BHARTI VISHWAVIDYALAYA

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SCHEME OF EXAMINATION

&

SYLLABUS

OF

BACHELOR OF SCIENCE

(HONORS) CHEMISTRY

UNDER

FACULTY OF CHEMISTRY

Session: 2021-2022

(Approved by Board of Studies)

EXAMINATION SCHEME

B. Sc. (Honors) Chemistry

B. Sc. (Honors) examination will be conducted in six SEMESTER

SEMESTER – I

THEORY

PAPER CODE	SUBJECT	CREDITS	THEORY MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHCY-101	Inorganic Chemistry –I	4	70	30	100
BSHCY -102	Physical Chemistry –I	4	70	30	100
GE-I	A. Physics-l B. Mathematics-I C. Zoology-I D. Botany-I E. Biotechnology-I F. Microbiology-I (Inorganic Chemistry-I)	4	35	15	50
AECC	English Communication / MIL	2	35	15	50
ECA	Industrial Chemistry	2	35	15	50

PRACTICAL

PAPER CODE	SUBJECT	CREDITS	PRACTICAL MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHCY-L101	Inorganic Chemistry I:	2	35	15	50
BSHCY-L102	Physical Chemistry I:	2	35	15	50
GEL-I	Generic Elective - Practical-I	2	35	15	50

B. Sc. (Honors) Chemistry

SEMESTER –II

THEORY

PAPER	COURSE	CREDITS	THEORY MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHCY-201	Organic Chemistry-I	4	70	30	100
BSHCY-202	Physical Chemistry-II	4	70	30	100
GE-II	A. Physics-II B. Mathematics-II C. Zoology-II D. Botany-II E. Biotechnology-II F. Microbiology-II (Organic Chemistry-I)	4	35	15	50
AECC	Environmental Science	2	35	15	50
ECA	ECA-Extracurricular activity/ Tour, Industrial training/ Field visit, NSS/ Swachhta/ vocational Training/ Sports/ others	2	35	15	50

PRACTICAL

PAPER	COURSE	CREDITS	PRACTICAL MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHCY-L201	Organic Chemistry-I	2	35	15	50
BSHCY-L202	Physical Chemistry-II	2	35	15	50
GEL-II	Generic Elective - Practical-II	2	35	15	50

B. Sc. (Honors) Chemistry

SEMESTER –III

THEORY

PAPER	COURSE	CREDITS	THEORY MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHCY-301	Inorganic Chemistry-II	4	70	30	100
BSHCY-302	Organic Chemistry-II	4	70	30	100
BSHCY-303	Physical Chemistry-III	4	70	30	100
GE-III	A. Physics-III B. Mathematics- III C. Zoology- III D. Botany- III E. Biotechnology-III F. Microbiology-III G. *Physical Chemistry-I	4	35	15	50
SEC – 1	Select one from the pool of sec courses offered by different department	2	35	15	50

PRACTICAL

PAPER	COURSE	CREDITS	PRACTICAL MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHCY-L301	Inorganic Chemistry –II	2	35	15	50
BSHCY-L302	Organic Chemistry-II	2	35	15	50
BSHCY-L303	Physical Chemistry-III	2	35	15	50
GEL-III	Generic Elective – Practical-III	2	35	15	50

*Students may Opt any one GE-III & GE-IV Chemistry as mention in the above

B. Sc. (Honors) Chemistry

SEMESTER –IV

THEORY

PAPER	COURSE	CREDITS	THEORY MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHCY-401	Inorganic Chemistry- III	4	70	30	100
BSHCY -402	Organic Chemistry-III	4	70	30	100
BSHCY-403	Physical Chemistry-IV	4	70	30	100
GE-IV	A. Physics-IV B. Mathematics- IV C. Zoology- IV D. Botany- IV E. Biotechnology-IV F. Microbiology-IV G. *Physical Chemistry-V	4	35	15	50
SEC -2	Select one from the pool of sec courses offered by different department	2	35	15	50

PRACTICAL

PAPER	COURSE	CREDITS	PRACTICAL MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHCY-L401	Inorganic Chemistry- III	2	35	15	50
BSHCY-L402	Organic Chemistry-III	2	35	15	50
BSHCY-L403	Physical Chemistry-IV	2	35	15	50
GEL-IV	Generic Elective - Practical-IV	2	35	15	50

*Students may Opt any one GE-III & GE-IV Chemistry as mention in the above

B. Sc. (Honors) Chemistry

SEMESTER –V

THEORY

PAPER	COURSE	CREDITS	THEORY MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHCY-501	Organic Chemistry-IV	4	70	30	100
BSHCY-502	Physical Chemistry-V	4	70	30	100
DSE-l	DSE-l- Theory	4	70	30	100
DSE-2	DSE-2- Theory	4	70	30	100

PRACTICAL

PAPER	COURSE	CREDITS	PRACTICAL MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHCYL-501	Organic Chemistry-IV	2	35	15	50
BSHCYL-502	Physical Chemistry-V	2	35	15	50
DSEL-l	DSE-l- Lab	2	35	15	50
DSEL-2	DSE-2- Lab	2	35	15	50

B. Sc. (Honors) Chemistry

SEMESTER –VI

THEORY

PAPER	COURSE	CREDITS	THEORY MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHCY-601	Inorganic Chemistry-IV	4	70	30	100
BSHCY-602	Organic Chemistry-V	4	70	30	100
DSE-3	DSE-3- Theory	4	70	30	100
DSE-4	DSE-4- Theory	4	70	30	100

PRACTICAL

PAPER	COURSE	CREDITS	PRACTICAL MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHCY-L601	Inorganic Chemistry-IV	2	35	15	50
BSHCY-L602	Organic Chemistry-V	2	35	15	50
DSEL-3	Lab	2	35	15	50
DSE-4-Project	Dissertation/ Project work followed by seminar	2	35	15	50

* As per UGC CBCS guidelines, University / departments have liberty to offer GE and SEC courses offered by one department to students of other departments. The No. of GE course is four. One GE course is compulsory in first 4 semesters each Minimum One Skill Enhancement course shall be proposed by each department (4 credits) [4 L or 2 L+ 2 P or l L+3 P or 3L+ l T] 1P = 2 hours.

*Credit= L+T+P/2   Where, **L-**Lecture**, T-**Tutorial and **P-** Practical

Total Credits=144

SCHEME FOR PRACTICAL EXAMINATION

EXPERIMENT	MARKS
Experiment	25
Viva-voce	10
Teacher Assessment	15
TOTAL MARKS	50

CHEMISTRY DSE 1-4 (ELECTIVES)

DSE-1:   ANALYTICAL METHODS IN CHEMISTRY

DSE-2:   BIOCHEMSITRY

DSE-3:   SOLID STATE CHEMISTRY

DSE-4:   GREEN CHEMISTRY

SKILL ENHANCEMENT COURSE (ANY TWO)

SEC-I: BASIC ANALYTICAL CHEMISTRY

SEC-2:   PHARMACEUTICAL CHEMISTRY

SEC-3:   CHEMISTRY OF COSMETICS & PERFUMES

SEC-4:   PESTICIDE CHEMISTRY

NAME OF THE GENERIC ELECTIVE SUBJECTS OFFERED BY YOUR DEPARTMENT

GE I: INORGANIC CHEMISTRY-I

GE II: ORGANIC CHEMISTRY-I

GE III: Students may Opt any one GE-III Chemistry as mention in the above

GE IV: Students may Opt any one GE-IV Chemistry as mention in the above

CORE SUBJECTS (HONORS IN CHEMISTRY)

Semester I

INORGANIC CHEMISTRY-I (BSHCY-101)

CREDITS- 4

UNIT –I Atomic Structure

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de-Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2. Quantum numbers and their significance. Normalized and orthogonal wave functions. Shapes of *s, p, d* and *f* orbitals.

Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.

UNIT –II Periodicity of Elements

s, p, d, f block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to s &p-block'

(a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.

(b) Atomic radii (van der Waals)

(c) Ionic and crystal radii.

(d) Covalent radii (octahedral and tetrahedral)

(e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.

(f) Electron gain enthalpy, trends of electron gain enthalpy.

(g) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-JafIe's

electronegativity scales. Variation of electronegativity with bond order, pa(ial charge, hybridization, group electronegativity. Sanderson's electron density ratio.

UNIT –III Chemical Bonding

Ionic bond- General characteristics, types of *ions,* size effects, radius ratio rule and its limitations. Packing of ions in crystals. Bonn-Landé equation with derivation and importance of

Kapustinskii expression for lattice energy. Madelung constant, Bonn-Haber cycle and its application, Solvation energy.

Covalent bond- Lewis structure, Valence Bond theory (HeitIer-London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions; HCI, BeF_2, CO_2, (idea of *s-p* mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons.

UNIT –IV Chemical Bonding-II

Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization.Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electro-negativity difference.

Metallic Bond: Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids.

Weak Chemical Forces. van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment) Effects of chemical force, melting and boiling points, solubility energetics of dissolution process.

UNIT- V Oxidation-Reduction

Redox equations, Standard Electrode Potential and its application to inorganic reactions. Principles involved in volumetric analysis to be carried out in class.

Reference Books:

1. Lee, J.D. Concise Inorganic Chemistry, ELBS, 1991.

2. Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970

3. Atkins, P.W. & Paula, J. Physical Chemistry, Oxford Press, 2006.

INORGANIC CHEMISTRY-1 LAB: (BSHCY-L101)

CREDITS- 2

1. **Titrimetric Analysis**

   (i) Calibration and use of apparatus

   (ii) Preparation of solutions of different Polarity/Normality of titrants

2. **Acid-Base Titrations**

   (iii) Estimation of carbonate and hydroxide present together in a mixture.

   (iv) Estimation of carbonate and bicarbonate present together in a mixture.

   (v) Estimation of free alkali present in different soaps/detergents

3. **Oxidation-Reduction Titrimetry**

   (vi) Estimation of Fe (II) and oxalic acid using standardized $KMnO_4$ solution.

   (vii) Estimation of oxalic acid and sodium oxalate in a given mixture.

   (viii) Estimation of Fe (II) with $K_2Cr_2O_7$ using internal (diphenylamine, anthranilic acid) and external indicator.

Reference Books:

l. Vogegl, A.l. A Textbook of Quantitatlve I norgganic Analysis, ELBS.

PHYSICAL CHEMISTRY-I (BSHCY-102)

CREDITS: 4

UNIT –I Gaseous state

Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η; variation of viscosity with temperature and pressure.

Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy.

Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, Z, Causes of deviation from ideal behaviour. Van der Waals equal *ion of state,* its derivation and application in explaining real gas behaviour, mention of other equations of state (Berthelot, Dietrici); continuity of states, critical state, relation between critical constants and v

an der Waals constants, law of corresponding states.

UNIT –II Liquid state

Qualitative treatment of the structure of the liquid state; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases. Qualitative discussion of structure of' mater.

UNIT –III Solid state

Nature of the solid state, law of constancy interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry. symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal system and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaC1, CsC1 and KCl etc.

UNIT –IV lonic equilibria-I

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.

UNIT –V Ionic equilibria-II

Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts.

Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry .

Solubility and solubility product of sparingly soluble salts-applications of solubility product principle. Theory of acid-base indicators; selection of indicators and their limitations.

Reference Books:

1. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry Ed., Oxford University Press (2006).
2. Ball, D. W. Physical Chemistry Thomson Press, lndia (2007).
3. Castellan, G. W. Physical Chemist 4th Ed. Narosa (2004).
4. Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).

PHYSICAL CHEMISTRY-I LAB: (BSHCY-L102)

CREDITS- 2

1. To Calibration of thermometer

2. To Determine the Melting point of Organic Compound

3. To Determine the Boiling Point of Water

4. Preparation of solutions of various concentrations, NaOH, HCl and H_2SO_4

5. To Determine the percentage composition of given Organic mixture (glycerol & water) using stalgmometer by surface tension method.

6. To determine the percentage composition of Acetone and Methyl Ethyl Ketone given mixture by surface tension method.

7. To Determine the viscosity/ percentage composition of given Amyl alcohol with respect to water by viscometer method.

8. To Determine the viscosity/ percentage composition of given binary mixture(Glycerol & Water) by viscometer method

9. To determine the velocity constant (specific reaction rate) of the hydrolysis of methyl acetate catalyzed by hydrogen ions at room temperature.

10. To determine the specific rate of hydrolysis of ethyl acetate catalyzed by hydrogen ions at room temperature.

any other experiment carried out in the class.

Reference Books:

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

2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8 th Ed.* McGraw-Hill: New York (2003).

3. Halpem, A. *M.* & McBane, G. C. *Experimental Physical ChemistryEd.;* W.H. Freeman & Co.: New *Work* (2003).

PHYSICS: MATHEMATICAL PHYSICS-I: (BSHP-101)

CREDITS- 4

The emphasis of course is on applications in solving problems of interest to physicists. The students are to be examined entirely on the basis of problems, seen and unseen.

UNIT-I

Calculus-I

Recapitulation: Introduction to Cartesian spherical and cylindrical coordinate system, Intuitive ideas of plotting of curves with example of different curves. Elementary ideas of differentiation of function and Integration of function, multiple integrals (line, surface, volume) and its application with simple curves Approximation: Taylor theorems of single variable.

UNIT-II

Calculus-II

First order and Second Order Differential equations, First Order Differential equations and integrating factor. Homogeneous Equations with constant coefficients, Particular Integral. Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor with simple illustration.

UNIT-III

Vector Calculus-I

Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector pro uct, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields. Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities.

UNIT-IV

Vector Calculus-II

Vector Integration: Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs).

UNIT-V

Dirac Delta function and its properties

Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular function. Properties of Dirac delta function.

Reference Books:

1. Higher engineering Mathematics, B.S.Grewal (Khanna Publishers)
2. Theory and Problems of vector analysis, M.R.Spiegel (Schaum's Outline series)
3. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Ed., Elsevier.
4. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
5. Differential Equations, George F. Simmons, 2007, McGraw Hill.
6. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
7. Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
8. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
9. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
10. Essential Mathematical Methods, K.F.Riley&M.P.Hobson, 2011, Cambridge Univ. Press

GEL- I: PHYSICS LAB (BSHP-L101)

CREDITS- 2

The aim of this Lab is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics.

- *Highlights the use of computational methods to solve physical problems*
- *The course will consist of lectures (both theory and practical) in the Lab*
- *Evaluation done not on the programming but on the basis of formulating the problem*
- *Aim at teaching students to construct the computational problem to be solved*
- *Students can use any one operating system Linux or Microsoft Windows*

Topics (Description with Applications):

Introduction and Overview Computer architecture and organization, memory and Input/output devices Basics of scientific computing Binary and decimal arithmetic, Floating point numbers, algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow &overflow emphasize the importance of making equations in terms of dimensionless variables, Iterative methods Errors and error Analysis Truncation and round off errors, Absolute and relative errors, Floating point computations. Review of C & C++ Programming fundamentals Introduction to Programming, constants, variables and data types, operators and Expressions, I/O statements, scan f and print f, c in and c out, Manipulators for data formatting, Control statements (decision making and looping statements) (*If---statement. If---else Statement. Nested if Structure. Else---if Statement. Ternary Operator.Goto Statement. Switch Statement. Unconditional and Conditional Looping. While Loop. Do-While Loop. FOR Loop. Break and Continue Statements. Nested Loops*), Arrays (*1D & 2D*) and strings, user defined functions, Structures and Unions, Idea of classes and objects Programs: Sum & average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending descending order, Binary search Random number generation Area of circle, area of square, volume of sphere, value of π Solution of Algebraic and Transcendental equations by Bisection, Newton Raphson and Secant methods Solution of linear and quadratic equation, solving $\alpha = \tan\alpha$; $I = I_o\ [(\mathrm{Sin}\alpha)/\alpha]2$ in optics Interpolation by Newton Gregory Forward and Backward difference formula, Error estimation of linear interpolation Evaluation of trigonometric functions e.g. *sin θ, cos θ, tan θ, etc.* Numerical differentiation (Forward and Backward difference formula) and Integration (Trapezoidal and Simpson rules), Monte Carlo method Given Position with equidistant time data to calculate velocity and acceleration and vice versa. Find the area of B-H Hysteresis loop

Also attempt some problems on differential equations like:

1. Solve the coupled first order differential equations for four initial conditions. Plot x vs y for each of the four initial conditions on the same screen for $0 \leq t \leq 15$.

2. The ordinary differential equation describing the motion of a pendulum. The pendulum is released from rest at an angular displacement α. Use the RK4 method to solve the equation for α = 0.1, 0.5 and 1.0 and plot P as a function of time in the range $0 \leq t \leq 8\pi$. Also, plot the analytic solution valid in the small P (sinP ≈P).

3. Solve differential equation with the boundary conditions and plot y and dy/dx against x in the given range. Both should appear on the same graph.

Reference Books:

1. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn. , 2012, PHI Learning Pvt. Ltd.
2. Schaum's Outline of Programming with C^{++}. J. Hubbard, 2000, McGraw-Hill Pub.
3. Numerical Recipes in C: The Art of Scientific Computing, W.H. Pressetal, 3rd Edn. , 2007, Cambridge University Press.
4. A first course in Numerical Methods, U.M. Ascher& C. Greif, 2012, PHI Learning.
5. Elementary Numerical Analysis, K.E. Atkinson, 3 rd Edn. , 2 0 0 7 , Wiley India Edition.
6. Numerical Methods for Scientists & Engineers, R.W. Hamming, 1973, Courier Dover Pub.
7. An Introduction to computational Physics, T. Pang, 2nd Edn. , 2006,Cambridge Univ. Press

GE-I: B.Sc. (Hon's) Zoology (BSHZO-101)

Animal Diversity– I (Non-Chordates)

CREDITS: 4

UNIT-I

Taxonomy: definition, taxonomic procedure, classification, systemic, taxonomic levels, taxa, hierarchy, species concepts, Zoological nomenclature: kinds of taxonomic characters (morphological, embryological, cytogenetic, and numerical characters).

