and development: population-resource regions 7. Population policies in Selected Countries: India and China 8. Contemporary Issues in Population: Health and Unemployment	06 06 04 04 04 04 04 02 02 02 04 02	BC BC BC BC BC AD AD AD AD AD AD AD

DEPARTMENT OF COMPUTER SCIENCE

1ST SEMESTER UNDER NEP 2024

MAJOR (THEORY)

CourseCode	Course Title	Course Content	Assigned Teacher	No. of Lectures (inclusive of Tutorials)
CS-MJ-T-1	Computer Fundamental and Programming using C	Unit 1: Introduction to Computer and Problem Solving: Information and Data. Hardware: CPU, Primary and Secondary storage, I/O devices Software: Systems and Application.	BB	3
		Unit 2: Number Systems: Super, Mainframe, Mini and Personal Computer. Introduction to Programming Languages: Machine Language, Assembly Language, High Level Language. Problem Solving: Flow Charts, Decision Tables and Pseudo codes.	UD	6
		Unit 3: Number Systems and Codes: Number representation: Weighted Codes, Non-weighted codes, Positional, Binary, Octal, Hexadecimal, Binary Coded Decimal (BCD), Conversion of bases. Complement notions. Binary Arithmetic, Binary Codes: Gray, Alphanumeric, ASCII, EBCDIC; Parity Bits. Single Error-Detecting and Correcting Codes, Hamming Codes, Fixed and Floating Point Arithmetic , Addition, Subtraction, Multiplication and Division:	BB	12
		Unit 4: Boolean Algebra: Fundamentals of Boolean Algebra, Switches and Inverters, Functionally Complete Gates (AND, OR, NOT), NAND, NOR. Switching function and Boolean function. De Morgan‘s theorem, Min-term and Maxterm, Truth table and minimization of switching function up to four variables, Algebraic and K-map method of logic circuit synthesis: Two level and Multi level	UD	6
		Unit 5: C Language preliminaries : C character set, Identifiers and keywords, Data types, Declarations, Expressions, statements and symbolic constants. Input-Output: getchar, putchar, scanf, printf, gets, puts, functions. Pre-processor commands: #include, #define, #ifdef	BB	6
		Unit 6: Operators and expressions: Arithmetic, unary, logical, bit-wise, assignment and conditional operators Storage types: Automatic, external, register and static variables.	UD	4
		Unit 7: Functions: Defining and accessing, passing arguments, Function prototypes, Recursion, Library functions, Static functions	BB	3
		Unit 8: Arrays: Defining and processing, Passing arrays to a function, Multi dimensional arrays. Strings: Defining and operations on stringsGeneral characteristics; salient features of Cycadophyta,	UD	4

		Coniferophyta and Gnetophyta.; Ecological and economic importance.		
		Unit 9: Pointers: Declarations, Passing pointers to a function, Operations on pointers, Pointer Arithmetic, Pointers and arrays, Arrays of pointers function pointers.	BB	4
		Unit 10: Structures: Defining and processing, Passing to a function, Unions, typedef, array of structure, and pointer to structure	UD	4
		Unit 11: File structures: Definitions, concept of record, file operations: Storing, creating, retrieving, updating Sequential, relative, indexed and random access mode, Files with binary mode(Low level), performance of Sequential Files, Direct mapping techniques: Absolute, relative and indexed sequential files (ISAM) concept of index, levels of index, overflow of handling. File Handling: File operation: creation, copy, delete, update, text file, binary file.	BB	8

CS-MJ- P-01	Lab: Programming using C Lab	**1.** Write a C Program to read radius of a circle and to find area and circumference **2.** Write a C Program to read three numbers and find the biggest of three **3.** Write a C Program to demonstrate library functions in math.h **4.** Write a C Program to check for prime **5.** Write a C Program to generate n primes **6.** Write a C Program to read a number, find the sum of the digits, reverse the number and check it for palindrome **7.** Write a C Program to read numbers from keyboard continuously till the user presses 999 and to find the sum of only positive numbers **8.** Write a C Program to read percentage of marks and to display appropriate message (Demonstration of else-if ladder) **9.** Write a C Program to find the roots of quadratic equation (demonstration of switch-case statement) **10.** Write a C program to read marks scored by n students and find the average of marks (Demonstration of single dimensional array) **11.** Write a C Program to remove Duplicate Element in a single dimensional Array **12.** Write a C Program to demonstrate string functions. **13.** Write a C Program to demonstrate pointers in C **14.** Write a C Program to check a number for prime by defining isprime( ) function **15.** Write a C Program to read, display and to find the trace of a square matrix **16.** Write a C Program to read, display and add two m x n matrices using functions **17.** Write a C Program to read, display and multiply two matrices using functions **18.** Write a C Program to read a string and to find the number of alphabets, digits, vowels, consonants, spaces and special characters. **19.** Write a C Program to Reverse a String using Pointer **20.** Write a C Program to Swap Two Numbers using Pointers **21.** Write a C Program to demonstrate student structure to read & display records of n students. **22.** Write a C Program to demonstrate the difference between structure & union. **23.** File related programs.	The following programs are to be discussed in the lab during the initial period of the semester by BB & UD	40