UNIT -II

Classification of multicellular animals: symmetry and early development (spiral and radial cleavage). Protostomes and Deuterostomes; body cavities: acoelomates, pseudocoelomates, coelomates.

ZUNIT- III

General characters and classification up to classes with examples showing distinctive and adaptive features:

1. Protozoans (locomotion)
2. Poriferans (canal system and skeleton),
3. Platyhelminthes and Nematodes (parasitic adaptations),
4. Annelids (metamerism),
5. Arthropods (mouthparts),
6. Molluscs (modification of foot),
7. Echinodermata (water vascular system and larval forms).

UNIT- IV

Overview of different patterns:

1. Digestion- intracellular, extracellular, feeding mechanisms (suspension, deposit, cropping, sucking, herbivorous and raptorial carnivorous)
2. Gas exchange and internal transport (structure and function of gills, trachea, book lungs)

UNIT- V

Overview of different patterns:

1. Excretory organs - open tubular (metanephridia) and closed saccular (protonephridia and Malpighian tubules)
2. Pattern of nervous system in non-chordates.
3. Types of asexual reproduction: fission, regeneration and parthenogenesis; sexual reproduction: primary and accessory sex organs in non- chordates.

Reference Books:

1. Kotpal Series on Non-chordates (Rastogi Publications)
2. Nigam: Biology of Non-Chordates (1997, S. Chand)
3. Barnes: The invertebrate (3rd ed. 2001, Wiley-Blackwell)
4. Moore: An introduction to the invertebrates (2006, Cambridge)
5. Kotpal, Agarwal and Khetrapal: Modern Text Book of Zoology; Invertebrates. Edition, 6. Publisher, Rastogi Publications, 1990

GEL-I Lab: Zoology-Animal Diversity–I (Non-Chordates)(BSHZO-L101)

CREDITS- 2

1. Study of transverse sections/chart of the following: Sycon, Hydra, Fasciola, Ascaris,
   a. Hirudinaria.
2. Study of salient features and classification up to classes of the following non-chordates: Amoeba, Euglena, Plasmodium, Paramecium, Euplectella, Physalia, Taenia, Ascaris (male and female), Nereis, Chiton, Mytilus, Octopus, Limulus, Sacculina, Asterias, Echinus, Holothuria.
3. External features of Earthworm.
4. Dissection of Earthworm showing alimentary canal, nervous system, reproductive system.
5. Dissection of snail showing radula, nervous system, Osphradium.
6. Culture of amoeba and paramecium.

Reference Books:
1. Kotpal Series on Non-chordates (Rastogi Publications)
2. Nigam: Biology of Non-Chordates (1997, S. Chand)

B.Sc. (Hon's) SEMESTER- I

GE-I: MATHEMATICS- I

Algebra and Trigonometry: (BSHM-101)

CREDITS-4

UNIT-I

Elementary operations on matrices, Inverse of a matrix. Linear independence of row and column matrices, Row rank, column rank and rank of a matrix. Equivalence of column and row ranks.

UNIT-II

Application of matrices to a system of linear (both homogeneous and nonhomogeneous) equations. Theorems on consistency of a system of linear equations.

UNIT-III

Solutions of cubic equations (Cardons method), Biquadratic equation. Mappings, Equivalence relations and partitions.

UNIT-IV

Lagrange's theorem and its consequences. Fermat's and Euler's theorems. Normal subgroups. Quo tient group, Permutation groups. Even and odd permutations. The alternating groups An. Cayley's theorem.

UNIT- V

De-Moivre's theorem and its applications. Direct and inverse circular and hyperbolic functions.

Reference Books:

1. I.N. Herstein, Topies in Algebra, Wiley Eastern Ltd., New Delhi, 1975
2. K.B. Datta, Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd. New Delhi, 2000.
3. Chandrika Prasad, Text-Book on Algebra and Theory of equations, Pothishala Private Ltd., Allahabad.

GEL-I LAB: MATHEMATICS- I (BSHM-L101)

ALGEBRA-I

CREDITS- 2

1. Elementary operations on matrices
2. Inverse of a matrix.
3. Linear independence of row and column matrice
4. rank of a matrix
5. Application of matrices to a system of linear (both homogeneous and nonhomogeneous) equations.
6. Theorems on consistency of a system of linear equations.
7. Lagrange's theorem and its consequences
8. Euler's theorems. Normal subgroups.
9. Quotient group, Permutation groups.
10. Even and odd permutations.

Reference Books:

1. P.B. Bhattacharya, S.K. Jain and S. R. Nagpaul, First Course in linear Algebra, Wiley Eastern, New Delhi, 1983.
2. P.B. Bhattacharya, S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra (2 edition), Cambridge University Press, Indian Edition, 1997.
3. S.K. Jain, A. Gunawardena and P.B. Bhattacharya, Basic linear Algebra with MATLAB, Key College Publishing (Springer-Verlag), 2001.

GE-I: PLANT DIVERSITY-I (BSHB-101)
(VIRUS, BACTERIA, ALGAE & FUNGI)

CREDITS- 4

UNIT-I

Discovery, general characteristics; Types-archaebacteria, eubacteria, wall-less forms (mycoplasma and spheroplasts); Cell structure; Nutritional types; Reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction).

UNIT-II

Viruses: General characteristics, general account of Retrovirus, TMV; General characteristics, general structure with special reference to viroids and prions; replication (general account),

UNIT-III

Cyanobacteria: General characteristics; heterocyst and akinetes; General account of *Nostoc, Oscillatoria* and *Scytonema*; Economic importance of cyanobacteria. General account of actinomycetes.

UNIT-IV

Algae: General characteristics; Chlorophyceae: *Volvox,* Xanthophyceae:*Vaucheria;* Phaeophyceae: *Sargassum;* Rhodophyceae: *Polysiphonia*; Single cell protein, Economic importance of algae.

UNIT-V

Fungi:General characteristics; Mastigomycotina: *Phytophthora*; Zygomycotina:

Rhizopus; Ascomycotina: *Peziza;* Basidiomycotina: *Puccinia;* Deuteromycotina: *Alternaria.*

Reference Books:

1. Ananthanarayan and Paniker:7th Edison. A text book of Microbiology, Orient Blackswan Publisher,Delhi
2. Kumar H D, 1990. Introductory Phycology. East-west Press, India
3. Lee R E. 2008. Introduction to Algae .Cambridge University Press, U K.
4. Pelczar Mi J., Chan, E.C.S., Krieg, NR, 1972. Microbiology, McGraw-Hill publisher, Columbus, OH

GEL-I: PLANT DIVERSITY-I LAB (BSHB-L101)

CREDITS- 2

1. Micro preparation observations of bacteria and viruses.

2. Gram staining of bacteria

3. Identification of cyanobacterial specimens

4. Identification of algal specimens

5. Identification of fungal specimens

6. *Albugo*: Study of symptom of plants infected with *Albugo*

7. Specimen of different stage of mushroom(*Agaricus*)

Reference Books:

1. Ananthanarayan and Paniker:7th Edison. A text book of Microbiology, Orient Blackswan Publisher, Delhi

2. Kumar H D, 1990. Introductory Phycology. East-west Press, India

3. Lee R E. 2008. Introduction to Algae .Cambridge University Press, U K.

AECC- ENGLISH LANGUAGE

CREDITS- 2

UNIT- I COMMUNICATION

Theory of Communication, Types and modes of Communication Verbal and Non-verbal (Spoken and Written) Personal, Social and Business Barriers and Strategies Intra-personal, Inter-personal and Group communication

UNIT- II SPEAKING SKILLS

Monologue Dialogue Group Discussion Effective Communication/ Mis-Communication, Interview Public Speech.

UNIT- III READING AND UNDERSTANDING

Close Reading Comprehension Summary Paraphrasing Analysis and Interpretation Translation (from Indian language to English and vice-versa) Literary/Knowledge Texts.

UNIT- IV WRITING SKILLS

Documenting Report Writing Making notes Letter writing .

UNIT-V FUNCTIOANL GRAMMAR

Parts of Speech, Word order / Types of Sentences, Questions (Affirmative and Negative), Present Perfect – Simple & Continuous, Present Perfect and Past Simple, Future Tense, Articles, Prepositions, Modals, Conjunctions, Quantifiers and Voice.

Reference Books:

1. English Language and Indian Culture - Published by M.P. Hindi Grant Academy Bhopal.

ECA- INDUSTRIAL CHEMISTRY

CREDITS-2

UNIT-I

Water: Specifications for water, analysis of water alkalinity, hardness. Water for domestic use, water softening processes – Lime – Soda process, Zeolite and ion exchange method, boiler feed water, boiler problems-scale, sludge, priming and foaming, caustic embitterment and corrosion, their causes and prevention, removal of silica, removal of dissolved gases, carbonate and phosphate conditioning, colloidal conditioning, calgon treatment, Numerical problems on Lime-Soda process, Zeolite and Ion exchange method.

UNIT – II

Fuels: Classification, combustion and chemical principles involved in it, calorific value: gross and net calorific values and their determination by bomb calorimeter.

Solid Fuels: Proximate and ultimate analysis of coal and their importance, High and low temperature carbonization, Coke. Its manufactures by Otto Hoffman oven.

Liquid Fuels: Petroleum: its chemical composition and fractional distillation, knocking and chemical structure, octane number and cetane number and their significance, power alcohol, Analysis of fuel gases by Orsat's apparatus, Numerical on calorific value, combustion, proximate and ultimate analysis of coal.

UNIT – III

Corrosion: Types of corrosion (dry, wet, atmospheric, galvanic and concentration corrosion), theories of corrosion, protective measures against corrosion, factors affecting corrosion, pitting corrosion, water line corrosion, underground corrosion, stress corrosion, micro biological corrosion, corrosion fatigue. Batteries and Battery Technology: Primary cells, secondary batteries reserve batteries, fuel cells, solar cells.

Metallurgy: Preparation and purification of metals (ferrous and non-ferrous) and ultra-pure metals for semiconductor technology

UNIT – IV

Portland Cements: Introduction, types of Portland Cement, methods of manufacturing (dry and wet process), properties of cement, characterization of constitutional compounds of cement, ISI specification.

Lubricants: Classification of lubricants and mechanisms of lubrication.

Polymers: Industrial applications of thermoplastic, thermosetting, polymers, properties and applications of the major polymers viz polyethylene, Teflon, PVC, nylon, phenol formaldehyde. Elastomers, Natural Polymers.

UNIT – V

Introduction to Important Industrial Chemicals: Industrial Method of preparation (one each), properties and major industrial uses of following chemicals: Ammonium Chloride, Ammonium Nitrate, Ammonium Sulphate, Acrylonitrile, Benzene (Benzol), Butyl Acetate, Caprolactam, Carbon Tetrachloride, Chloroform (Trichloromethane), Ether (Ethyl Ether), Ethyl Alcohol (Ethanol, Industrial Alcohol), Glycerine (glycerol), and Melamine. Explosives and **Propellants:** Characteristics of Explosives, Oxygen Balance, Classification of Explosives: Primary or Initiating Explosives or Detonators; Low Explosives or Propellants; High Explosives, Rocket Propellants, Characteristics of a Good Propellant, Classification of Propellants.

Text Books:

1. A Textbook of Engineering Chemistry by S.S. Dara (S. Chand and Company).
2. Engineering Chemistry by P.C. Jain (Dhanpat Rai publishing company)

Reference Books:

1. Chemistry in Engineering and Technology (Vol-2) by J. C. Kuriacose, J. Rajaram (Tata McGraw Hill).
2. Engineering Chemistry by M.M. Uppal, Revised by S.C. Bhatia (Khanna Publishers).
3. Engineering Chemistry by B. K. Sharma(Krishna Prakashan).

GE-I: GENERAL BIOCHEMISTRY (BSHBT-101)

CREDITS-4

UNIT –I

Carbohydrates: General Properties, Types (Monosaccharide, Oligosaccharide and Polysaccharide) andBiological Importance.

Monosaccharide: Structure, Occurrence, Reactions and Biological importance of Monosaccharide.

Isomerism: Stereoisomerism and Optical isomerism, Ring Structure and Anomeric forms, Mutarotation.

Derivatives: Derivatives of Monosaccharide, Di and Tri-saccharide.

Important Polysaccharide: Glycogen, Starch and Cellulose.

UNIT –II

Lipids: General Properties and Classification.

Fatty acids: Nomenclature, Classification, Structure and Properties of Saturated and Unsaturated fattyacids. Essential Fatty Acids.

Triacylglycerols: Properties and Characterization of Fats, Hydrolysis, Saponification value, Acid value,Rancidity of fats and Functions.Biological Significance of Glycerophospholipids, Sphingomyelins and Glycolipids.

UNIT –III

Amino acids: Definition, Classification and Properties of Amino acids.

Peptide bond: Definition, Structure, Solid phase Protein Synthesis in brief, C – terminal and N – terminalAmino acid determination.

Protein: Structure, Types (Primary, Secondary, Tertiary and Quaternary) and Functions.

UNIT –IV

Nucleic Acids: Definition, Structure, Phosphodiester bond and Properties.

Purine and Pyrimidine Bases: Structure and Types, Composition of DNA and RNA, Nucleosides andNucleotides.

DNA double helix: Watson - Crick Model, Complementary base- pairings, Base staking, Chargaff's rule.Different forms of DNA structure (A, B & Z DNA), Major and Minor groove, Denaturation and Annealingof DNA

RNA: Types of RNA, Secondary and Tertiary structure of t-RNA.

UNIT- V

Porphyrin: General Properties, Structure of Nucleus and Classification.

Metalloporphyrins: Structure of Haemoglobin, Myoglobin, Chlorophyll, Cyanocobalamin and theirBiological Importance.

Reference Books:

1. Biochemistry: J M Berg, J L Tymoczko and L Stryer.
2. Lehninger Principles of Biochemistry: David L Nelson and Michael M Cox.
3. Biochemistry: D Voet, J Voet and C W Pratt.
4. Biochemistry: U Satyanarayana and U Chakrapani.
5. Textbook of Biochemistry: Edward S West.
6. Fundamentals of Biochemistry: J L Jain, Sunjay Jain and Nitin Jain
7. Harpers Illustrated Biochemistry: Robert K Murray, Daryl K Garner and Peter A Mayes

GENERAL BIOCHEMISRTY LAB
(BSHBT-L101)

CREDITS-2

1. Molisch's test for Carbohydrate.

2. Benedict's test- distinguishes between reducing and non-reducing sugars.

3. Barfoed's test- distinguishes between monosaccharides and disaccharides.

4. Iodine test for starch.

5. Ninhydrin test for amino acids.

6. Thiol group test using sodium nitroprusside.

7. Test for indole group using Ehlrich's reagent.

8. Test for hydroxyphenylaniline using Million's test.

9. Iodine value of oil and wax.

10. Acid value of oil and wax.

11. Saponification value of oil and wax.

Reference Book:

1. Practical Biotechnology – Methods and Protocols - By S. janarthanan and S. Vincent (Universities Press).

2. Essentials of Biotechnology for Students - By Satya N. Das.

INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY (BSHMB-101)

CREDITS- 4

UNIT-I History of Development of Microbiology

Development of microbiology as a discipline, Spontaneous generation *vs*. biogenesis. Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming. Role of microorganisms in fermentation, Germ theory of disease, Development of various microbiological techniques and golden era of microbiology, Development of the field of soil microbiology: Contributions of Martinus W. Beijerinck, Sergei N. Winogradsky, Selman A. Waksman Establishment of fields of medical microbiology and immunology through the work of Paul Ehrlich, Elie Metchnikoff, Edward Jenner.

UNIT-II Diversity of Microbial World

Systems of classification
Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's threekingdom classification systems and their utilit. Difference between prokaryotic and eukaryotic microorganisms.

General characteristics of different groups: **A cellular** microorganisms (Viruses,Viroids, Prions) and **Cellular** microorganisms (Bacteria, Algae, Fungi andProtozoa) with emphasis on distribution andoccurrence, morphology, mode ofreproduction and economic importance.

UNIT-III Algae
General characteristics of algae including occurrence, thallus organization, algae cell ultra-structure, pigments, flagella, eyespot food reserves and vegetative, asexual and sexual reproduction. Different types of life cycles in algae with suitable examples: Haplobiontic, Haplontic, Diplontic, Diplobiontic and Diplohaplontic life cycles. Type studies: *Chlamydomonas, Volvox* and *Spirogyra*. Applications of algae in agriculture, industry, environment and food.

UNIT-IV Fungi

General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra-structure, thallusorganization and aggregation, fungal wall structure and synthesis, a sexual reproduction, sexual reproduction, heterokaryosis, heterothallism and para sexual mechanism. Type studies: *Rhizopus, Aspergillus, Saccharomyces* and *Agaricus*. Economic Importance of Fungi with examples in agriculture, environment, Industry, medicine, food, biodeterioration, mycotoxins.

UNIT-V Protozoa

General characteristics with special reference to *Amoeba, Paramecium and Plasmodium.*

References Books:

1. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. (1993). Microbiology. 5th Edition' Tata McGraw Hill Publishing Co., Ltd., New Delhi'

2. Stanier, R.Y., Adelberg, E.A. and Ingram, J.L. (1991)' General Microbiology, 5th Ed., Prentice Hall of India Prt. Ltd., New Delhi.

3. Madigan, M.T., Martinkl, J.M. and Parker, J' (2000). Brock Biology of Microorganisms, 9th Edition, MacMillan Press, England.

INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY LAB (BSHMB-L101)

CREDITS- 2

1. Microbiology Good Laboratory Practices and Biosafety.

2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology laboratory.

3. Sterilization of medium using Autoclave and assessment for sterility.

4. Sterilization of glassware using Hot Air Oven and assessment for sterility.

5. Sterilization of heat sensitive material by membrane filtration and assessment for sterility.

6. Demonstration of the presence of microflora in the environment by exposing nutrient agarplates to air.

7. Study of *Rhizopus*, *Penicillium*, *Aspergillus, Saccharomyces* using temporary mounts.

8. Study of *Spirogyra* and *Chlamydomonas, Volvox* using temporarymounts.

9. Study of the following protozoans using permanent mounts/photographs: *Amoeba*, *Entamoeba*, *Paramecium* and *Plasmodium*.

Reference Books:

1. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. PearsonEducation.

2. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms.14th edition. Pearson International Edition.

3. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. PearsonEducation Limited.

4. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGrawHill International.

Semester II

ORGANIC CHEMISTRY I (BSHCY-201)

CREDIT- 4

UNIT- I Structure and Bonding

Classification, *nomenclature* and general structure *of* organic compounds. Hybridization. orbital representation of methane, ethane, ethylene, acetylene and benzene. Bond energy, bond length and bond angels. Polarity of covalent bonds-Inductive, resonance, hyper-conjugation and steric inhibition in resonance and its influence on acidity and basicity of organic compounds.

UNIT- II Mechanism of Organic reactions

Curved arrow notation, drawing electron movements with arrows, half-headed and double headed arrows. Homoljsis and heterolysis of carbon-carbon bonds; Reactive species e.g. Carbocations, carbanions, free radicals and their stability. Nucleophiles and electrophiles.

UNIT- III Alkanes and cycloalkanes

Preparation and general reactions of alkanes and cycloalkanes, Bayer Strain theory of strain less ring; Conformation of ethane, *n*-butane and cyclohexane, chlorination of methane and side chain chlorination of toluene.

UNIT-IV Alkenes

General methods for preparation of alkenes, Reactions of alkenes: Addition reactions (Electrophilic and free radical), Halogenation, Hydrohalogenation, Hydration, Hydroxylation, Hydroboration-oxidation, Mercuration-demercuration, Epoxidation and Ozonoloysis.

Dienes: Conjugated and isolated Dienes; 1,2- versus 1,4-addition. Diels-Alder reaction of dienes: Mechanism.

UNIT-V Alkynes

Preparation of alkynes, acidity and metal acetylides, Electrophilic addition reactions viz.,Halogenation, Hydrohalogenation, Hydration. Hydroboration-oxidation, Mercuration-demercuration and Ozonoloysis.

Reference Books:

1. *"Organic Chemistry"*, R. T. Morrison and R. N. Boyd, 6th Edition (1992), Prentice-Hall of India (P)Ltd., New Delhi.

2. *"Organic Chemistry",* S. M. Mukherjee, S. P. Singh, and R. P. Kapoor, I st Edition (1985), New Age International (P) Ltd. Publishers, New Delhi.

3. *"Organic Chemistry", I.* L. Finar, [Vol. 1, 6th Edition (1973), Reprinted in 1980 & Vol. II, 5th Edition (1975), Reprinted in 1996], ELBS and Longman Ltd., New Delhi.

4. *'Organic Chemistry - Structure and Reactivity", Seyhan N' Ege, 3rd Edition (1998), AITBS Publishers and Distributtors, Delhi'*

5. *-Organic Chemistry", Paula Y. Bruice, 2nd Edition, Prentice-Hall, lntemational Edition* (1998).

6. "Organic Chemistry",*",* G. Solomon, W illey India, Paper Back, 9" Edition.

7. *"Modern Organic Chemistry",* M. K. Jain and S. C. Sharma, V ishal Publishing CO. Jalandhar, India. 4th Edition (2012).

ORGANIC CHEMISTRY-I LAB

(BSHCY-L201)

CREDITS-2

1. Calibration of the thermometer

2. Purification *of organic* compounds by crystallization using the following solvents: a. Water b. Alcohol, c. Alcohol-Water

3. Determination of the melting points of unknown organic compounds (Kjeldahl method and electrically heated melting point apparatus)

4. Effect of impurities on the melting point-mixed melting point of two unknown organic compounds.

5. Detection of special elements (N, S, C1. Br, I).

Reference Books

1. Mann, F.G. & Saunders, B.C. *Practical Organic Chemisstry,* Pearson Education (2009)

2. Furniss, B.S.; Hannaford, A.J.: Smith, P.W.G.: Tatchell, A.R. *Practical Organic Chemistry, 5th Ed., Pearson (2012*

PHYSICAL CHEMISTRY II (BSHCY-202)

CREDITS: 4

UNIT- I Chemical Thermodynamics

Intensive and extensive variables; state and path functions; isolated' closed and open systems; zeroth law of thermodynamics.

First law: Concept of heat, q, work, w, internal energy, U, 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.

Thermochemistry: Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermo-chemical data, effect of temperature (Kirchhoff's equations; and pressure on enthalpy of reactions. Adiabatic flame temperature' explosion temperature.

UNIT- II Second Law

Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes.

Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules.

Free Energy Functions: Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.

UNIT-III Systems of Variable Composition

Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs-Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.

UNIT-IV Chemical Equilibrium

Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, concept of fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Coupling of exoergic and endoergic reactions.

Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants Kp, Kc and Kx. Le-Chatelier principle (quantitative treatment); equilibrium between ideal gases and a pure condensed phase.

Solutions and Colligative Properties:

Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications.

UNIT-V Excess thermodynamic functions

Thermodynamic derivation using chemical potential to derive relations between the four colligative properties (i) relative lowering of vapour pressure (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) Osmotic pressure and amount of solute.

Reference Books:

1. Peter, A. & Paula, l.de. Physical Chemistry 9th Ed., Oxford University Press (2011)
2. Castellan, G. W. Physical Chemistry 4h Ed, Narosa (2004)
3. Engel, T. & Reid, P. Physical Chemistry 3''' Ed.. Prentice-Hall (2012)
4. MdQuarrie, D. A. & Simon, J. D. Molecular Thermodynamics *viva* Books Pvt. Ltd.: New Delhi (2004).
5. Assael, M. j.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham' W' A' & Will, S' Commonly Asked Questions in Thermodynamics. CRC Press: NY (201l)
6. Levine, I .N. Physical Chemistry 6'n Ed.. Tata Mc Graw Hill (2010)
7. Metz, C.R. 2000 solved problems in chemistry, Schaum Series (2006)

PHYSICAL CHEMISTRY-II LAB (BSHCY-L202)

CREDITS- 2

Thermochemistry

1. To determine the solubility of benzoic acid at different temperature and to determine ΔH of the dissolution process

2. To determine the enthalpy of neutralization of a weak acid /weak base versus strong base/strong acid and determine the enthalpy of of the week acid/weak base

3. To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born Haber cycle.

4. To study the effect of a solute (e.g. NaCI. Succinic acid) on the critical solution temperature of two partially miscible liquids (e.g. phenol-water system) and to determine the concentration of that solute in the given phenol-water system.

5. To construct the phase diagram of two component system (e.g. diphenylamine benzophenone) by cooling curve method

6. Distribution of acetic acid/benzoic acid between water and phenol.

Reference Books

1. Khosla B. D.; Garg, V. C. & Gulati, A., Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (201 l).

2. Athawale, V. D. & Mathur, P. Experimental Physical Chemistry New Age International: New Delhi (2001).

GE-II: PHYSICS: ELECTRICITY AND MAGNETISM (BSHP-201)

CREDIT- 4

UNIT-I

Electric Field and Electric Potential

Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry.

Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torque on a dipole. Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere.

UNIT-II

Dielectric Properties of Matter

Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector **D**. Relations between **E**, **P** and **D**. Gauss' Law in dielectrics.

UNIT-III

Magnetic Field

Magnetic force between current elements and definition of Magnetic Field **B**. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of **B**: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field.

Magnetic Properties of Matter: Magnetization vector (**M**). Magnetic Intensity(**H**). Magnetic Susceptibility and permeability. Relation between **B, H, M**. Ferromagnetism. B-H curve and hysteresis.

UNIT-IV

Electromagnetic Induction

Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current.

UNIT-V

Electrical Circuits

AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit.

Network theorems: Ideal Constant-voltage and Constant-current Sources. Network Theorems: Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem. Applications to dc circuits.

Reference Books:

1. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw.
2. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education.
3. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
4. Feynman Lectures Vol. 2, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education.
5. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
6. Electricity and Magnetism, J. H. Fewkes & J. Yarwood. Vol. I, 1991, Oxford Univ. Press.

GEL- II: PHYSICS LAB (BSHP-L201)

CREDITS- 2

1.   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 RC Circuit.

3.   Measurement of field strength B and its variation in a solenoid (determine dB/dx)

4.   To verify the Thevenin Theorem.

5.   To verify the Norton theorem.

6.   To verify the Superposition, and Maximum power transfer theorems.

7.   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.

8.   To study the response curve of a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.

9.   To determine self-inductance of a coil by Rayleigh's method.

10. To determine the mutual inductance of two coils by Absolute method.

11. To determine the frequency of AC Mains using Sonometer.

 Reference Books:

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

2.   A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Ed., 2011, Kitab Mahal

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

4.   A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

5.   Engineering Practical physics S. Panigrihi and B. Mallick, 2015, Cengage Learning.

GE-II: ANIMAL DIVERSITY– II (CHORADATES): (BSHZO-201)

CREDITS-2

UNIT- I

Hemichordates: General characters and classification up to the order, Protochordates: Urochordates,Cephalochordates, Cyclostomes: General characters, Comparative account of Petromyzon and myxine.

UNIT- II

General characters and classification of Pisces and Amphibians up to orders, Fishes: migration, Parental care, Amphibian: Parental care, Neoteny.

UNIT- III

General characters and classification of Reptiles up to orders, Difference between poisonous and non-poisonous snakes with examples, Poison apparatus and biting mechanism of poisonous snakes. Snake venom, its uses and antivenin.

UNIT- IV

General characters and classification of Aves up to orders, Migration and flight adaptation, Beaks and claws in birds, Ratitae, Archaeopteryx.

UNIT- V

General characters and classification of Mammals up to orders,Receptors and Sense organs: Phonoreception and Photoreception, Oviparity, Ovoviviparity, Viviparity, Aquatic and Flying mammals.

Reference Books:

1. Cambell and Reece: Biology (7th ed. 2005, Pearson)
2. Nigam: Biology of Chordates (1997, Chand)
3. Kotpal Series of Chordates (Rastogi Publications)

GEL-II LAB: LABORATORY EXERCISES (BSHZO-L201)

ANIMAL DIVERSITY– II (CHORDATES)

1.Study of museum specimens relevant to theory paper.

2.Study of models relevant to theory paper.

3.Dissection of fish showing digestive system.

4.Mounting of scales.

5.Fish dissection showing afferent and efferent cranial nerves.

6.Fish internal ear.

Reference Books

1. Nigam: Biology of Chordates (1997, Chand).
2. Kotpal Series of Chordates (Rastogi Publications)

GE-II: MATHEMATICS- II (BSHM-102)
CALCULUS-I

DIFFERENTIAL CALCULUS:

UNIT- I

Definition of the limit of a function. Basic properties of limits. Continuous functions and classification of discontinuties.

UNIT-II

Asymptotes. Curvature. Tests for concavity and convexity. Points of inflexion Multiple points.

INTEGRAL CALCULUS:

UNIT-III

Integration of transcendental functions. Reduction formulae. Definite integrals.

ORDINARY DIFFERENTIAL EQUATIONS :

UNIT-IV

Degree and order of a differential equation. Equations reducible to the linear form. Exact differential equations. First order higher degree equations solvable for x, y, p. Clairaut's form and singular solutions.

UNIT-V

Linear differential equations of second order. Transformation of the equation by changing the dependent variable/the independent variable.

Text Books :

1. Gorakh Prasad, Differential Calculaus, Pothishala Private Ltd. Allahabad.
2. Gorakh Prasad, Integral Calculus, Pothishala Private Ltd. All ahabad.
3. D. A. Murray Introductory Course in Differential Equations, Orient Longman (India), 1976.

Reference Books:

1. Gabriel Klambauer, Mathematical Analysis, Marcel Dekkar, Inc. New York, 1975.
2. N. Piskunov, Differential and Integral Calculus, Peace Publishers, Moscow.
3. E. A. Codington, An Introduction to Ordinary Differential Equa tions, Prentics Hall of India, 1961.
4. H.T.H. Piaggio, Elementary Treatise on Differential Equations and their Applications, C.B.S. Publishe & Distributors, Dehli, 1985.
5. W.E. Boyce and P.O. Diprima, Elementary Differential Equations and Boundary Value Problems, John Wiley, 1986.

GE-II LAB: MATHEMATICS- II (BSHM-L102)

CALCULUS - I PRACTICAL

CREDITS- 2

1. Asymptotes, Curvature.

2. Tests for concavity and convexity

3. Points of inflexion. Multiple points

4. Degree and order of a differential equation.

5. Equations reducible to the linear form. Exact differential equations.

6. First order higher degree equations

7. Clairaut's form and singular solutions

8. Linear differential equations of second order

9. Transformation of the equation by changing the dependent variable

10. Transformation of the equation by changing the independent variable

Reference Books:

1. Gabriel Klambauer, Mathematical Analysis, Marcel Dekkar, Inc. New York, 1975.

2. N. Piskunov, Differential and Integral Calculus, Peace Publishers, Moscow.

3. E. A. Codington, An Introduction to Ordinary Differential Equa tions, Prentics Hall of India, 1961.

4. H.T.H. Piaggio, Elementary Treatise on Differential Equations and their Applications, C.B.S. Publishe & Distributors, Dehli, 1985.

5. W.E. Boyce and P.O. Diprima, Elementary Differential Equations and Boundary Value Problems, John Wiley, 1986.

GE-II: Botany–II(BSHB-201)

TAXONOMY AND EMBRYOLOGY OF ANGIOSPERMS

CREDITS-4

UNIT-I
Structure and Development of Plant Body Internal organization of plant body: The three tissue systems, types of cells and tissues. Development of plant body: Polarity, Cytodifferentiation and organogenesis during embryogenic development.Induction of flowering; flower as a modified determinate shoot. Flower development: genetic and molecular aspect

UNIT-II
General feature and classification of Angiosperms, merits and demerits (Bentham and Hooker, Takhtajan); Modern trends in plants taxonomy.

UNIT-III
General features of the following families: Ranunculaceae, Malvaceae, Brassicaceae,Asclepiadaceae, Solanaceae, Asteraceae, Euphorbiaceae, Poaceae.

UNIT-IV
Embryology: structure of angiosperms flower, Androecium (stamens), pollen morphology only, Gynoecium (Ovary, style and Stigma). Types of ovary, ovules and placentation, structure and main types.

UNIT-V
Pollination types, Double fertilization and triple fusion, Monocot and dicot embryo. Types of embryo sacs, organization and ultrastructure of mature embryo sac. Embryo endosperm relationship

Reference Books:

1. BhojwaniS Sand Bhatnagar S P, 2009. Embryology of Angiosperm, Vikas Publication House, NewDelhi.

2. Eames, A.J, 1961: Morphology of Angiosperms, McGraw Hill Publication, New Delhi.

3. Pandey B P, 2001: Plant Anatomy, S Chand and Company, New Delhi.

4. Sharma O P, 2005. Plant Taxonomy, Tata Mc Graw Hill, New Delhi.

GEL-II LAB: TAXONOMY AND EMBRYOLOGY OF ANGIOSPERMS (BSHBL-201)

<div align="right">**CREDITS-2**</div>

1. Study of Floral characters and Floral diagram of representative member of some families:Malvaceae, Brassicaceae, Asclepiadaceae, Solanaceae, Euphorbiaceae, Poaceae

2. Study of type of ovary,

3. Study of type ovules, placentation types,

4. Study of type types of pollen grains and stages of dicotembryo.

Field trips: for habitat study & collection of samples.

Reference Books:

1. Lawrence, G. H. M 1951. Taxonomy of Vascular Plants. N. Y.

2. Pande B. P 1997. Taxonomy of Angiosperms. S. Chand Publication.

3. Takhtajan A. 1969. Flowering Plants; Origin and Dispersion.

AECC- ENVIRONMENTAL SCIENCE

CREDITS-2

UNIT – I

General: Environmental segments, environmental degradation, environmental impact assessment. Concept of Ecosystem: Fundamental of Ecology and Ecosystem, components of ecosystem, food-chain, foodweb, trophic levels, energy flow, cycling of nutrients, major ecosystem types (forest, grass land and aquatic ecosystem).

UNIT – II

Air Pollution: Atmospheric composition, energy balance, classification of air pollutants, source and effect of pollutants – Primary (CO, SO_x, NO_x, particulates, hydrocarbons), Secondary [photochemical smog, acid rain, ozone, PAN (Peroxy Acetyl Nitrate)], green house effect, ozone depletion, atmospheric stability and temperature inversion, Techniques used to control gaseous and particulate pollution, ambient air quality standards.