Skill Enhancement Course: Practical

CS-SEC-P-1	Office Automation Lab	Unit 1: Computer software and Introduction to Operating System and Installation: Computer software : Introduction, Software definition, Software categories, Installing and uninstalling software, Software piracy, Software terminologies. Introduction to Operating System with GUI, CUI and installation of different OS with required software. Office package : Introduction, Office user interface, Different office package software.	BB	40
		Unit 2: Word Processing : Introduction, Starting Word, working with word documents, working with text, working with tables checking spelling and grammar, adding graphs to the document, mail merge, header and footers, page numbers, protect the document, working with formatting tools.	UD	
		Unit 3:	BB	

		Presentation: Starting Presentation, Working with Presentation, Creating, Saving and Printing a presentation, Working with Animation, adding a slide to presentation, Navigating through a presentation, Slide-sorter, Slide-show, Editing slides, Working with Graphics and Multimedia (Inserting Photo, Video & Sound)		
		Unit 4: Spreadsheet: Introduction, starting Spreadsheet, Spreadsheet environment, Working with Spreadsheet workbook, Working with worksheet – Entering data, formatting tips and Techniques, Generating graphs, Formulas and Functions, Inserting charts, sorting, Pivot Tables, data extraction, adding clip art, add an image from a file, Printing in Spreadsheet. Formulas and Functions: Understanding formulas and cell references, basic mathematical operations, using common functions (e.g., SUM, AVERAGE, COUNT), applying absolute and relative cell references, nesting functions	BB	
		Unit 5: Spreadsheet: Data Analysis and Manipulation Working with text functions for data cleaning, Splitting and combining data, Data normalization and standardization, working with ranges and named ranges, conditional formatting, data validation and error checking, using logical functions (e.g., IF, AND, OR), sorting and filtering data. Advanced Spreadsheet Features :Creating and managing tables, creating and modifying pivot tables, using lookup functions (e.g., VLOOKUP, HLOOKUP), working with charts and graphs, importing and exporting data.	UD	
		UNIT 6: Spreadsheet: Collaboration and Sharing Protecting worksheets and workbooks, sharing spreadsheets with others, tracking changes and commenting, collaborating in real-time, using version history and revision control. Statistical Functions and Analysis Descriptive statistics (mean, median, mode, variance, etc.), Calculating measures of central tendency and dispersion, Correlation and regression analysis, Hypothesis testing and confidence intervals, Analysis of variance (ANOVA).	BB	
		UNIT 7: Spreadsheet: Pivot Tables and Data Aggregation: Creating pivot tables for data summarization, grouping and aggregating data by categories, applying filters and slicers to pivot tables, calculating calculated fields and items. Advanced Data Visualization: Creating charts and graphs for data representation, customizing chart elements (titles, axes, legends), Using sparklines and data bars for visual analysis, creating interactive dashboards, incorporating trendlines and forecasting in charts.	UD	
		UNIT 8: Spreadsheet: Exploratory Data Analysis: Identifying patterns and outliers in data, creating histograms and box plots, using conditional formatting for data visualization, Data segmentation and drill-down analysis, Applying data validation rules for data integrity.	BB	
		UNIT 9: Spreadsheet:	UD	

		Advanced Analysis Techniques :Using goal seek and solver for optimization problems, performing "what-if" analysis with data tables, simulating data using random number functions, Monte Carlo simulation for risk analysis. Creating scenario analysis models Reporting and Presentation of Results : Designing informative reports and summaries. Creating interactive dashboards for data presentation, Data visualization best practices, Documenting data analysis processes Presenting findings to stakeholders.		

MINOR-1 (Theory)

CourseCode	Name of the Course	Course Content	Assigned Teacher	No. of Lectures (inclusive of Tutorials)
CS-MI-T-1	Computer Fundamental and Programming using C	Unit 1: Introduction to Computer and Problem Solving: Information and Data. Hardware: CPU, Primary and Secondary storage, I/O devices Software: Systems and Application.	BB	3
		Unit 2: Number Systems: Super, Mainframe, Mini and Personal Computer. Introduction to Programming Languages: Machine Language, Assembly Language, High Level Language. Problem Solving: Flow Charts, Decision Tables and Pseudo codes.	UD	6
		Unit 3: Number Systems and Codes: Number representation: Weighted Codes, Non-weighted codes, Positional, Binary, Octal, Hexadecimal, Binary Coded Decimal (BCD), Conversion of bases. Complement notions. Binary Arithmetic, Binary Codes: Gray, Alphanumeric, ASCII, EBCDIC; Parity Bits. Single Error-Detecting and Correcting Codes, Hamming Codes, Fixed and Floating Point Arithmetic , Addition, Subtraction, Multiplication and Division:	BB	12
		Unit 4: Boolean Algebra: Fundamentals of Boolean Algebra, Switches and Inverters, Functionally Complete Gates (AND, OR, NOT), NAND, NOR. Switching function and Boolean function. De Morgan‘s theorem, Minterm and Maxterm, Truth table and minimization of switching function up to four variables, Algebraic and Kmap method of logic circuit synthesis: Two level and Multi level	UD	6
		Unit 5: C Language preliminaries : C character set, Identifiers and keywords, Data types, Declarations, Expressions, statements and symbolic constants. Input-Output: getchar, putchar, scanf, printf, gets, puts, functions. Pre-processor commands: #include, #define, #ifdef	BB	6
		Unit 6: Operators and expressions: Arithmetic, unary, logical, bit-wise, assignment and conditional operators Storage types: Automatic, external, register and static variables.	UD	4

		Unit 7: Functions: Defining and accessing, passing arguments, Function prototypes, Recursion, Library functions, Static functions	BB	3
		Unit 8: Arrays: Defining and processing, Passing arrays to a function, Multi dimensional arrays. Strings: Defining and operations on stringsGeneral characteristics; salient features of Cycadophyta, Coniferophyta and Gnetophyta.; Ecological and economic importance.	UD	4
		Unit 9: Pointers: Declarations, Passing pointers to a function, Operations on pointers, Pointer Arithmetic, Pointers and arrays, Arrays of pointers function pointers.	BB	4
		Unit 10: Structures: Defining and processing, Passing to a function, Unions, typedef, array of structure, and pointer to structure	UD	4
		Unit 11: File structures: Definitions, concept of record, file operations: Storing, creating, retrieving, updating Sequential, relative, indexed and random access mode, Files with binary mode(Low level), performance of Sequential Files, Direct mapping techniques: Absolute, relative and indexed sequential files (ISAM) concept of index, levels of index, overflow of handling. File Handling: File operation: creation, copy, delete, update, text file, binary file.	BB	8

MINOR-1 (PRACTICAL)

CourseCode	Name of the Course	Course Content	Assigned Teacher	No. of Lectures (inclusive of Tutorials)
CS-MI P-1-Lab	Practical, Programming using C Lab	C Programming elements: Character sets, Keywords, Constants, Variables, Data Types, Operators-Arithmetic, Relational, Logical and Assignment; Increment and Decrement and Conditional, Operator Precedence and Associations; Expressions, type casting. Comments, Functions, Storage Classes, Bit manipulation, Input and output.	BB	The following activities be carried out/ discussed in the lab during the initial period of the semester.
		C Preprocessor: File inclusion, Macro substitution.	BB	
		Statements: Assignment, Control statements- if, ifelse, switch, break, continue, goto, Loops-while, do-while, for.	BB	
		Functions: argument passing, return statement, return values and their types, recursion	UD	

		Arrays: String handling with arrays, String handling functions.	UD	
		Pointers: Definition and initialization, Pointer arithmetic, Pointers and arrays, String functions and manipulation, Dynamic storage allocation.	UD	
		User defined Data types: Enumerated data types, Structures. Structure arrays, Pointers to Functions and Structures, Unions.	BB	
		File Access: Opening, Closing, I/O operations.	UD	