UNIT – III

Water Pollution: Hydrosphere, natural water, classification of water pollutants, trace element contamination of water, sources and effect of water pollution, types of pollutants, determination and significance of D.O., B.O.D., C.O.D. in waste water, Eutrophication, methods and equipment used in waste water treatment preliminary, secondary and tertiary.

UNIT – IV

Land Pollution & Noise Pollution: Lithosphere, pollutants (agricultural, industrial, urban waste, hazardous waste), their origin and effect, collection of solid waste, solid waste management, recycling and reuse of solid waste and their disposal techniques (open dumping, sanitary land filling, thermal, composting). Noise Pollution: Sources, effect, standards and control.

UNIT – V

Environmental Biotechnology: Definition, current status of biotechnology in environmental protection, bio-fuels, bio-fertilize, bio-surfactants, bio-sensor, bio-chips, bio-reactors. Pollution Prevention through Biotechnology: Tannery industry, paper and pulp industry, pesticide industry, food and allied industry.

Text Books:

1. Environment and Ecology by Piyush Kant Pandey and Dipti Gupta (Sum India Publication)

2. A Textbook of Environmental Chemistry and Pollution Control by S.S. Dara (S. Chand and Company)

Reference Books:

1. Masters, G.M. Introduction to Environment Engineering and Science (Prentice Hall of India).

2. Environmental Chemistry by A.K. Dey (Eastern Ltd.).

3. Environmental Chemistry by B.K. Sharma (Krishna Prakashan).

4. Nebel B.J. Environmental Science (Prentice Hall of India-1987).

5. Environmental Biotechnology by S.N. Jogdand (Himalaya Publishing House).

6. Introduction to Environmental Biotechnology by A.K. Chatterji (Prentice Hall of India).

INDUSTRIAL FERMENTATIONS (BSHBT-201)

CREDITS-4

UNIT- I

Production of industrial chemicals, biochemicals and chemotherapeutic products. Propionic acid,butyric acid, 2-3 butanediol, gluconic acid, itaconic acid, Biofuels: Biogas, Ethanol, butanol,hydrogen, iodiesel, microbial electricity, starch conversion processes; Microbialpolysaccharides; Microbial insecticides; microbial flavours and fragrances, newer antibiotics,anti-cancer agents, amino acids.

UNIT-II

Microbial products of pharmacological interest, steriod fermentations and transformations.Overproduction of microbial metabolite, Secondary metabolism – its significance and products.Metabolic engineering of secondary metabolism for highest productivity.

UNIT- III

Enzyme and cell immobilization techniques in industrial processing, enzymes in organicsynthesis, proteolytic enzymes, hydrolytic enzymes, glucose isomerase, enzymes in foodtechnology/organic synthesis.

UNIT- IV

Purification & characterization of proteins, Upstream and downstream processing, solids andliquid handling. Distribution of microbial cells, centrifugation, filtration of fermentation broth,ultra centrifugation, liquid extraction, ion-exchange recovery of biological products.Experimental model for design of fermentation systems, Anaerobic fermentations.

UNIT- V

Rate equations for enzyme kinetics, simple and complex reactions.Inhibition kinetics; effect ofpH and temperature on rate of enzyme reactions. Mathematical derivation of growth kinetics,mathematical derivations of batch and continuous culture operations; single stage CSTR; masstransfer in aerobic fermentation; resistances encountered; overall mass transfer co-efficient (Ka)determination, factors depending on scale up principle and different methods of scaling up.Metabolic engineering of antibiotic biosynthetic pathways.

Reference Books:

1. Casida LE. (1991). Industrial Microbiology.1st edition.Wiley Eastern Limited.

2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial

Microbiology.

2nd edition.Panima Publishing Co. New Delhi.

3. Patel AH. (1996). Industrial Microbiology.1st edition, Macmillan India Limited.

4. Stanbury PF, Whitaker A and Hall SJ.(2006). Principles of Fermentation Technology.

2nd edition, Elsevier Science Ltd.

INDUSTRIAL FERMENTATIONS (BSHBT-L201)

CREDITS-2

1. Comparative analysis of design of a batch and continuous fermenter.

2. Calculation of Mathematical derivation of growth kinetics.

3. Solvent extraction & analysis of a metabolite from a bacterial culture.

4. Perform an enzyme assay demonstrating its hydrolytic activity (protease/peptidase/glucosidase etc.)

Reference Book:

1. Principles and Practice of Animal Tissue Culture - By Sudha Gangal (Universities Press)

BIOCHEMISTRY (BSHMB-201)

CREDITS- 4

UNIT-I Bioenergetics

First and second laws of Thermodynamics. Definitions of Gibb's Free Energy, Enthalpy, and Entropy and mathematical relationship among them, Standard free energy change and equilibrium constant Coupled reactions and additive nature of standard free energy change, Energy rich compounds: Phosphoenolpyruvate, 1,3- Bisphosphoglycerate, Thioesters, ATP.

UNIT-II Carbohydrates

Families of monosaccharides: aldoses and ketoses, trioses, tetroses, pentoses, and hexoses. Stereo-isomerism of monosaccharides, epimers, Mutarotation and anomers of glucose. Furanose and pyranose forms of glucose and fructose, Haworth projection formulae for glucose; chair and boat forms of glucose, Sugar derivatives, glucosamine, galactosamine, muramic acid, N- acetyl neuraminic acid, Disaccharides; concept of reducing and non-reducing sugars, occurrence and Haworth projections of maltose, lactose, and sucrose, Polysaccharides, storage polysaccharides, starch and glycogen. Structural Polysaccharides, cellulose, peptidoglycan and chitin.

UNIT-III Lipids

Definition and major classes of storage and structural lipids. Storage lipids. Fatty acids structure and functions. Essential fatty acids. Triacyl glycerols structure, functions and properties. Saponification Structural lipids. Phosphoglycerides: Building blocks, General structure, functions and properties. Structure of phosphatidylethanolamine and phosphatidylcholine, Sphingolipids: building blocks, structure of sphingosine, ceramide. Special mention of sphingomyelins, cerebrosides and gangliosides Lipid functions: cell signals, cofactors, prostaglandins, Introduction of lipid micelles, monolayers andbilayers.

UNIT-IV Proteins

Functions of proteins, Primary structures of proteins: Amino acids, the building blocks of proteins. General formula of amino acid and concept of zwitterion. Titration curve of amino acid and its significance, classification, biochemical structure and notation of standard protein amino acids. Ninhydrin reaction.Natural modifications of amino acids in proteins hydrolysine, cystine and hydroxyproline, Non protein amino acids: Gramicidin, beta-alanine,

D-alanine and D- glutamic acid Oligopeptides: Structure and functions of naturally occurring glutathione and insulin and synthetic aspartame, Secondary structure of proteins: Peptide UNIT and its salient features. The alpha helix, the beta pleated sheet and their occurrence in proteins, Tertiary and Quaternary structures of proteins. Forces holding the polypeptide together. Human haemoglobin structure.

UNIT-V Enzymes

Structure of enzyme: Apoenzyme and cofactors, prosthetic group-TPP, coenzyme NAD,metal cofactors, Classification of enzymes, Mechanism of action of enzymes: active site, transition state complex and activation energy. Lock and key hypothesisand Induced Fit hypothesis. Significance of hyperbolic, double reciprocal plots of enzyme activity, Km, and allosteric mechanism Definitions of terms – enzyme UNIT, specific activity and turnover number, Multienzyme complex: pyruvate dehydrogenase; isozyme: lactate dehydrogenase, Effect of pH and temperature on enzyme activity. Enzyme inhibition: competitive- sulfa drugs; non-competitive-heavy metal salts.

Reference Books:

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning.
2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by ChurchillLivingstone.
3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman.

BIOCHEMISTRY (BSHMB-L201)

CREDITS- 2

1. Properties of water, Concept of pH and buffers, preparation of buffers and Numerical problems toexplain the concepts.

2. Handling of micropipettes and checking their accuracy.

3. Standard Free Energy Change of coupled reactions.

4. Qualitative tests for carbohydrates, reducing sugars, non reducing sugars.

5. Qualitative tests for lipids and proteins.

6. Study of protein secondary and tertiary structures with the help of models.

7. Study of enzyme kinetics – calculation of V_{max}, Km, Kcat values.

Reference Books:

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning.

2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by ChurchillLivingstone.

3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman.

4. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company.

5. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition. W.H. Freemanand Company.

6. Willey MJ, Sherwood, LM & Woolverton C J (2013) Prescott, Harley and Klein's Microbiologyby. 9th Ed., McGraw Hill.

7. Voet D. and Voet J.G (2004) Biochemistry 3rd edition, John Wiley and Sons.

Semester- III

INORGANIC CHEMISTRY-II (BSHCY-301)

CREDITS-4

UNIT- I General Principles of Metallurgy

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon and carbon *monoxide as* reducing agent. Electrolytic Reduction, Hydrometallurgy. Methods of purification of metals, Zone refining.

UNIT- II Acids and Bases

Bronsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, leveling solvents, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB) Application of HSAB principle.

UNIT- III Chemistry of *s* and *p* Block Elements

Inert pair effect. Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Complex formation tendency of *s* and *p* block elements.

Basic beryllium acetate and nitrate. Study of tfic following compounds with emphasis on structure, bonding, preparation, properties and uses.

Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and graphitic compounds, silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acids of sulphur, interhalogen compounds, polyhalide ions, pseudohalogens and basic properties of halogens.

UNIT- IV Noble Gases

Occurrence and uses, rationalization of inertness of noble gases, C lathrates; preparation and properties of XeF_2, XeF_4 and XeF_6: Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF_2). Molecular shapes of *noble* gas compounds(VSEPR theory).

UNIT- V Inorganic Polymers

Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, and polysulphates.

Reference Books:

1. Lee, J.D. Concise Inorganic Chemistry, ELBS, 1991.
2. Douglas. B.E; Mc Daniel. D.H. & Alexander. J.J. Concepts & Models of Inorganic Chemistry 3rd Ed., John Wiley Sons, N.Y. 1994.
3. Greenwood, N.N. & Earnshaw, Chemistry of the Elements, Butterworth-Heinemann. 1997.
4. Cotton, F.A. & Wilkinson, G. Advanced Inorganic Chemistry, Wiley' VCH, 1999.
5. Miessler, G. L. & Donald, A.Tarr. Inorganic Chemistry 4th Ed., Pearson.20l0.
6. Shriver & Atkins, Inorganic Chemistry 5th Ed.

INORGANIC CHEMSITRY-II LAB: (BSHCY-L301)

CREDITS-4

(A) **Iodo / Iodimetric Titrations**

(i) Estimation of Cu (II) and $K_2Cr_2O_7$ using sodium thiosulphate solution (Iodimetrically)

(ii) Estimation of (i) arsenite and (ii) antimony in tartar-emetic iodimetrically

(iii) Estimation of available chlorine in bleaching powder iodometrically

(B) Inorganic preparations

(i) Cuprous Chloride, Cu_2Cl_2

(ii) Preparation of Manganese (III) phosphate, $MnPO_4.H_2O$

(iii) Preparation of Aluminium potassium sulphate $KAl(SO_4)_2.12H2O$ (Potash alum) or chrome alum.

Reference Books:

1. Vogel, A. l. A Textbook of Quantitative Inorganic Analysis, ELBS, 1978

ORGANIC CHEMISTRY-II (BSHCY-302)

CREDITS-4

UNIT- I Alkyl halides

Preparation and general reactions of alkyl halides; Grignard reagents: preparation and synthetic applications; Reformatsky reaction; Wurtz reactions.

Substitution and Elimination Reactions: Nucleophilic substitution – S_N^1 and S_N^2 mechanisms; Elimination reaction: E_1 and E_2 mechanisms, Elimination *Vs* Substitution reactions; energy profile diagrams - transition states, intermediates (general considerations).

UNIT- II Alcohols and ethers

General properties of alcohols, Synthesis of alcohols from alkenes *via* hydroboration-oxidation, oxymercuration-demercuration. Reactions of alcohols: Dehydration, oxidation and distinction of primary, secondary and tertiary alcohols. Acetal and ketal formation, Pinacole-pinacolone rearrangement. Preparation and general reactions of ethers; nucleophilic ring opening of epoxides.

UNIT- III Aldehydes and Ketones

Preparation of carbonyl compounds. Oxidation and reduction reaction, Condensation reactions, Nucleophilic addition reactions; aldol condensation, Perkin reaction, Wittig Reaction, Cannizzaro reaction, benzoin condensation, Haloform reaction, Keto-enol tautomerism.

UNIT- IV Carboxylic acids & its Derivatives

General method for the preparation ofcarboxylic acids, amides, esters, anhydrides, acid halides, and acid azides; Relative reactivity of carboxylic acids and their chemical reactions.

UNIT- V Stereochemistry

Optical activity and plane-polarized light. Plane and centre of symmetry, Chirality, enantiomers, diasteroisomers, mesomers, atropisomers and recemic mixtures. Fischer, Newman and Sawhorse Projection Formula. EIZ'DIL and R/S nomenclature. Walden inversion.

Reference Books:

1. "Organic chemistry", R. T. Morrison and R. N. Boyd, 6th Edition (1992), prentice-Hall of India (P) Ltd., New Delhi.

2. "Organic Chemistry", S. M. Mukherjee, S' P' Singh, and R. P. Kapoor, 1st Edition (1985), New Age International (P) Ltd. Publishers, New Delhi.

3. "Organic Chemistry - Structure and Reactivity", Seyhan N. Ege, 3rd Edition (1998), ITBS Publishers and Distributtors, Delhi.

4. "Organic Chemistry", I. L. Finar, [Vol. I, 6th Edition (1973), Reprinted in 1980 & Vol. II, 5th Edition (1975), Reprinted in 1996], ELBS and Longman Ltd., New Delhi.

5. "A Guide Book to Mechanism in organic Chemistry", P. Sykes, 6th Edition (1997), Orient Longman Ltd., New Delhi.

6. "Organic Chemistry", J. Clayden, N. creeves, S. Warren, and E. wothers, oxford univ. Press, Oxford (2001).

7. "Stereochemistry of Organic Compounds", D. Nasipuri, New Age International.

8. "Stereochemistry if Organic Compounds ",P.S. Kalsi, New Age International'

9. "Organic Chemistry", G. Sotomon, Willey lnida, Paper Back 9th Edition.

10. "Mordern Organic Chemistry", M.K. Jain and S. C. Sharma, Vishal Publishing CO' Jalandhar, India, 4th Edition (2012).

ORGANIC CHEMSITRY-II LAB (BSHCY-L302)

CREDIT-2

1. Functional group tests for alcohols, phenols, carbonyl and carboxylic acid group.
2. Preparation of Derivatives of functional groups.

Reference Books:

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
2. Fumiss. B.S.; Hannaford, A.J.; Smith, P.W.G; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012).

PHYSICAL CHEMISTRY-III (BSHCY-303)

CREDIT-4

UNIT- I Phase Equilibria

Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for non-reactive and reactive systems; Clausius-Clapeyron equation and its applications to solid liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systems, with applications.

Phase diagrams for systems of solid liquid equilibria involving eutectic, congruent and incongruent melting points, solid solutions.

Three component systems, water-chloroform-acetic acid system, triangular plots, azeotropes, Nernst distribution law: its derivation and applications.

UNIT- II Chemical Kinetics

Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expansion up to second order reactions, experimental methods of the determination of rate laws.

Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates, Lindemann mechanism, qualitative treatment of the theory of absolute reaction rates.

Catalysis: Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces; effect of particle size and efficiency of nanoparticles as catalysts..

UNIT- III Surface chemistry

Physical adsorption, chemisorption, adsorption isotherms, nature of adsorbed state.

UNIT- IV Photo Chemistry

Characteristics of electromagnetic radiation, interaction of radiation with matter, differences between thermal and phtotchemical process, Lamberts law and its limitations, physical significance of absorption coefficient, Law of photochemistry, Grothus Dropper law, Einstein Law, quantum yield, actinometry, examples of low and high quantum yield, photochemical equilibrium, quenching.

UNIT- V Liquid state

Qualitative treatment of the structure of the liquid state; physical properties of liquids; vapour, pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition, of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases. Qualitative, discussion of structure of water.

Reference Books:

1. Peter Atkins & Julio De paula, Physical Chemisrry 9th Ed. Oxford University Press (2010).
2. Castellan, G. W. Ptrysical Che.isrry. 4th Ed. Narosa (2004).
3. McQuarrie, D. A. & Simon, J. D' Molecular Thermodynamics, Viva Books Pvt. Ltd.: New Delhi (2004).
4. Engel, T. & Reid, P. Physical Chemistry 3rd Ed., Prentice-Hall (2012).
5. Asseal, U. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S. Commonly Asked Questions in Thermodynamrcs. CRC Press: NY (201 l).
6. Zundhal, S.S. Chemistry concepts and application Cengage India (201 l).
7. Ball, D. W. Physical Chemistry Cengage lndia (2012).
8. Mortimer, R. G. Physical Chemistry 3rd Ed., Elsevier: NOIDA, UP (2009).
9. Levine, I. N. Physical Chemistry 6th ed., Tata McGraw-Hill (201l).
10. Metz, C. k Physical Chemistry 2nd Ed., Tata McGraw-Hill (2009).

PHYSICAL CHEMISTRY-III LAB (BSHCY-L303)

CREDITS-2

1. Determination of critical solution temperature and composition of the phenol-water system and to study the effect of impurities on it.