MULTIDISCIPLINARY COURSE

CourseCode	Name of the Course	Course Content	Assigned Teacher	No. of Lectures (inclusive of Tutorials)
CS-MU-T-1	THEORY: COMPUTER SCIENCE FOR BEGINNERS	Generation of Computers A brief history of generation of computers, Super, Mainframe, Mini and Personal Computer.	CLASS ARE CONDUCTED BY : BB &UD	2
		Introduction to Computer Hardware and Softwares Components of modern computers: CPU, Primary and Secondary storage, I/O devices Software: Systems and Application		4
		Number Systems : A brief history of different number systems. Number representations and conversion rules in different number systems such as binary, octal, hexadecimal and decimal.		5
		Boolean Algebra : Fundamentals of Boolean Algebra, Switches and Inverters, Functionally Complete Gates (AND, OR, NOT), NAND, NOR. Switching function and Boolean function. De Morgan's theorem, Minterm and Maxterm, Truth table and minimization of switching function up to four variables, Algebraic and Kmap method of logic circuit synthesis: Two level and Multi level		8
		Problem Solving : Flow Charts, Decision Tables and Pseudo codes.		5
		Programming Languages : A brief history of Programming languages: Machine Language, Assembly Language, High Leve l Language.		4

		Introduction to Database Management Systems What is DBMS? Difference between DBMS and File structure, Architectures of DBMS. Different Types of DBMS.		4
		Internet: History of the internet and different internet enabled services used in our daily life. Different internet service providers. Cloud services and service providers.		3
		Information Technology Laws : Information Technology laws provided to electronic commerce – electronic signatures, data protection, cyber security; penalties & offences under the IT Act, dispute resolution, and other contemporary issues.		5

3RD SEMESTER UNDER NEP

MAJOR (THEORY)

COURSE CODE	COURSE TITLE	COURSE CONTENT	TEACHER ASSIGNED	No. of Lectures (inclusive of Tutorials)
CS-MJ-T-3	Computer Organization & Architecture	Unit 1: Introduction: Logic gates, Boolean algebra, combinational circuits, circuit simplification, flip-flops and sequential circuits, decoders, multiplexers, registers, counters and memory units.	BB	9L
		Unit 2: Data Representation and Basic Computer Arithmetic: Number systems, complements, fixed and floating point representation, character representation, addition, subtraction, magnitude comparison, multiplication and division algorithms for integers.	UD	12L
		Unit 3: Basic Computer Organization and Design: Computer registers, bus system, instruction set, timing and control, instruction cycle, memory reference, input-output and interrupt, Interconnection Structures, Bus Interconnection design of basic computer.	BB	10L
		Unit 4: Central Processing Unit: Register organization, arithmetic and logical micro-operations, stack organization, micro programmed control. Instruction formats, addressing modes, instruction codes, machine language, assembly language, input output programming, RISC, CISC architectures, pipelining and parallel architecture.	UD	9L
		Unit 5: Memory Organization: Cache memory, Associative memory, mapping.	BB	10L
		Unit 6: Input-Output Organization: Input / Output: External Devices, I/O Modules, Programmed I/O, Interrupt-Driven I/O, Direct Memory Access, I/O Channels.	UD	10L

Skill Enhancement Course: Practical

CS-SEC-P-3	Practical: Data Analysis through Python/R (Lab)	1. Write a Python/R script to create, manipulate, and perform basic operations on lists (Python) or vectors (R). Perform operations such as slicing, indexing, and appending elements. 2. 2. Write a Python/R program to load and manipulate data using dictionaries (Python) or	BB	40