2. Phase equilibrium: construction of the phase diagram using cooling curves or ignition tube method:

   a. simple eutectic and

   b. congruent melting point.

3. Distribution of acetic/ benzoic acid between water and cyclohexane.

4. Study the kinetics of the following reactions.

a) Initial rate method: Iodide-persulphate reaction

b) Integrated rate method:

   i) Acid hydrolysis of methyl acetate with hydrochloric acid.

   ii) Saponification of ethyl acetate

Reference Books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.; New Delhi (201 l).

2. Garland, C. W.; Nibler, J. W. & Shoemaker, D.P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).

3. Halpem, A. M. & McBane, G. C. Experimenrat Physical Chemisrry 3rd Ed.; W.H. Freeman & Co.: New York (2003).

GE-III: PHYSICS: MATHEMATICAL PHYSICS-III
(BSHP-301)

CREDITS-4

The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen.

UNIT-I

Fourier Series

Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series.

UNIT-II

Frobenius Method and Special Functions

Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite and Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. Bessel Functions of the First Kind: Generating Function, simple recurrence relations.

UNIT-III

Some Special Integrals

Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral).

UNIT-IV

Partial Differential Equations

Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry.

UNIT-V

Special Theory of Relativity

Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications.

Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass-energy Equivalence.

References Books:

1. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
2. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
3. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
4. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
5. Partial Differential Equations for Scientists & Engineers, S.J. Farlow, 1993, Dover Pub.
6. Mathematical methods for Scientists & Engineers, D.A. McQuarrie, 2003, Viva Books

GEL-III: PHYSICS LAB (BSHP-L301)

CREDITS-2

The aim of this Lab is to use the computational methods to solve physical problems. Course will consist of lectures (both theory and practical) in the Lab. Evaluation done not on the programming but on the basis of formulating the problem

Topics	Description with Applications
Introduction to Numerical computation software Scilab	Introduction to Scilab, Advantages and disadvantages, Scilab environment, Command window, Figure window, Edit window, Variables and arrays, Initialisingvariables in Scilab, Multidimensional arrays, Subarray, Special values, Displaying output data, data file, Scalarand array operations, Hierarchy of operations, Built in Scilab functions, Introduction to plotting, 2D and 3Dplotting (2), Branching Statements and program design, Relational & logical operators, the while loop, for loop, details of loop operations, break & continue statements, nested loops, logical arrays and vectorization (2) Userdefined functions, Introduction to Scilab functions,Variable passing in Scilab, optional arguments, preserving data between calls to a function, Complexand Character data, string function, Multidimensionalarrays (2) an introduction to Scilab file processing, file opening and closing, Binary I/o functions, comparing binary and formatted functions, Numerical methods and developing the skills of writing a program (2).

Curve fitting, Least square fit, Goodness of fit, standard deviation	Ohms law to calculate R, Hooke's law to calculate spring Constant
Solution of Linear system of equations by Gauss elimination method and Gauss Seidal method. Diagonalization of matrices, Inverse of a matrix, Eigen vectors, eigen values problems	Solution of mesh equations of electric circuits (3 meshes) Solution of coupled spring mass systems (3 masses)
Solution of ODE First order Differential equation Euler, modified Euler and Runge-Kutta second order methods Second order differential equation Fixed difference method	First order differential equation • Radioactive decay • Current in RC, LC circuits with DC source • Newton's law of cooling • Classical equations of motion Second order Differential Equation • Harmonic oscillator (no friction) • Damped Harmonic oscillator • Over damped • Critical damped • Oscillatory • Forced Harmonic oscillator
Using Scicos / xcos	Generating square wave, sine wave, saw tooth wave Solution to harmonic oscillator Study of beat phenomenon Phase space plots

Reference Bookss:

1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press

2. Complex Variables, A.S. Fokas&M.J. Ablowitz, 8th Ed., 2011, Cambridge Univ. Press

3. First course in complex analysis with applications, D.G. Zill and P.D. Shanahan, 1940, Jones & Bartlett

4. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A.V. Wouwer, P. Saucez, C.V. Fernández. 2014 Springer

5. Scilab by example: M. Affouf 2012, ISBN: 978-1479203444

6. Scilab (A free software to Matlab): H. Ramchandran, A. S. Nair. 2011 S. Chand& Company

7. Scilab Image Processing: Lambert M. Surhone. 2010 Betascript Publishing

GEL-III: B.Sc. (Hon's) Zoology (BSHZO301)
GENETICS AND EVOLUTION

CREDITS-4

UNIT- I

Elements of heredity and variation: Mendel's laws of inheritance; Chromosomal basis of inheritance.

Extension of Mentalism: dominance relationships,Multiple allelism, Leathalalleles', Pleiotropy, Epistasis, Complementary, Supplementary inheritance; Cytoplasmic inheritance.

UNIT- II

Linkage and crossing-over, Sex-linkage; Sex chromosome systems,Sex determination; Structural and numerical alterations of chromosomes, Pedigree analysis: symbols of pedigree, Pedigrees of sex linked and autosomal inheritance.

UNIT- III

Human genetics: Karyotype, banding, nomenclature of chromosome subdivisions and genetic map. Genetic disorders: Chromosomal aneuploidy (Down, Turner and Klinefelter syndromes),Chromosome translocation (chronic myeloid leukemia) and deletion ("cry of cat" syndrome), Gene mutation (cystic fibrosis);Genetic counselling.

UNIT- IV

Concept of organic evolution, Evidences of organic evolution from comparative anatomy, embryology, palaeontology, Theories of organic evolution: Lamarckism, Darwinism, Modern synthetic theory, natural selection in action.

UNIT- V

Gene frequency in Mendelian population, Hardy-Weinberg equilibrium; major evolutionary forces; isolating mechanisms, modes of speciation (allopatric and sympatric).

Reference Books:

Genetics

1. Gardner et al: Principles of Genetics (2006, John Wiley)

2. Griffith et al: An Introduction to Genetic Analysis (2008, Freeman)

3. Hartl& Jones: Essential Genetics - A Genomic Perspective (2009, Jones &Bartlet)

4. Pierce: Genetics – A Conceptual Approach (W. H. Freeman, 12-Apr-2011)

5. Russell: iGenetics (2009, Benjamin Cummings)

6. Snustad& Simmons: Principles of Genetics (2012, John Wiley)

Evolution

1. P A Moody: Introduction to Evolution

2. Rastogi: Organic Evolution (2007, Kedarnath& Ramnath)

3. Strickberger: Evolution

GEL-III: GENETICS AND EVOLUTION LAB (BSHZO-L301)

1. Application of probability in the law of segregation with the coin tossing

2. Frequency of following genetic trait in human attached ear lobe, widow's peak, dimple in chin mid-digital Hair, Thumb, hypertrichosis, color blindness, PTC (phenyl thiocarbamide)

3. Study of mode of inheritance of the following traits by pedigree charts – attached ear lobe,

 widow's peak

4. Familiarization with techniques of handling Drosophila, identifying males and females; observing wild type and mutant (white eye, wing less) flies, and setting up cultures.

5 Study of structural chromosome aberrations (dicentric, ring chromosomes and inversions in

 polytene chromosomes) from prepared slides/photographs.

6. Study of human karyotypes and numerical alterations (Down, Klinefelter and Turner syndrome).

7. Preparation of temporary slide of Barr body by own cheek epithelium or hair root.

Reference Books:

1. Gardner et al: Principles of Genetics (2006, John Wiley) Griffith et

GE-III MATHEMATICS- III (BSHM-103)
VECTOR ANALYSIS AND GEOMETRY PART- I

VECTOR ANALYSIS:

UNIT-I

Scalar and vector product of three vectors. Product of four vectors. Reciprocal Vectors.

UNIT- II

Vector integration.

UNIT- III

General equation of second degree. Tracing of conics.

UNIT- IV

Sphere. Cone. Cylinder.

UNIT- V

Central Conicoids. Paraboloids. Plane sections of conicoids. Genera ting lines.

Text Books:

1. N. Saran and S.N. Nigam, Introduction to vector Analysis, Pothishala Pvt. Ltd. Allahabad.

2. Gorakh Prasad and H. C. Gupta, Text Book on Coordinate Geometry, Pothishala Pvt. Ltd., Allahabad.

3. R.J.T. Bell, Elementary Treatise on Coordinate Geometry of three dimensions, Machmillan India Ltd. 1994.

Reference Books:

1. Murray R. Spiegel, Theory and Problems of Advanced Calculus, Schaum Publishing Company, New York.

2. Murray R. Spiegel, Vector Analysis, Schaum Publishing Company, New York.

3. Shanti Narayan, A Text Book of Vector Calculus, S. Chand & Co., New Delhi.

4. S. L. Loney, The Elements of Coordinate Geometry, Macmillan and Company, london.

5. P.K. Jain and Khalil Ahmad, A Text Book of Analytical Geometry of two Dimensions, Wiley Eastern Ltd., 1994.

6. P.K. Jain and Khalil Ahmad, A Text Book of Analytical Geometry of three Dimensions, Wiley Eastern Ltd., 1999.

7. N. Saran and R.S. Gupta, Analytical Geometry of three

GEL-III LAB: MATHEMATICS- III (BSHM-L103)

CREDITS-2

PRESENTATION-I

PRESENTATION-II

GE-III: Botany-III (BSHB 301)

PLANT PHYSIOLOGY (BSHB-301)

CREDITS: 4

UNIT-I

Water Potential and its components, water absorption by roots, aquaporins, pathway of water movement, symplast, apoplast, transmembrane pathways, root pressure, guttation. Ascent of sap– cohesion-tension theory. Transpiration and factors affecting transpiration, antit ranspirants, mechanism of stomatal movement.

UNIT-II

Nutrient Uptake: Soil as a nutrient reservoir, transport of ions across cell membrane, passive absorption, Electrochemical gradient, facilitated diffusion, active absorption, role of ATP, carrier systems, proton ATPase pump and ion flux, uniport, co-transport, symport, antiport.

UNIT-III

Photosynthesis: role of photosynthetic pigments (chlorophylls and accessory pigments), antenna molecules and reaction centres, photochemical reactions, photosynthetic electron transport, PSI, PSII, Q cycle, CO_2 reduction photophosphorylation, C3, C4 and CAM pathways of carbon fixation, photorespiration.

UNIT-IV

Respiration: Glycolysis, TCA cycle, electron transport, oxidative phosphorylation, alpha and betaoxidation of fatty acid.

UNIT-V

Plant growth hormones: Physiological role of auxins, gibberellins, cytokinins, abscisic acid and ethylene, Phytochrome: Structure and function; Photoperiodism; Vernalization; Seed dormancy

Reference Books:

1. Devlin Robert M. 1983. Plant Physiology, Prindle Weber and Schmidt Publisher; 4th edition. UK

2. Hopkins, W.G. 1995. Introduction to Plant Physiology, John Wiley & Sons. Inc., New York, USA.

3. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones. Springer Verlag, New York,USA.

4. Pandey S N and Sinha B K. 2009.Plant physiology: Vikas Publishing, New Delhi

5. Singh G S. Renger G, Sopory, S K, Irrganag K D, Govindjee; 1999. Concepts in Photobiology, Photosynthesis and Phytomorphognesis,Narosa Pub. House, New Delhi.

6. Taiz L andZeiger E. 2010.Plant physiology.Sinauer Associates, UK.

GEL-III: Botany:Plant Physiology Lab (BSHB- L301)

1. Determination of diffusion pressure deficit (DPD)
2. Study of transpiration rate
3. Transpiration rate by Ganong's potomter
4. Study of effect of different light on photosynthetic rate
5. Separation of plant pigments by paper chromatography
6. Demonstration of osmosis phenomenon
7. Role of plant growth hormones

Reference Books:

1. Salisbury F. B and Ross C.W 1992. Plant physiology (Fourth Edition) Wadsworth Publishing Company, California, USA.
2. Singhal G. S., Renger G., Sopory, S. K. Irrgang K. D and Govindjee1999.Concept in Photobiology; Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi.
3. Taiz L. and Zeiger E. 1998. Plant Physiology (Second Edition). Sinauer Associates, Inc. Publishes, Massachusetts, USA.

GE-III: CELL AND MOLECULAR BIOLOGY (BSHBT-301)

CREDITS- 4

UNIT-I CELL

Discovery of cell, The Cell theory. Prokaryotic and Eukaryotic cell – Plant and Animal cell. CellMembrane, Cellular Reproduction. Techniques in Cell Biology.

UNIT- II CELL ORGANELLES

Cell Organelles: Structure and Functions of Endoplasmic reticulum, Golgi complex, Mitochondria,Chloroplast, Ribosomes, Lysosomes, Peroxisomes, Nucleus and hromosomes.

UNIT- III CELL DIVISION

Cell Division - Cell cycle, Amitosis, Mitosis and Meiosis. Regulation of cell cycle. Central Dogma: Briefintroduction of Structure and Functions of DNA, RNA and proteins.

UNIT- IV MECHANISM OF REPLICATION

DNA Replication: Prokaryotic and Eukaryotic – Mechanism, Enzymes and accessory proteins involved. DNA Repair.

UNIT- V INHERITENCE

Prokaryotic and Eukaryotic Transcription and Translation, Genetic code, Recombination in prokaryotes.

Reference Books:

1. Cell & Molecular Biology : Gerald Karp
2. Cell Biology : C.B. Powar
3. Essential Cell Biology : An introduction: Bruce, Alberts, Dennis
4. The Cell: A Molecular Approach: Geoffrey M. Cooper
5. Cell & Molecular Biology: SC Rastogi
6. Cell & Molecular Biology: Robertis&Robertis
7. Cell Biology & Genetics: Starr & Taggart
8. Molecular Cell Biology: Lodish

GEL-III: CELL AND MOLECULAR BIOLOGY LAB: (BSHBT-L301)

CREDITS- 2

1. Study of Parts of Microscope
2. To measure the length and breadth of the given cell sample by using micrometer.
3. To prepare permanent slides using the given sections like Stem, Root and Leaf.
4. Study of Mitosis.
5. Study of Meiosis.
6. Preparation of Blood Smear and study of blood cells.
7. Differential counting of white blood cells using Micrometer.
8. Identification of Barr Body in Buccal smear.
9. Identify the different types cells present in the leaf cross section.
10. Extraction of DNA from plants.
11. Extraction of DNA from animal tissues.
12. Extraction of DNA from fungus.
13. Estimation of DNA using Diphenyl amine.

Reference Book:
1. Principles and Practice of Animal Tissue Culture - By Sudha Gangal (Universities Press).
2. Essentials of Biotechnology for Students - By Satya N. Das.

GE-III: MICROBIAL PHYSIOLOGY AND METABOLISM
(BSHMB-301)

CREDITS- 4

UNIT-I Microbial Growth and Effect of Environment on Microbial Growth

Definitions of growth, Batch culture, Continuous culture, generation time and specific growth rate Effect of temperature and pH on microbial growth. Effect of solute and water activity on growth.Effect of oxygen concentration on growth. Nutritional categories of microorganisms.

UNIT-II Nutrient uptake and Transport

Passive and facilitated diffusion. Primary and secondary active transport, concept of uniport, symport and antiportGroup translocation. Iron uptake.

UNIT-III Chemoheterotrophic Metabolism - Aerobic Respiration

Concept of aerobic respiration, anaerobic respiration and fermentation. Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathwayTCA cycle.

Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterialETC, electron transport phosphorylation, uncouplers and inhibitors.

UNIT-IV Chemoheterotrophic Metabolism- Anaerobic respiration and fermentation

Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate

/nitrite and nitrate/ammonia respiration; fermentative nitrate reduction).

Fermentation - Alcohol fermentation and Pasteur effect; Lactate fermentation (homofermentative and heterofermentative pathways), concept of linear and branched fermentation pathways.

UNIT-V Chemolithotrophic and Phototrophic Metabolism

Introduction to aerobic and anaerobic chemolithotrophy with an example each. Hydrogen oxidation (definition and reaction) and methanogenesis (definition and reaction). Introduction to

phototrophic metabolism - groups of phototrophic microorganisms, anoxygenic *vs.* oxygenic photosynthesis with reference to photosynthesis in green bacteriaand cyanobacteria.

Reference Books:

1. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition. PrenticeHall International Inc.
2. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons.
3. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India.
4. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag.

GEL-III: MICROBIAL PHYSIOLOGY & METABOLISM LAB
(BSHMB-L301)

CREDITS- 2

1. Study and plot the growth curve of *E. coli* by turbidometric method.
2. Calculations of generation time and specific growth rate of bacteria from the graph plotted with thegiven data.
3. Effect of temperature on growth of *E. coli*.
4. Effect of pH on growth of *E. coli*.
5. Demonstration of alcoholic fermentation.
6. Demonstration of the thermal death time and decimal reduction time of *E. coli.*

Reference Books:

1. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition. PrenticeHall International Inc.
2. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons.
3. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India.
4. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag.
5. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition,McMillan Press.
6. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition.McGraw Hill Higher Education.

Semester-IV

INORGANIC CHEMISTRY-III (BSHCY-401)

CREDITS-4

UNIT- I Coordination Chemistry

Werner's theory, valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding. Crystal field theory, measurement of l0 Dq (o), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of l0 Dq(o,t). Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry. Qualitative aspect of Ligand field and MO Theory.

IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, poly-nuclear complexes, Labile and inert complexes.

UNIT- II Transition Elements

General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states and e.m.f. (Latimer & Bsworth diagrams). Difference between the first, second and third transition series.