		data frames (R). 3. Write a Python/R script to load a CSV file into a Pandas DataFrame (Python) or a data frame (R). Perform basic operations like viewing the first few rows, summary statistics, and exporting the modified dataset to a new CSV file. Import data from an Excel file and perform similar operations. 4. Write a Python/R script to identify and handle missing data (drop or impute missing values) in a dataset. Detect and treat outliers using statistical techniques. Perform data normalization or standardization on numerical columns. 5. Perform univariate and multivariate analysis using Python (Pandas, Matplotlib, Seaborn) or R (ggplot2, dplyr). Generate summary statistics (mean, median, mode, standard deviation, etc.) for numerical columns. Create visualizations such as histograms, boxplots, scatter plots, and pair plots to explore relationships between variables. 6. (a) Write a Python/R script to apply log transformations, binning, or scaling to numerical data. (b) Create new features using existing ones (e.g., adding a column for a calculated field). (c) Perform one-hot encoding for categorical variables and label encoding for target variables. 7. Write a Python/R script to compute and visualize the correlation matrix for a dataset. Perform hypothesis testing using t-tests or ANOVA to compare means between groups. Apply chi-square tests for independence on categorical data.		
		1. Create line plots, bar plots, pie charts, and heatmaps using Python (Matplotlib/Seaborn) or R (ggplot2). Create advanced visualizations like violin plots, KDE plots, and facet grids to represent multidimensional data. Customize plots by adding titles, labels, legends, and changing color schemes. 2. Implement a simple linear regression model in Python (Scikit-learn) or R to predict a target variable. Evaluate the model using metrics like R-squared, mean squared error, and visualize the regression line. Extend to multiple linear regression and evaluate its performance. 3. Implement a logistic regression model in Python/R to classify binary data. Evaluate model performance using confusion matrix, accuracy, precision, recall, and F1-score. Explore other classification algorithms like Decision Trees and K-Nearest Neighbors (KNN) for comparison. 4. Implement the K-means clustering algorithm in Python/R to group data based on similarity. Visualize clusters and calculate the silhouette score to evaluate cluster quality. Apply hierarchical clustering and compare the results with K-means. 5. Load and visualize time series data using Python (Pandas) or R. Perform decomposition of time series into trend, seasonality, and residuals. Implement ARIMA or exponential smoothing to forecast future data points.	UD	

		6. Write a Python/R script to perform PCA on a dataset and reduce its dimensions. Visualize the explained variance and transformed data. Use the reduced dataset to perform further analysis or machine learning. 7. Implement cross-validation techniques to evaluate model performance. Use techniques like Grid Search CV (Python) or tune. grid (R) to find the best hyperparameters for models. Compare multiple models and choose the best one based on performance metrics		

MINOR-2 THEORY

COURSE CODE	COURSE TITLE	COURSE CONTENT	TEACHER ASSIGNED	
CS-MI-T-2 (THEORY)	Database Management Systems	Unit 1: Introduction: Concept & Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS. Characteristics of database approach, data models, database system architecture and data independence.	BB	3
		Unit 2: Entity Relationship (ER) Modeling: Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features.	UD	5
		Unit 3: Relation data model: Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications Of the Database.	BB	5
		Unit 4: SQL and Integrity Constraints: Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested Subqueries, Database security application development using SQL, Stored procedures and triggers	UD	7
		UNIT 5: Relational Database Design: Functional Dependency, Different anomalies in designing a Database., Normalization using functional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Normalization using multi-valued dependencies, 4NF, 5NF	BB	7
		UNIT 6: Internals of RDBMS: Physical data structures, Query optimization: join algorithm, statistics and cost bas optimization. Transaction processing	UD	3
		UNIT 7: Transaction Processing: ACID properties, Concurrency control and Recovery Management : transaction model properties, state serializability, lock base protocols, two phase locking	BB	5
		UNIT 8: File Structure and Indexing: Operations on files, File of Unordered and ordered records, overview of File organizations, Indexing structures for files (Primary index, secondary index, clustering index), Multilevel indexing using B and B+ trees.	UD	5

MINOR-2 (Practical)

CS-MI-P-2 (PRACTICAL)		Database Management Systems: (SQL)	Unit 1: Creating Database: Creating a Database Creating a Table Specifying Relational Data Types Specifying Constraints Creating Indexes	BB	30
			Unit 2: Table and Record Handling: INSERT statement Using SELECT and INSERT together DELETE, UPDATE, TRUNCATE statements DROP, ALTER statements	BB	
			Unit 3: Retrieving Data from a Database: The SELECT statement Using the WHERE clause Using Logical Operators in the WHERE clause Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING clasue Using Aggregate Functions Combining Tables Using JOINS Subqueries	UD	
			UNIT 4: Database Management: Creating Views Creating Column Aliases Creating Database Users Using GRANT and REVOKE	UD	

MULTIDISCIPLINARY COURSE

CS-MU-T-3 (Theory):	AI for Everyone	Unit 1: Introduction to Artificial Intelligence: Definition and scope of AI; historical overview and key milestones; differentiating AI from human intelligence.	BB	40

		Unit 2: AI Subfields and Technologies: Introduction and basic concepts of machine learning, including supervised, unsupervised, and reinforcement learning, deep learning and neural networks (without technical details); basic concepts of natural language processing (NLP) and computer vision.	BB	
		Unit 3: Applications of AI: AI in healthcare (diagnosis, treatment, medical imaging); AI in finance (fraud detection, algorithmic trading, risk assessment); AI in transportation (autonomous vehicles, traffic optimization); AI in education (personalized learning, intelligent tutoring systems). Unit 4: Ethical and Social Implications of AI: Bias and fairness in AI systems; privacy and data protection concerns; impact of AI on employment and the workforce; AI and social inequality. Unit 5: Emerging Issues and Future Trends: Ethical guidelines and responsible AI practices; AI and innovation; emerging trends and future directions in AI; AI and creativity (generative models, artistic applications).	UD	

5TH SEMESTER UNDER CBCS

COURSE CODE	COURSE TITLE	COURSE CONTENT	TEACHER ASSIGNED	No. of Lectures (inclusive of Tutorials)
UG-G-DSE L-501A	Analysis of Algorithms and Data Structures (DSE-1A)	Unit 1: Introduction : Basic Design and Analysis techniques of Algorithms, Correctness of Algorithm	BB	4
		Unit 2: Algorithm Design Techniques: Iterative techniques, Divide and Conquer, Dynamic Programming, Greedy Algorithms	UD	6
		Unit 3: Sorting Techniques: Elementary sorting techniques-Bubble Sort, Insertion Sort, Merge Sort, Advanced Sorting techniques-Heap Sort, Quick Sort, Sorting in Linear Time-Bucket Sort, Radix Sort and Count Sort	BB	10

		Unit 4: Searching Techniques: Linear and Binary search.	UD	4
		Unit 5: Complexity Analysis: Medians & Order Statistics.	BB	4
		Unit 6: Data Structures: 1. Arrays:- Single and Multi-dimensional Arrays, Sparse Matrices 2. Stacks:- Implementing stack using array and linked list, Prefix, Infix and Postfix expressions, Utility and conversion of these expressions from one to another; 6. Trees :-Introduction to Tree as a data structure; Binary Trees, Binary Search Tree, (Creation, and Traversals of Binary Search Trees)	UD	14(4+5+5)
		Unit 7: Data Structures: 3.Queues :-Array and Linked representation of Queue, De-queue, Priority Queues 4. Linked Lists :-Singly, Doubly and Circular Lists, representation of Stack and Queue as Linked Lists. 5. Recursion :-Developing Recursive Definition of Simple Problems and their implementation; Advantages and Limitations of Recursion;	BB	15(5+5+5)

DISCIPLINE SPECIFIC ELECTIVE(DSE)- PRACTICAL

UG-G-DSE-P-501A (Practical)	Analysis of Algorithms and Data Structures Lab	1. Implement Insertion Sort (The program should report the number of comparisons) 2. Implement Merge Sort(The program should report the number of comparisons) 3. Implement Heap Sort (The program should report the number of comparisons) 4. Implement Randomized Quick sort (The program should report the number of comparisons) 5. Implement Radix Sort.	BB	10
		6. Implement Searching Techniques 7. Implementation of Recursive function. 8. Array and Linked list implementation of Stack and Queue. 9. Implementation of Single, Double and circular Linked List 10. Creation and traversal of Binary Search Tree.	UD	10

SKILL ENHANCEMENT COURSE - PRACTICAL

UG-G-SEC-P-503 (PRACTICAL)	Multimedia and Applications & Software Lab Based on	Unit 1: Multimedia: Introduction to multimedia, Components, Uses of multimedia.	UD	2
		Unit 2: Making Multimedia: Stages of a multimedia project, Requirements to make good multimedia, Multimedia Hardware - Macintosh and Windows	BB	4