Chemistry of Ti, V, Cr, Mn, Fe and Co in various oxidation states (excluding their metallurgy)

UNIT- III Lanthanoids and Actinoids

Electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only).

UNIT- IV Bioinorganic Chemistry

Metal ions present in biological systems, classification of elements according to their action in biological system. Sodium/K-pump, carbonic anhydrase and carboxy peptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine. lron and its application in bio-systems.

UNIT- V Organometallic compounds

Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. Metal carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct

combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. π-acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding.

Reference Books:

1. Purcell, K.F & Kotz, J.C. Inorganic Chemistry W.B. Saunders Co, 1977.
2. Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.
3. Lippard, S.J. & Berg, J.M. Principles of Bioinorganic chemistry Panima Publishing Company 1994.
4. Cotton, F.A. & Wilkinson, G, Advanced Inorganic Chemistry. Wiley-VCH, 1999.
5. Basolo, F, and Pearson, R.C., Mechanisms of Inorganic Chemistry, John Wiley & Sons, NY, 1967.
6. Greenwood, N.N. & Earnshaw A., Chemistry of the Elements, Butterworth-Heinemann, 1997.

INORGANIC CHEMISTRY-III LAB (BSHCY-L401)

CREDITS-2

Gravimetric Analysis:

    i.   Estimation of nickel (II) using Dimethylglyoxime (DMG).

    ii.   Estimation of copper as CuSCN.

    iii. Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$.

Inorganic Preparations:

    i.   Tetraammine copper (II) sulphate, $[Cu(NH_3)_4]SO_4.H_2O$.

    ii.   Cis and trars $K[Cr(C_2O_4)_2. (H_2O)_2]$ Potassium dioxalatediaquachromate (III).

    iii. Tetraamminecarbonatocobalt(III) ion.

    iv. Potassiumtris(oxalate)ferrate(III)

Chromatography of metal ions

Principles involved in chromatographic separations. Paper chromatographic separation of following metal ions:

    i.   Ni (II) and Co (II)

    ii.   Fe (III) and Al (III)

Reference Book:

    l. Vogel, A.l. A text book of Quantitative Analysis, ELBS 1986.

ORGANIC CHEMISTRY-III (BSHCY-402)

CREDITS-4

UNIT- I Aromatic Compounds

Introduction, nomenclature of benzene derivatives, the Kekule structure of benzene, Valance bond & molecular orbital theories of the structure of benzene, Huckel's rule: $(4n+2)\pi$ electron rule, Anti-aromatic compounds, non-aromatic, homoaromatic.

UNIT- II Electrophilic Substitution Reactions of Aromatic Compounds

Electrophilic substitution reactions (S_EAr), A general mechanism for electrophilic aromatic substitution-Arenium ions, Halogenation, Nitration and sulphonation of benzene, Friedel-Crafts alkylation and its limitations, Friedel-Crafts acylation; Effect of substituent's on reactivity and orientation.

Nucleophilic Substitution Reactions of Aromatic Compounds: Halobenzenes, and nucleophilic aromatic substitutions (S_NAr), bimolecular mechanism (A_ND_N), benzyne mechanism (D_NA_N). Preparation and uses of DDT and BHC.

UNIT- III Phenols

General methods of preparation and reactions ofphenol. Relative acidity ofphenol, alcohol and carboxylic acid. Reimer-Tiemann and Kolbe reactions; Claisen and Fries rearrangements.

UNIT- IV Nitrogen Containing Compounds

Nitrobenzene and reduction products. Amines, and amides. Comparative basicity of aliphatic and aromatic amines, Diazonium salts: preparation (Diazo reaction) and synthetic applications (Sandmeyer reactions).

UNIT- V Polynuclear Aromatic Hydrocarbons

Properties, Synthesis and reactions of naphthalene, anthracene, phenantherene.

Reference Books:

1. "Organic Chemistry", R. T. Morrison and R. N. Boyd, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
2. "Organic Chemistry", S. M. Mukherji , S. P. Singh, and R. P. Kapoor, 1st Edition (1985), 5th Reprint (1999), New Age lnternational (P) Ltd. Publishers, New Delhi.
3. Organic Chemistry - Structure and Reactivity ", Seyhan N. Ege, AITBS publishers, Delhi (1998).

ORGANIC CHEMISTRY-III LAB (BSHCY-L402)

CREDITS-2

Organic preparations:

1. Acetylation of one of the following compounds: amines (aniline, o-, m-, P-toluidines and o-, m-, p-anisidine) and phenols (B –naphthol, vanillin, salicylic acid) by any one method:

2. Benzolyation of one of the following amines (aniline, o-, m-, p- toluidines and o-, m-panisidine) and one of the following phenols (p -naphthol, resorcino[, p-cresol)

3. Hydrolysis of amides and esters.

4. Aldol condensation reactions.

The above derivatives should be prepared using 0.5-1 g of the organic compound. The solid samples must be collected and may be used for recrystallization and melting point.

Reference Books:

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).

2. Fumiis, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry 5th Ed., Pearson (2012).

3. Ahiuwalia, V. K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).

4. Ahluivalia, v.K. &Dhinga, S. comprehensive practical organic chemistry: QualitativeAnalysis, University Press (2000).

PHYSICAL CHEMISTRY-IV (BSHCY-403)

CREDITS-4

UNIT- I Conductance-I

Anhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions. Debye-Huckel-Onsager equation.

UNIT- II Conductance- II

Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes' (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts, (iv) conductometric titrations, and (v) hydrolysis constants of salts.

UNIT- III Electrochemistry-I

Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/ reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry. Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells.

UNIT- IV Electrochemistry- II

Application of EMF measurements in determining

(i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinine-hydroquinone, glass and SbO/Sb_2O_3 electrodes. Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation).

UNIT- V Electrical & Magnetic Properties of Atoms and Molecules

Basic ideas of electrostatics, Electrostatics of dielectric media Clausius-Mosotti equation, Lorenz-Laurentz equation, Dipole moment and molecular polarizabilities and their measurements. Diamagnetism, paramagnetism, magnetic susceptibility and its measurement, molecular interpretation.

Reference Books:

1. Atkins, P.W & Paula, I. D. Physical Chemistry, 9th Ed., Oxford University Press (2011).

2. Castellan, G.W. Physical Chemistry 4th Ed., Narosa (2004).

3. Mortimer, R. G. Physical Chemistry 3rd Ed., Elsevier: NOIDA, UP (2009).

4. Barrow, G.M., Physical Chemistry 5th Ed. Tata McGraw Hill: New Delhi (2006).

5. Engel, T. & Reid, P. Physical Chemistry 3rd Ed, Pr-entice-Hall (2012).

6. Rolers, D. W. Concise Physical Chemistry Wiley (2010).

7. L. Silbey, R. J.; Alberty, R. A. & Bawendi, M. c. Physical Chemistry 4th Ed" John Wiley & Sons, Inc. (2005).

PHYSICAL CHEMISTRY-IV LAB (BSHCY-L403)

CREDITS-2

Conductometry

I. Determination of cell constant

II. Determination of equivalent conductance, degree of dissociation and dissociation Constant of a weak acid.

III. Perform the following conductometric titrations:

i. Strong acid vs. strong base

ii. Weak acid vs. strong base

iii. Mixture of strong acid and weak acid vs. strong base

iv. Strong acid vs. weak base

Potentiometry

I. Perform the following potentiometric titrations:

i. Strong acid vs. strong base

ii. Weak acid vs. strong base

iii. Dibasic acid vs. strong base

iv. Potassium dichromate vs. Mohr's salt

Reference Books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (201 l).

2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).

3. Halpem, A. M. & McBane, G. C. Experimental Physical Chemistry Co.: New York (2003).

GE-IV: PHYSICS: MATHEMATICAL PHYSICS-III (BSHP-401)

CREDITS-4

The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen.

UNIT-I

Complex Analysis

Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions.

UNIT-II

Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's Integral formula. Simply and multiply connected region. Laurent and Taylor's expansion. Residues and Residue Theorem. Application in solving Definite Integrals.

UNIT-III

Integrals Transforms:

Fourier Transforms: Fourier Integral theorem. Fourier Transform. Examples.Fourier transform of trigonometric,Gaussian, finite wave train & other functions. Representation of Dirac delta function as a Fourier Integral.

UNIT-IV

Fourier transform of derivatives, Inverse Fourier transform, Convolution theorem. Properties of Fourier transforms (translation, change of scale, complex conjugation, etc.). Application of Fourier Transforms to differential equations: One dimensional Wave and Diffusion/Heat Flow Equations.

UNIT-V

Laplace Transforms: 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 Unit Step function, Dirac Delta function, Periodic

Functions. Convolution Theorem. Inverse LT. Application of Laplace Transforms to Differential Equations: Damped Harmonic Oscillator, Simple Electrical Circuits.

References Books:

1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
2. Mathematics for Physicists, P. Dennery and A.Krzywicki, 1967, Dover Publications
3. Complex Variables, A. S. Fokas & M. J. Ablowitz, 8th Ed., 2011, Cambridge Univ. Press
4. Complex Variables and Applications, J.W. Brown &R.V. Churchill, 7th Ed. 2003, Tata McGraw-Hill
5. First course in complex analysis with applications, D.G. Zill and P.D. Shanahan, 1940, Jones & Bartlett

GEL-IV: MATHEMATICAL PHYSICS LAB (BSHP- L401)

CREDITS-2

Scilab based simulations experiments based on Mathematical Physics problems like

1. Solve differential equations: $dy/dx = e^{-x}$ with $y = 0$ for $x = 0$ $dy/dx + e^{-x}y = x2$ $d^2y/dt^2 + 2\, dy/dt = -y$ $d^2y/dt^2 + e^{-t}dy/dt = -y$

2. Dirac Delta Function: Evaluate complex integrals .

3. Fourier Series: Program to sum $(0.2)^n$

Evaluate the Fourier coefficients of a given periodic function (square wave)

4. Frobenius method and Special functions. Plot $Pn(x)$, $jv(x)$ and show recursion relation

5. Calculation of error for each data point of observations recorded in experiments done in previous semesters (choose any two).

6. Calculation of least square fitting manually without giving weightage to error. Confirmation of least square fitting of data through computer program.

7. Evaluation of trigonometric functions e.g. *sin θ,* Given Bessel's function at N points find its value at an intermediate point. Complex analysis: Integrate $1/(x2+2)$ numerically and check with computer integration.

8. Integral transform: FFT of $^{(-x2)}$

References bOOKS:

1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press

2. Mathematics for Physicists, P. Dennery and A. Krzywicki, 1967, Dover Publications

3. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. VandeWouwer, P. Saucez, C. V. Fernández. 2014 Springer ISBN: 978-3319067896

4. Scilab by example: M. Affouf, 2012. ISBN: 978-1479203444

5. Scilab(A free software to Matlab): H.Ramchandran, A.S.Nair. 2011 S.Chand& Company

6. Scilab Image Processing: Lambert M. Surhone. 2010 Betascript Publishing

GE-IV: B.Sc. (Hon's) Zoology

COMPARATIVE ANATOMY OF VERTEBRATES (BSHZO-401)

CREDITS-4

UNIT- I

Origin of vertebrates, Integument and its derivatives, Structure of integument, scales, feathers, hair, beak, claw, nail, hoof, horn, antler, gland, Endoskeleton: Pectoral, Pelvic, Hindlimb, Forelimb.

UNIT- II

Digestive system: Modifications in relation to feeding habits, digestive glands, Oesophagus, Stomach; Dentition, dental formula in mammals.

UNIT- III

Respiratory System: Aquatic respiration, Aerial respiration, Circulatory system: Heart, Aortic arches,

UNIT- IV

Nervous system: Brain, Chemoreceptors, Photoreceptors, Photoreceptors of vertebrates, Cranial and spinal nerve.

UNIT- V

Urinogenital system: Excretory system- Types and evolution of kidney tubules, Urinary duct and bladder.

Reproductive system- General plan of gonads, Accessory reproductive organs.

Reference Books:

• Hildebrand: Analysis of Vertebrate Structure (1995, John Wiley)

• Kotpal: Modern Text Book of Zoology Vertebrates (2003, Rastogi)

• Nigam: Biology of Chordates (1983, S Chand)

GEL- IV:ZOOLOGY:COMPARATIVE ANATOMY OF VERTEBRATES LAB (BSHZO-L401)

1. Study of histological slides of Pisces.
2. Study of histological slides of Amphibians.
3. Study of histological slides of Reptiles.
4. Study of histological slides of Aves.
5. Study of histological slides of Mammals.
6. Dissection of Afferent and efferent arteries of available fish/ amphibia
7. Dissection of Cranial nerve of fish

Reference Book:

- Kotpal: Modern Text Book of Zoology Vertebrates (2003, Rastogi).
- Nigam: Biology of Chordates (1983, S Chand)

GE-IV MATHEMATICS- II (BSHM-402)

DIFFERENTIAL EQUATIONS

CREDITS-4

UNIT-I
Series solutions of differential equations- Power series method, Bessel and Legendre functions and their properties-convergence, recurrence and generating relations

UNIT-II
Orthogonality of functions, Sturm-Liouville problem, Orthogonality of eigen- functions, Reality of eigen values, Orthogonality of Bessel functions and Legendre polynomials.

UNIT-III
Laplace Transformation- Linearity of the Laplace transformation, Existence theorem for Laplace transforms, Laplace transforms of derivatives and integrals, Shifting theorems. Differentiation and integration of transforms.

UNIT-IV
Convolution theorem. Solution of integral equations and systems of differential equations using the Laplace transformation.

UNIT-V
Partial differential equations of the first order. Lagrange's solution.

Reference Books :

1. Erwin Kreysizig, Advanced Engineering Mathematics, John Wiley & Sons, Inc., New York, 1999.
2. D.A. Murray, Introductory Course on Differential Equations, Orient Longman, (India), 1967.
3. A.R. Forsyth, A Treatise on Differential Equations, Macmillan and Co. Ltd., London.
4. Lan N. Sneddon, Elements of Partial Differential

Equations, McGraw-Hill Book Company, 1988.

5. Francis B. Hilderbrand, Advanced Calculus for Applications, Prentice Hall of India Pvt. Ltd., New Delhi, 1977.

6. Jane Cronin, Differential equations, Marcel Dekkar, 1994.

7. Frank Ayres, Theory and Problems of Differential Equations, McGraw-Hill Book Company, 1972.

8. Richard Bronson, Theory and Problems of Differential Equations, McGraw-Hill, Inc., 1973.

9. A.S. Gupta, Calculus of variations with-Applications, Prentice-Hall of India, 1997. R. Courant and D. Hilbert, Methods of Mathematical Physics, Vots. I & II, Wiley.

GE-IV MATHEMATICS- IV LAB (BSHM-L402)

CREDITS-2

PRESENTATION-I

PRESENTATION-II

GE-IV: BOTANY: PLANT PATHOLOGY (BSHB-401)
CREDITS- 4

UNIT-I

History of plant pathology, classification of plant diseases, general symptoms of plant diseases.

UNIT-II

Mode of infection and role of enzymes and toxins in plant disease, defense mechanisms of plants against infection: Pre-existing structural and chemical defense, Host pathogen interactions and PR proteins.

UNIT-III

Control of plant diseases: biological, chemical, physical; bio-pesticides, plant quarantine, integratedpest management.

UNIT-IV

General account of some plant diseases: Late blight of Potato, Tikka disease of groundnut, Black rust of wheat, Red rot of sugarcane, leaf spot of rice, Citrus canker; Yellow vein mosaic of bhindi.

UNIT-V

Terms and concepts; General symptoms; Geographical distribution of diseases; Etiology; Symptomology; Host-Pathogen relationships; Disease cycle and environmental relation; prevention and control of plant diseases, and role of quarantine. Bacterial diseases – Citrus canker and angular leaf spot of cotton. Viral diseases – Tobacco Mosaic viruses, vein clearing. Fungal diseases – Early blight of potato, Black stem rust of wheat, White rust of crucifers.

Reference Books:

1. Agrios G N, 200. Plant Pathology, Academic press, London
2. Bilgrami K.H. & Dube H.C..1976. A textbook of Modern Plant Pathology. International BookDistributing Co. Lucknow.
3. Dubey H.C. 2009. An introduction to Fungi, Vikas Publisher New Delhi
4. R.S. Mehrotra and A. Agrawal, 2005. Plant Pathology, Tata McGraw New Delhi
5. Sharma P.D. 2004. Plant Pathology, Rastogi Publishers, Meerut.

GE-IV: Botany: Plant Pathology (BSHB-L401)

CREDITS- 2

1. To demonstrate control of plant diseases.

2. Symptomology of some viral disease specimens: Yellow vein mosaic of bhindi

3. Symptomology of some bacterial disease specimens: Bacterial blight of rice, Citrus cancer

4. Symptomology of some fungal disease specimens: Late blight of Potato,

5. Study of Tikka disease of groundnut, Black rust of wheat, Red rot of sugarcane.

Reference Books:

1. Crop plant Disease Colender- IARI-India.

2. K. S. Bilgrami and H. S.Dubey 2000 A text book of Modern Plant Pathology

3. R.S. Mehrotra and A. Agrawal, 2005. Plant Pathology, Tata McGraw New Delhi

4. R. S.singh Plant Pathology

5. Sharma P.D. 2004. Plant Pathology, Rastogi Publishers, Meerut.

GE-IV: ANIMAL BIOTECHNOLOGY AND GENETIC ENGINEERING: (BSHBT-401)

CREDITS- 4

UNIT -I

Animal Biotechnology: Animal Biotechnology- Introduction, History, Scope, Advantages & Disadvantages.Tissue Culture Media, Applications of Animal Biotechnology

UNIT- II

Cell Culture & Cell Lines, Culture Procedure, Large Scale Cell Culture in Biotechnology, Cell Banking &Scaling up of Cell Culture, Organ Culture- Types & Techniques, Applications in the field of Biotechnology

UNIT- III

Genetic Engineering- Concepts, Tools, Enzymes responsible for Genetic Engineering, Cloning Vectors andtheir Applications

UNIT -IV

Gene Libraries- Creating & Screening Methods & Its different TechniquesMethods of DNA Technology, Molecular Research Procedures of DNA

UNIT -V

DNA & its Sequencing, Applications of Genetic Engineering in the Field of Agriculture, Industry, Medicine& Diagnostics.

Reference Books:

1. Elements of Biotechnology (2nd Edition): P K Gupta
2. Animal Cell Culture: A Practical Approach: R. I. Freshney
3. Methods in Cell Biology(Vol-57): Animal Cell Culture Methods Mather & David Barnes
4. Principles of Genetic Manipulation: Old & Primrose
5. Animal Cell Culture Techniques- Martin Clynes
6. Recombination DNA Technology: Glick
7. Applied Molecular Genetics: Roger L Meisfeld
8. DNA Cloning:- A Practical Approach; A.M. Glover and B.D. Hames, IRL Press, Oxford

GEL-IV: ANIMAL BIOTECHNOLOGY AND GENETIC ENGINEERING LAB- (BSHBT-L401)

CREDITS- 2

1. To Isolate the Genomic DNA from spleen

2. To Estimate the DNA by DPA method.

3. To Estimate the RNA by Orcinol method.

4. To Isolate and Elute the DNA from Given sample by Agarose Gel Electrophoresis

5. To Isolate the Genomic DNA from Rice Plant by GFP Cloning mehtods

6. To Determine the Tm Value (GC) content in Denatured DNA.

7. To Determine the Competent Cell from the given sample.

8. To Transform the foreign DNA from given sample.

9. To Study the Bacterial conjugation by Genetic Engineering process.

10. To Isolate the Plasmid DNA from given sample.

Reference Books:

1. Essentials of Biotechnology for Students - By Satya N. Das.

2. Bioprocess Engineering - By Shuler (Pearson Education).

GE-IV: MICROBIAL GENETICS AND GENOMICS (BSHMB-401)

CREDITS- 4

UNIT-I Genome organization and mutations

Genome organization: *E. coli, Saccharomyces, Tetrahymena*. Organelle genome: Chroloroplast and Mitochondria. Mutations and mutagenesis: Definition and types of Mutations; Physical and chemical mutagens; Molecular basis of mutations; Functional mutants (loss and gain of function mutants); Uses of mutations. Reversion and suppression: True revertants; Intra- and inter-genic suppression; Ames test; Mutator genes.

UNIT-II Plasmids

Types of plasmids – F plasmid, R Plasmids, colicinogenic plasmids, Ti plasmids, linear plasmids, yeast-2 μ plasmid, Plasmid replication and partitioning, Host range, plasmid-incompatibility, plasmid amplification, Regulation of copy number, curing of plasmids.

UNIT-III Mechanisms of genetic exchange

Transformation - Discovery, mechanism of natural competence. Conjugation - Discovery, mechanism, Hfr and F' strains,Interrupted mating technique and time of entry mapping. Transduction - Generalized transduction, specialized transduction, LFT & HFT lysates,Mapping byrecombination and co-transduction of markers.

UNIT-IV Phage genetics

Features of T4 genetics, Genetic basis of lytic *versus* lysogenic switch of phage lambda.

UNIT-V Transposable elements

Prokaryotic transposable elements – Insertion Sequences, composite and non-composite transposons, Replicative and Non replicative transposition, Mu transposon. Eukaryotic transposable elements - Yeast (Ty retrotransposon), Drosophila (P elements), Maize (Ac/Ds). Uses of transposons and transposition.

Reference Books:

1. Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed.,Benjamin Cummings.
2. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and BartlettLearning.

GEL-IV: MICROBIAL GENETICS AND GENOMICS LAB
(BSHMB-L401)

CREDITS-2

1. Preparation of Master and Replica Plates.

2. Study the effect of chemical (HNO2) and physical (UV) mutagens on bacterial cells

3. Study survival curve of bacteria after exposure to ultraviolet (UV) light.

4. Isolation of Plasmid DNA from *E.coli.*

5. Study different conformations of plasmid DNA through Agaraose gel electrophoresis.

6. Demonstration of Bacterial Conjugation.

7. Demonstration of Ames test.

Reference Books:

1. Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed.,Benjamin Cummings.

2. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and BartlettLearning.

3. Pierce BA (2011) Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher EducationLearning.

4. Watson JD, Baker TA, Bell SP et al. (2008) Molecular Biology of the Gene, 6th Ed., BenjaminCummings.

5. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India.

Semester-V

ORGANIC CHEMISTRY-IV (BSHCY-501)

CREDITS-4

UNIT- I Methods of Determining Reaction Mechanism: Mechanism of bonds breaking and formation. Inter and intra-molecular migration of groups, crossover experiments, exchange with solvents, importance reactive intermediates. Isotopic substitution in a molecule: primary and secondary kinetic isotope effects - their importance in mechanistic studies.

UNIT- II Chemistry of reaction intermediates: Preparation, reactions and stability of carbenes, nitrenes and arynes.

Molecular Rearrangements: Favourskii reanangement, Demzov rearrangement. Beckmann,Hofmann, Lossen, Curtius and Wolf reengagements, Baeyer-Villiger oxidation.

UNIT- III Reagents and reactions in organic Synthesis: Reducing agents: lithium aluminium hydride, sodium borohydride, Birch reduction. Oxidizing agents: Osmium tetraoxide, Woodward & Prevorst oxidation and m-Chloroperbenzoic acid. Hydroboration.

UNIT- IV Ultra-Violet Spectroscopy: Electromagnetic radiation, UV Spectroscopy- Electronic transitions, auxochromes, chro.ophoies, bathochromic and hypsochromic shift, Wood words-Fieser rule for calculating λ_{max} for conjugated dienes and α-β-unsaturated aldehydes and ketones. Interpretation of UV spectra.

UNIT- V Infrared Spectroscopy: Vibration modes and bond stretching. Absorption of common functional groups, Factors affecting vibrational frequency, effects of Hydrogen bonding. Fingerprint region and interpretation of IR spectra.

Reference Books:

1. "Organic Chemistry", I. L. Finar, [Vol. l, 6th Edition (1973), Reprinted in 1980 & Vol. II' 5th Edition (t975), Reprinted inl996l, ELBS and Longman Ltd', New Delhi.

2. "A Guide Book to Mechanism in Organic Chemistry", P. Sykes, 6th Edition (1997), Orient Longman Ltd., New Delhi.

3. "Organic Chemistry", R. T. Morrison and R. N. Boyd, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.

4. "Organic Chemistry", S. M. Mukherji , S. P. Singh, and R. P. Kapoor, Ist Edition (1985), 5th Reprint (1999), New Age International (P) Ltd. Publishers, New Delhi.

5. Organic Chemistry", J. Clayden, N. Greeves, S. Warren, and E. Wothers, Oxford Univ. Press, Oxford (2001).

6. "Organic Chemistry", G. Solomon, Willey India Paper Back, 9th Edition.

7. "Mordern Organic Chemistry", M. K. Jain and S. C- Sharma Vishal Publishing CO. Jalandhar, India, 4th Edition (2012).

ORGANIC CHEMISTRY IV LAB: (BSHCY-L501)

CREDITS-2

8. Functional group test for nitro, amine and amide groups.

9. Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols, carbonyl compounds and esters)

Reference Books:

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).

2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell' A.R. Practical Organic Chemistry 5th Ed., Pearson (2012).

3. Ahluwalia, V. K. & Aggarwal, R. comprehensive Practical organic chemistry: Preparation and Quantitative Analysis, University Press (2000).

4. Ahluwalia, V. K. & Dhingra, S. Comprehensive Practical organic chemistry: Qualitative Analysis, University Press (2000).

PHYSICAL CHEMISTRY-V (BSHCY-502)

CREDITS: 4

UNIT- I Quantum Chemistry

Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and "particle-in-a-box" (rigorous treatment), quantization of energy levels, zero-point energy and Heisenberg Uncertainty principle; wave functions, probability distribution functions, nodal properties, Extension to two and three dimensional boxes, separation of variables, degeneracy.

Angular momentum: Commutation rules, quantization of square of total angular momentum and z-component.

UNIT- II Molecular Spectroscopy

Interaction of electromagnetic radiation with molecules and various types of spectra; Bom-Oppenheimer approximation.

Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear tri atomic molecules, isotopic substitution.

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, degrees of freedom for polyatomic molecules, modes of vibration.

UNIT- III Raman spectroscopy

Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectr4 Stokes and anti-stokes lines; their intensity difference, rule of mutual exclusion.

UNIT- IV Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and pre-dissociation.

Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, chemical shift and low resolution spectra, different scales, spin-spin coupling and high resolution spectra, interpretation of PMR spectra of organic molecules.

UNIT- V Electron Spin Resonance (ESR) spectroscopy: Its principle, hyperfine structure, ESR of simple radicals.

Reference Books:

1. Banwell, C. N. & Mccash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw- Hill: New Delhi (2006).
2. Chandra A. K. lntroductory Quantum Chemistry Tata Mccraw-Hill (2001).

3. House, J. E. Fundamentals ofQuantum Chemistry 2no Ed. Elsevier: USA (2004).

4. Lowe, J. P. & Peterson, K. Quantum Chemistry, Academic Press (2005).

5. Kakkar, R. Atomic & Molecular Spectroscopy, Cambridge University Press (2015).

PHYSICAL CHEMISTRY V LAB: (BSHCY-L502)

CREDITS-2

UV/Visible spectroscopy

I. Study the 200-500 nm absorbance spectra of $KMnO_4$ and $K_2Cr_2O_7$ (in 0.1 M H_2SO_4) and determine the λ_{max} values. Calculate the energies of the two transitions in different units (J molecule^{-1}, kJ mol^{-1}, cm^{-1}, eV).

II. Study the pH dependence of the UV-Vis spectrum (200-500 nm) of $K_2Cr_2O_7$.

III. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2- propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.

Colourimetry

I. Verify Lambert-Beer's law and determine the concentration of $CuSO_4$/$KMnO_4$/$K_2Cr_2O_7$ in a solution of unknown concentration.

II. Determine the concentrations of $KMnO_4$ and $K_2Cr_2O_7$ in a mixture.

III. Study the kinetics of iodination of propanone in acidic medium.

IV. Determine the amount of iron present in a sample using l, 10-phenathroline.

V. Determine the dissociation constant of an indicator (phenolphthalein).

VI. Study the kinetics of interaction of crystal violet phenolphthalein with sodium hydroxide.

VII. Analysis of the given vibration-rotation spectrum of HCI(g)

Reference Books:

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

2. Garland C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed,' McGraw-Hill: New York (2003).

3. Halpem, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W-H.Freeman & Co.: New York (2003).

Semester-VI

INORGANIC CHEMISTRY-IV (BSHCY-601)

CREDITS-4

UNIT- I Theoretical Principles in Qualitative Analysis

Basic principles involved in analysis of cations and anions and solubility products, common ion effect. Principles involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II.

UNIT- II Metal carbonyls

l8 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. π-acceptor behavior of CO (MO diagram of CO to be discussed), synergic effect.

Zeise's salt: Preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls.

UNIT- III Metal Alkyls

Important structural features of methyl lithium (tetramer) and tri alkyl aluminium (dimer), concept of multicentre bonding in these compounds. Role of triethylaluminium in potymerisation of ethene (Ziegler - Natta Catalyst). Species present in ether solution of Grignard reagent and their structures, Schlenk equilibrium.

Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, Mannich Condensation).

Structure and aromaticity. comparison of aromaticity and fugacity with that of benzene.

UNIT- IV Reaction Kinetics and Mechanism

Introductions to inorganic reaction mechanisms. Substitution reactions in square planar complexes, Trans effect, theories of trans effect, Mechanism of nucleophilic substitution in square planar complexes, thermodynamic and Kinetic stability, Kinetics of octahedral substitution, Ligand field effects and reaction rates.

UNIT- V Catalysis by Organometallic Compounds

Study; the following industrial processes and their mechanism:

1. Alkene hydrogenation (Wilkinsons Catalyst)

2. Wacker Process

3. Synthesis gas by metal carbonyl complexes

Reference Books:

1. Vogel, A.l. Suatitotive Inorganic Analysis, Longman, 1972.

2. Svehla, G. Yogel's Qualitative Inorganic Analysri, 7th Edition, Prentice Hall, 1996-03-07 .

3. Cotton, F.A. G.; wilkinson & caus, P.L. Basic Inorganic Chemistry 3rd Ed.; Wiley lndia.

4. Huheey, J. E.; Keiter, E.A. & Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed., Harper Collins 1993. Pearson.2006.

5. Sharpe, A.G. Inorganic Chemisrry,4th Indian Reprint (Pearson Education) 2005.

6. Douglas, B..E.; McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry 3rd Ed.. John Wiley and Sons, NY, 1994.

7. Greenwood, N.N. & Eamshaw, A. Chemistry of the Etements, Elsevier 2nd Ed, 1997 (Ziegler Natta Catalyst and Equilibria in Grignard Solution).

8. Lee, J.D. Concise Inorganic Chemistry 5th Ed.. John Wiley and sons 2008.

9. Powell, P. Principles of Organometallic Chemistry,,Chapman and Hall, 1988.

10. Shriver, D.D. & P. Atkins, Inorganic Chemistry 2nd Ed., Oxford University Press, 1994.

11. Basolo, F. & Person, R. Mechanisms of Inorganic Reactions: Study of Metal Complexes in Solurion 2ru Ed.. John Wiley & Sons Inc: NY.

12. Purcell, K.F. & Koa, J. C., Inorganic Chemistry, W.B. Saunders Co. 1977.

13. Miessler, G. L. & Donald, A.Tin, lnorganic Chemistry 4th Ed., Pearson, 2010.

14. Collman, James P. et al. Principles and Applications of Orgsnotransition Metal Chemistry. Mill Valley, CA: University Science Books, 1987.

15. Crabtree, Robert H. The Organometallic Chemistry of the Trawition Metals. J. New York, NY: John Wiley,2000.

16. Spessard, Gary O., &Gary L. Miessler. Organometallic Chemistry. Upper Saddle River, NJ: Prentice-Hall, 1996.

INORGANIC CHEMISTRY-IV LAB: (BSHCY-L601)

CREDITS-2

1. Qualitative semi-micro analysis of mixtures containing 3 anions and 3 cations. Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested:

   CO_3^{2-}, NO_2^-, S^{2-}, SO_3^{2-}, $S_2O_3^{2-}$, CH_3COO^-, F^-, Cl^-, Br^-, I^-, NO_3^-, BO_3^{3-}, $C_2O_4^{2-}$, PO_4^{3-}, NH_4^+, K^+, Pb^{2+}, Cu^{2+}, Cd^{2+}, Bi^{3+}, Sn^{2+}, Sb^{3+}, Fe^{3+}, Cr^{3+}, Al^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}

   Mixtures should preferably contain one interfering anion, or insoluble component ($BaSO_4$, $SrSO_4$, $PbSO_4$, CaF_2 or Al_2O_3) or Combination of anions e.g. CO_3^{2-} and SO_3^{2-}, NO_2^- and NO_3^- Cl^- and Br^-, Cl^- and I^-, Br^- and I^-, NO_3^- and Br^-, NO_3^- and I^-.

   Spot tests should be done whenever possible.

2. Synthesis of ammine complexes of Ni(+2 and its ligand exchange reactions (e.g. bidentate ligands like acetylacetone, DMG, glycine) by substitution method-

Reference Books:

1. Vogel's Qualitative Inorganic Analysis, Revised by G. Svehla.
2. Man & Rockett Inorganic Preparalions.

ORGANIC CHEMISTRY-V (BSHCY-602)

CREDITS-2

UNIT- I Carbohydrates:

Introduction, monosaccharadies, glycoside bond formation, mutarotation. Reactions of aldoses and ketoses (oxidation and reductions). Killiani synthesis, Osazone formation. Glucose-structure (including cyclic structure), Fructose (reactions only). Degradation of monosaccharaides: Ruff degradation.

UNIT- II: Heterocyclic Compounds

Synthesis and chemistry of furan, thiophene, pyrrole, indole, pyridines, isoquinoline and quinoline.

UNIT- III Chemistry of Natural Products:

A study of the following compounds involving their isolation, structure elucidation and synthesis: Alkaloids- Hofmann exhaustive methylation, nicotine; Terpenes- Isoprene rule, citral.

UNIT- IV Organic Synthesis *via* enolates

Preparation of DEM and EAA. Synthesis of mono/dicarboxylic acid diketones, uracil, barbutric acid using DEM/EAA: Mukhayama Aldol reactions and Michael reactions.

UNIT- V Photochemistry

Principles of photochemistry, photochemical reactions of carbonyl compounds and olefins. ^{1}H NMR Spectroscopy: NMR phenomenon, processional motion, Chemical shift, Shielding and deshielding effects, Spin-spin splitting, Coupling constant, Interpretation of NMR spectra.