	Multimedia (FLASH as a multimedia S/W)	production Platforms, Hardware peripherals - Connections, Memory and storage devices, Multimedia software and Authoring tools		
		Unit 3: Text: Fonts & Faces, Using Text in Multimedia, Font Editing & Design Tools, Hypermedia & Hypertext.	BB	2
		Unit 4: Images: Still Images – Bitmaps, Vector Drawing, 3D Drawing & rendering, Natural Light & Colors, Computerized Colors, Color Palletes, Image File Formats.	UD	3
		Unit 5: Sound: Digital Audio, MIDI Audio, MIDI vs Digital Audio, Audio File Formats. (2L) Video: How Video Works, Analog Video, Digital Video, Video File Formats, Video Shooting and Editing.	BB	2
		Unit 6 Animation: Principle of Animations. Animation Techniques, Animation File Formats	BB	2
		Software Lab Based on Multimedia (FLASH as a multimedia S/W)		
		1. Draw an animation to show a bouncing ball. 2. Draw an animation to show a moving stick man. 3. Draw an animation to show a fainting banana. 4. Draw an animation to show sunrise and sunset. 5. Draw an animation to show a disappearing house. 6. Draw an animation to show two boats sailing in river	BB	Practical exercises based on concepts listed in theory using Flash
		7. Draw an animation to show a scene of cricket match. 8. Draw an animation to help teach a poem or a song 9. Draw an animation to show cartoon with a message 10. Make a movie showing Shape Tweening. 11. Make a movie showing Motion Tweening. 12. Add sound and button to the movie	UD	

DEPARTMENT OF ENVIRONMENTAL SCIENCE

Semester –I (Major-1 & Minor-1):
July, 2024-December, 2024
NEP -2020 (SESSION 2024-2025)

Course	Course title	Topic	No. of Lectures	Teachers
MAJOR (Code- ENVS-M-1) FULL MARKS: 75 Semester End Exam-40+ 10(Internal Assessment)-50 Practical-20+5 (Internal Assessment) =25	Fundamentals of Environment & Ecology	Unit 1: Life & Environment Unit 2: Environmental Systems & Subsystems Unit 3: Ecology of Individuals Unit 4: Population Ecology Unit 5: Community Ecology Unit 6: Ecosystem Ecology Unit 7: Biogeochemical Cycles & Nutrient Cycling Unit-8:ENVS-M-1-P(PRACTICAL)	09 10 10 09 09 10 09 09	AK AK AK AK RP RP RP AK & RP
MINOR Code- ENVS-MI-(I)-1 FULL MARKS: 50 Semester End Exam-40 Internal Assessment-10	Environmental Pollution	Unit 1: Air Pollution Unit 2: Water Pollution Unit 3: Soil Pollution Unit 4: Solid & Hazardous Waste Unit 5: Noise Pollution & Radioactive Pollution Unit 6: Practical	09 09 08 09 08 07	AK AK AK RP RP AK&RP

Semester -I
VALUE ADDED COURSE (VAC)
NEP -2020 (SESSION 2024-2025)
All Science & Arts Group students

Course	Course title	Topic	No. of Lectures	Teachers
VALUE ADDED COURSE (VAC) (Code: UG-ENVS-VA) FULL MARKS: 50, Semester End Exam-40 Internal Assessment-10	ENVIRONMENTAL EDUCATION	Unit 1: Humans & the Environment Unit 2: Natural Resources Unit 3: Ecosystem & Biodiversity Unit 4: Environmental Pollution & Degradation Unit 5: Climate Change Unit 6: Environmental Treaties & Legislation Unit 7: Environmental Ethics & Sustainable Development	06 08 08 08 04 08	AK UG UG AK RP RP

			08	AK

Semester –I (SEC-1):
SEC (Skilled Enhancement Course)
NEP -2020 (SESSION 2024-2025)

Course	Course title	Topic	No. of Lectures	Teachers
SEC (Code: ENVS-SEC-1-P) FULL MARKS: 45 Semester End Exam-35 Internal Assessment-10	WATER & AIR QUALITY ANALYSIS	Unit 1: Water & Air Quality Techniques Unit 2: Estimation of Physicochemical & biological properties of water Unit 3: Flamephotometry / Spetrophotometry Unit 4: Air Quality Parameters Unit 5: Relative Humidity & Wind Rose Preparation Unit 6: Field Visit	08 09 09 09 08 02	AK RP AK RP RP AK & RP

Semester –III (Major-3)
NEP-2020

Course	Course title	Topic	No. of Lectures	Teachers
ENVS-M-3 FULL MARKS: 75 Semester End Exam-40+10 (Internal Assessment) Practical-20+5 (Internal Assessment)	Water Resources & Waste water Management	Unit 1: Introduction Unit 2: Properties of water Unit 3: Surface & Sub surface water Unit 4: Wetlands & their management Unit 5: Marine Resource management Unit 6 : Water resource in India Unit7: Waste water Management Unit 8 : Practical	10 10 10 10 10 10 08 07	AK RP AK AK RP AK RP AK & RP