Reference Books:

1. "Chemical Applications of Group Theory" F. Albert Cotton, 3'rd Edition 1993, Wiley-lndia .
2. "Environmiital Chemistry", A. K. De, 3rd Edition (1994), Wiley Eastem, New Delhi.
3. "Analyticat Chemistry",G. D. Christian,4th Edition (1986), John Wiley & Sons, New York.
4. "Principles of Instrumental Analysis", D.A. Skoog, 5th Edition (1998), Saunders College Publishing, Philadelphia, London. y, New York.
5. "Basic concept of Analytical Chemistry", S. M. Khopkar, 2nd Edition (1998), New Age International Publications, New Delhi.

ORGANIC CHEMISTRY-V LAB

(BSHCY-L602)

CREDITS-2

1. Preparation of organic dye.

2. Preparation of organic compounds

Reference Books:

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).

2. Fumiss, B.S.; Hennaford, A. I.; Smidt, P.W.G.; Tatchell, A.R. Practical Organic Chemistry 5th Ed., Pearson (2012).

3. Ahluwalia, V. K. & Aggarwal, R Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).

4. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry Qualitative Analysis, University Press (2000).

CHEMISTRY-DSE I-IV (ELECTIVES)
DSE-I: ANALYTICAL METHODS IN CHEMISTRY

CREDITS-4

UNIT- I Qualitative and quantitative aspects of analysis

Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals.

UNIT- II Optical methods of analysis

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.

UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument;

Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers.

Infrared Spectrometry: Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument: sampling techniques. Structural illustration through interpretation of data,

UNIT- III Flame Atomic Absorption and Emission Spectrometry

Basic principles of instrumentation (choice of source, monochromalor, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. ICP-OES techniques for the quantitative estimation of trace level of metal ions from water samples.

UNIT- IV Thermal methods of analysis

Theory of thermogravimetry (TG), basic principle of instrumentation, Techniques for quantitative estimation of Ca and Mg from their mixture.

UNIT- V Electroanalytical methods and Separation Technique

Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pK_a values.

Separation techniques:

Solvent extraction: Classification, principle and efficiency of the technique.

Mechanism of extraction: extraction by solvation and chelation.

Technique of extraction: batch, continuous and counter current extractions.

Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and non-aqueous media.

Chromatography: Classification, principle and efficiency of the technique.

Mechanism of separation: adsorption, partition & ion exchange.

Development of chromatograms: frontal, elution and displacement methods.

Qualitative and quantitative aspects of chromatographic methods of analysis: lC, GLC, GPC, TLC and HPLC.

Role of computers in instrumental methods of analysis.

Reference Books:

1. Vogel,Arthur I:ATest book of Quantitative lnorganic Analysis (Rev.by G. H. Jeffery and others) 5th Ed. The English Language Book Society of Longman.

2. Willard, Hobert H. et al.: Instrumental Methods of Analysis. 7th Ed. Wardsworth Publishing Company, Belmont, Califomia.USA, 1988.

3. Christian, Gary D; Analyical Chemistry. 6th Ed. John Wiley & Sons, New York,2004.

4. Hanis, Daniel C: Exploring Chemical Analysis, Ed.New York, W.H. Freeman, 2001.

5. Khopkar, S.M. Basic concepts of Analytical chemistry. New Age, International Publisher, 2009.

6. Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Thomson Asia Pvt. Ltd. SingaPore.

7. Mikes, O. & chilmes, R.A. Laboratory Hand Book of chromatoglaphic & Allied Methods, Elles Harwood Ltd. London.

8. Ditts, R.V. Analytical Chemistry - Methods of separation.

DSEL-I- LAB: ANALYTICAL METHODS IN CHEMISTRY

CREDITS-2

I. **Separation Techniques**

1. Chromatography:

(a) Separation of mixtures

(i) Paper chromatographic separation of Fe^{3+}, Al^{3+}, and Cr^{3+}.

(ii) Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the Rl values.

(b) Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their R_f values.

(c) Chromatographic separation of the active ingredients of plants, flowers and juices by TLC.

II. **Solvent Extractions:**

(i) To separate a mixture of Ni^{2+} & Fe^{2+} by complexation with DMG and extracting the Ni^{2+}-DMG complex in chloroform, and determine its concentration by spectrophotometry.

(ii) Solvent extraction of zisconium with amberliti LA-I, separation from a mixture of irons and gallium.

(iii) Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.

(iv) Determination of Na, Ca, Li in cola drinks and fruit juices using fame photometric techniques.

(v) Analysis of soil:

   1. Determination of PH of soil.

   2. Total soluble salt.

   3. Estimation of calcium, magnesium' phosphate, nitrate

   4. Ion exchange:

(vi) Determination of exchange capacity of cation exchange resins and anion exchange resins.

(vii) Separation of metal ions from their binary mixture.

(viii) Separation of amino acids from organic acids by ion exchange chromatography.

III. **Spectrophotometry**

l. Determination of pK_a values of indicator using spectrophotometry.

2. Structural characterization of compounds by infrared spectroscopy.

3. Determination of dissolved oxygen in water.

4. Determination of chemical oxygen demand (COD).

5. Determination of Biological oxygen demand (BOD).

6. Determine the composition of the Ferric-salicylate/ ferric thiocyanate complex by Job's method.

Reference Books:

1. Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis (Rev. by G.H. Jeffery and others) 5th Ed. The English Language Book Society of Longman.

2. Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardswonh Publishing Company, Belmonl California. USA. 1988.

3. Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York,2004.

4. Hanis, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.

5. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009.

6. Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Thomson Asia Pvt. Ltd. Singapore.

7. Mikes, O. & Chalmes, R.A. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood Ltd. London.

DSE-II: BIOCHEMSITRY

CREDITS-4

UNIT- I Amino acids

Amino acids-Preparative methods, physical properties, dipolar nature, chemical reactions and configuration. Concept of unnatural amino acids. Importance of amino acids.

UNIT- II Peptides and Proteins

Peptides: Peptide linkage, peptide synthesis and structure of polypeptides.

Proteins: General characteristics and primary, secondary and tertiary structure. Common deficiency diseases.

UNIT- III Metalloproteins

Enzymes: Classification, nomenclature, co-enzymes (representative examples from different classes). Enzyme kinetics and enzyme inhibition. Hemoglobin: oxygen and carbon dioxide transport by hemoglobin.

UNIT- IV Vitamins and Hormones

Chemical constitution and physiological functions of vitamins A, B_2 (Riboflavin), C (Ascorbic acid); Thyroxin and estrone.

UNIT- V Drugs

Classification, preparation and Mechanism of action of the following:

(i) Antipyretics and Analgesics: Aspirin, Paracetamol,

(ii) Sulpha drugs: Sulphanilamide, Sulphaguanidine

(iii) Antimalarials: Chloroquine

(iv) Antibiotics: Chloramphenicol

Reference Books:

1. "Organic Chemistry", R.T. Morrison and R. N. Boyd, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
2. "Organic Chemistry", S. M. Mukherji, S. P. Singh, and R. P. Kapoor, 1st Edition (1985), 5th Reprint (1999), New Age International (P) Ltd. Publishers, New- Delhi.
3. "Organic Chemistry", I. L. Finar, vol. II, 5th Edition (1975), Reprinted in l996, ELBS and Lonsman Ltd. New Delhi.
4. "Biochemistry" L. Stryer. 5th edition (2002) Freeman & Co New York.

DSEL-II LAB: BIOCHEMISTRY CHEMISTRY LAB

CREDITS-2

Identification and estimation of the following:

1. Carbohydrates - qualitative and quantitative.

2. Lipids - qualitative.

3. Proteins - qualitative.

4. Isolation of protein.

5. Determination of protein by the Biuret reaction.

Reference Books:

1. T.G. Cooper: Tool of Biochemistry.

2. Keith Wilson and John Walker: Practical Biochemistry.

3. Alan H Gowenlock: Varley's Practical Clinical Biochemistry.

4. Thomas M. Devlin: Textbook of Biochemistry.

5. Jeremy M. Berg, John L Tymoczko, Lubert Stryer: Biochemistry.

6. G. P. Talwar and M Srivastava: Textbook of Biochemistry and Human Biology.

7. A. L. Lehninger: Biochemistry.O. Mikes, R. A. Chalmers: Laboratory Handbook of Chromatographic Methods.

8. Qualitative analysis of unknown organic compounds containing mono functional groups (carbohydrates, aryl halides, aromatic hydrocarbons, nitro compounds, amines and amides) and simple bi functional groups, for e.g. salicylic acid, cinnamic acid, nitrophenols etc.

9. Identification of simple organic compounds by IR spectroscopy and NMR spectroscopy (Spectra to be provided).

CHEMISTRY DSE-III: SOLID STATE CHEMISTRY

CREDITS-4

UNIT-I Crystal structure and X-ray diffraction

Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices;

UNIT-I Crystal structure analysis

X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Defects in crystals. Glasses and liquid crystals.

UNIT-I Semiconductors and Band Theory

Band theory of insulators and semiconductors, intrinsic semiconductors, extrinsic semiconductors, doped semiconductors, rectifiers, transistors, p-n junctions and their applications, Schottky and Frenkel defects, stoichimetric imbalance, origin of colours.

UNIT-I Magnetic properties of solids

Origin and classifications of magnetic substance, magnetic moment, ferromagnetic, antiferromagentic and ferromagnetic ordering, magnetic susceptibility, thermal nature of magnetic compounds.

UNIT-I Nanotehcnology

Types and size of nano compounds, carbon nano tubes, graphenes and their structure, advancements in structure elucidation of nano and supra materials.

Reference Books:

1. C. Kittel, Introduction to Solid State Physics, John Wiley & Sons, Inc., New York, Chichester.

2. O. Madelung, Introduction to Solid State Theory

3. A. R. West, Solid State Chemistry and its Applications, (1984) John Wiley and Sons, Singapore.

4. L.V. Azaroff, Introduction to Solids, (1977) Tata McGraw-Hill, New Delhi.

5. A. J. Dekker, Solid State Physics, Prentice Hall

DSEL-III LAB: SOLID STATE CHEMISTRY

CREDIT-2

1. Synthesis, characterization and applications of nanomaterials

2. Magnetic behavior of solid crystals

3. Solubility of different solid in various solvents

4. Synthesis of metal/metal oxide nanoparticles.

Reference Book:

1. Fahan, Materials Chemistry, Springer (2004).

DSE-IV: GREEN CHEMISTRY

CREDITS-4

UNIT- I Introduction to Green Chemistry

What is Green Chemistry? Importance of Green Chemistry. Limitations/Obstacles in the pursuit of the goals of Green Chemistry Goals of Green Chemistry.

UNIT- II Principles of Green Chemistry

Principles of Green Chemistry with their explanations and special emphasis on the following with examples:

1. Green Synthesis using these principles; Prevention of waste/ byproducts; maximum incorporation of the materials used in the process into the final products.

2. Prevention/ minimization of hazardous toxic products reducing toxicity risk: (function) hazardous exposure; waste or pollution prevention hierarchy.

UNIT- III Energy requirements for reactions

Alternative sources of energy: use of microwaves and Ultrasonic energy, Selection if starting materials; avoidance of unnecessary derivatization - careful use of blocking/protecting groups; Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; catalysis and green chemistry, comparison of heterogeneous and homogeneous catalysis, bio catalysis, asymmetric catalysis and photo catalysis.

UNIT- IV Green Synthesis

1. Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodi acetate (Alternative to Strecker synthesis)

2. Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols; microwave assisted reactions in organic solvents Diels-Alder reaction and Decarboxylation reaction

3. Healthier Fats and oil by Green Chemistry: Enzymatic Inter esterification for production of no Trans-Fats and Oils.

UNIT- V Future Trends in Green Chemistry

Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solvent less reactions; co crystal controlled solid state synthesis (C_2S_3); Green chemistry in sustainable development.

Reference Books:

1. Ahluwalia V.K. and Kidwai, M.R. New Trends in Green Chemistry, Anamalaya publishers, 2005.

2. Anastas, P.T. and Wamer, J.K. Oxford Green Chemistry -Theory and Pract?d/, University Press, 1998.

3. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker, 2001.

4. Cann, M.C. and Connely, M.E. Real-llorld Cases in Green Chemistry, American Chemical Society, Washinglon, 2000.

5. Ryan, M.A. and Tinnesand, M., Inlroduction to Green Chemistry, American Chemical Society Washinglon, 2002.

6. Lancaster, Mike, Green Chemistry an Introductory Text 2nd Ed., RSC Publishing,. ISBN: 978-1-84755-873-2

DSEL-IV PROJECT: BASED ON SUBJECT

CREDITS-2

DISSERTATION/ PROJECT WORK FOLLOWED BY SEMINAR

(DSEL-IV-Project)

SKILL ENHANCEMENT COURSE (ANY FOUR)
(SEC-1 TO SEC-4)
SEC-I: BASIC ANALYTICAL CHEMISTRY

CREDITS-2

UNIT- I Introduction

Introduction to Analytical chemistry and its interdisciplinary nature. concept of sampling. Importance of accuracy, precision and sources oferr-or in analytical measurements. Presentation of experimental data and results, from the point ofview ofsignificant figures.

Analysis of soil: Composition of soil, Concept of pH and pH measurement, Complexometric Titrations, Chelation, Chelating agents, use of indicators

a. Determination of pH of soil samples.

b. Estimation of calcium and Magnesium ions as calcium carbonate by complexometric titration,

UNIT- II Analysis of water

Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.

a. Determination of pH, acidity and alkalinity of a water sample.

b. Determination of dissolved oxygen (DO) of a water sample.

Analysis of food products: Nutritional value of foods' idea about food processing and food preservations and adulteration.

1. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc.

2. Anatysis of preservalives and colouring matter.

UNIT- III Chromatography

Definition, general introduction on principles of chromatography, paper Chromatography, TLC etc.

a. Paper chromatographic separation of mixture of metal ion (Fe^{3+} and Al^{3+}).

b. To compare paint samples by TLC method.

UNIT- IV Ion-exchange

Column, ion-exchange chromatography etc. Determinati6n of ion exchange capacity of anion/ cation exchange resin (using batch procedure if use of column is not feasible).

UNIT- V Analysis of cosmetics

Major and minor constituents and their function

a. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate.

b. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration.

Suggested Applications (Any one):

a. To study the use of phenolphthalein in trap cases.

b. To analyze arson accelemnts.

c. To carry out analysis of gasoline.

Suggested Instrumental demonstrations:

   a. Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by flame photometry.
   b. Spectrophotometric determination of Iron in Vitamin / Dietary Tablets.
   c. Spectrophotometric ldentification and Determination of caffeine and Benzoic Acid in Soft Drink.

Reference Books:

1. Willard, H. H. Instrumental Methods of Analysis, CBS Publishers.
2. Skoog & Lerry. Instrumental Methods of Analysis, Saunders college Publications, New York.
3. Skoog, D.A.; West, D.M. & Holler' F. l. Fundamentals of Analytical Chemistry 6th Ed., Saunders Coltege Publishing, Fort Worth (1992).
4. Harris, D. C. Quantitative Chemical Analysis, W' H Freeman.
5. Dean, J. A. Analytical Chemistry Notebook, McGraw Hill.
6. Day, R. A. & Underwood, A-L. Quantitative Analysis, Prentice Hall of India.
7. Freifelder, D. Physical Biochemistry 2nd Ed, W. H. Freeman and Co., N.Y. USA (1982).
8. Cooper, T. G. The Tools of Biochemistry, John Wiley and Sons, N.Y. USA, l6 (1977).
9. Vogel, A. l. Vogel's qualitative Inorganic Analysis 7th Ed., Practice Hall.
10. Vogel, A. l. Vogel's qualitative Inorganic Analysis 6th Ed., Practice Hall.
11. Robinson, J. W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc., New York (l995).

SEC-2: PHARMACEUTICAL CHEMISTRY

CREDITS-2

Drugs & Pharmaceuticals

Drug discovery, design and development: Basic Retro synthetic approach. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, lbuprofen); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam),Cardiovascular (Glyceryltrinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine).

Fermentation

Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin. (iii) Lysine, Glutamic acid, Vitamin B_2, Vitamin B_{12} and Vitamin C.

Reference Books:

1. G.L. Patrick: Introduction to Medicinol Chemistry, Oxford University Press, UK.
2. Hakishan, V.K. Kapoor: Medical and Pharmaceuticals Chemistry, Vallabh Prakashan, Pitampura, New Delhi.
3. William O. Foye, Thomas L., Lemke, David A. William: Principles of Medicinal chemistry. B. I. Waverly Pvt. Ltd. New Delhi.

SEC-3: CHEMISTRY OF COSMETICS & PERFUMES

CREDITS-2

A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel. Creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. Essential oils and their importance in cosmetic industries with reference to Eugenol. Ceraniol. sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone. Civetone, Muscone.

Reference Books:

1. E. Stocchi: Industrial Chemistry. Vol 1, Ellis Horwood Ltd. UK.
2. P.C. Jain, M. lain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
3. B.K. Sharma: Industrial Chemistry, Goel Publishing House, Meerut.

SEC-4: PESTICIDE CHEMISTRY

CREDITS-2

General introduction to pesticides (natural and synthetic), benefits and adverse effects, changing concepts of pesticides, structure activity relationship, synthesis and technical manufacture and uses of representative pesticides in the following classes: organochlorines (DDT, Gammexene); Oiganophosphates (Malathion, parathion); Carbamates (Carbofuran and carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor).

Reference Book:

1. R. Cremlyn: *Pesticides*, John Wiley.