Semester –III (Minor-2)
NEP - 2020

Course	Course title	Topic	No. of Lectures	Teachers
ENVS- MI – Course -2 FULL MARKS: 50, Semester End Exam-40 Internal Assessment-10	Basics of Biodiversity	Unit 1: Levels of organization in living world Unit 2: Introduction to Biodiversity Unit 3: Threats to Biodiversity	11 11 11	AK RP AK

		Unit 4: Biodiversity Conservation Unit 5: Practical	11 06	RP AK&RP

Semester –III (SEC-3)
NEP -2020

Course	Course title	Topic	No. of Lectures	Teachers
ENVS-SEC-3 FULL MARKS: 45 Semester End Exam-35 Internal Assessment-10	Analytical Techniques in Environmental Monitoring	Unit 1: Introduction Unit 2: Principle & Application Unit 3: Environmental Sampling Unit 4: Field Survey	11 14 12 08	RP AK & RP RP AK

Semester -V
Core Course (CC)
CBCS

Course	Course title	Topic	No. of Lectures	Teachers
CORE COURSE 11 (Code: UG-ENVS-H-CC-11) FULL MARKS: 75 Semester End Exam-40 Practical-20 Internal Assessment-10 (test exam)+5(attendance)=15	ENVIRONMENTAL BIOTECHNOLOGY	Unit 1: The structure and function of DNA, RNA and protein Unit 2: Recombinant DNA technology Unit 3: Bioremediation and ecological restoration Unit 4: Ecologically safe products and processes UG-ENVS-H-CC-P -11 (Practical)	15 15 15 15 10	AK AK AK RP AK & RP
CORECOURSE 12 (Code: UG-ENVS-H-CC-12) FULL MARKS: 75 Semester End Exam-40 Practical-20 Internal Assessment-10 (test exam)+5(attendance)=15	EVOLUTIONARY BIOLOGY	Unit 1: History of life on Earth Unit 2: Introduction Unit 3: Evolution of unicellular life Unit 4: Geography of evolution Unit 5: Molecular evolution Unit 6: Fundamentals of population genetics UG-ENVS-H-CC-P -12 (Practical)	09 11 10 10 11 09 10	RP AK AK RP AK RP RP

Semester -V

DSE (Discipline Specific Elective)

CBCS

Course	Course title	Topic	No. of Lectures	Teachers
DISCIPLINE SPECIFIC ELECTIVE 01 (Code: UG-ENVS-H-DSE -01a) FULL MARKS: 75 Semester End Exam-40 Practical-20 Internal Assessment-10 (test exam)+5(attendance)=15	ENERGY AND ENVIRONMENT	Unit 1: Introduction Unit 2: Energy resources Unit 3: Energy demand Unit 4: Energy, environment and society Unit 5: Energy, ecology and the environment Unit 6: Politics of energy policy Unit 7: Our energy future UG-ENVS-H-DSE-P -01a (Practical)	09 08 09 08 09 08	AK RP AK RP RP AK AK
DISCIPLINE SPECIFIC ELECTIVE 01 (Code: UG-ENVS-H-DSE- 01b) FULL MARKS: 75 Semester End Exam-40 Practical-20 Internal Assessment-10 (test exam)+5(attendance)=15	ECOTOXICOLOGY AND ENVIRONMENTAL HEALTH	Unit 1: Introduction to Environmental toxicology Unit 2: Toxicity of heavy metals: Unit 3: Pesticide toxicity Unit 4: Emerging contaminants Unit 5: Environmental epidemiology Unit 6: Environmental Health UG-ENVS-H-DSE-P-01b (Practical)	10 10 10 10 10 10 08	RP AK RP AK RP RP RP

Scheduled of Internal Examination

Stream: Science

Session July,24 -December,24

Tentative schedule of the internal examination is given in the following table

Serial No.	Semester	Topic	Date
1.	5th	Honours & Program course	15th Dec -22nd Dec, 2024
2.	3rd	Major & Minor course	5th Feb – 12th Feb 2025
3.	1st	Major & Minor course	1st Mar -8th Mar 2025

……The End……