

SYLLABUS FOR THE

B.Sc. APPLIED LIFE SCIENCES

WITH

AGRO-CHEMICALS AND PEST MANAGMENT

(In Semester Mode)

UNIVERSITY OF DELHI, DELHI- 110007

YEAR-1

Semester-1

- PAPER -1 CHPT 101 CHEMISTRY-1
PAPER 2 BIOLOGY-I (INTRODUCTION TO BIOLOGY
PAPER -3 MACT 303-MATHEMATICS AND STATISTICS
PAPER -4/8 ENAT 101/201-TECHNICAL WRITING AND COMMUNICATION IN
ENGLISH/ COMPUTATIONAL SKILLS

Semester-2

- PAPER -5 CHPT 202- CHEMISTRY-2
PAPER-6 BIOLOGY-II (CELL AND CELLULAR PROCESSES)
PAPER-7 SOILS AND FERTILIZERS
PAPER -4/8 ENAT 101/201-TECHNICAL WRITING AND COMMUNICATION IN
ENGLISH/ COMPUTATIONAL SKILLS

In addition, there shall be one qualifying paper in self-learning mode called Environmental Studies offered in Semester-2

YEAR-2

Semester-3

- PAPER -9 CHPT 303- CHEMISTRY-3
PAPER-10 BIOLOGY OF LIFE FORMS
PAPER-11 BIOLOGY OF ANIMALS: FORM STRUCTURE AND FUNCTION
PAPER-12 HERBICIDES

Semester-4

- Paper- 13 CHPT 404: CHEMISTRY-4
PAPER-14 AGRICULTURAL BOTANY, PLANT PATHOLOGY AND ALLELOPATHY
PAPER-15 IMMUNOLOGY, MOLECULAR BIOLOGY AND DEVELOPMENT
BIOLOGY
PAPER- 16 FUNGICIDES

YEAR-3

SEMESTER- 5

PAPER -17 CHPT 505- CHEMISTRY-5

PAPER- 18 GENETICS, BIOTECHNOLOGY AND DEVELOPMENTAL BIOLOGY
(PLANTS)

PAPER- 19 APPLIED ENTOMOLOGY

PAPER- 20 CONVENTIONAL AND BIOLOGICAL INSECTICIDES

SEMESTER-6

PAPER -21 CHPT 606- CHEMISTRY-6

PAPER- 22 PLANT SYSTEMATICS AND PHYSIOLOGY

PAPER- 23 INTEGRATED PEST MANAGEMENT

PAPER- 24 PESTICIDE FORMULATION AND ANALYTICAL TECHNIQUES

PAPER -1

CHPT 101- Chemistry-1 (Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons)

THEORY

Marks: 100

Section A: Inorganic Chemistry-1

(30 Periods)

Unit 1. Atomic Structure: Recapitulation of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Need of a new approach to Atomic structure.

What is Quantum mechanics? Time independent Schrodinger equation ($H\Psi = E\Psi$) and meaning of various terms in it. Significance of Ψ and Ψ^2 , Schrodinger equation for hydrogen atom in Cartesian coordinates (x,y,z). Need of polar coordinates, transformation of Cartesian coordinates (x,y,z) into polar coordinates (r,θφ). Radial and angular parts of the hydrogenic wavefunctions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals. (Only graphical representation), Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distances with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers m_l and m_s . Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (m_s). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

Unit 2. Chemical Bonding and Molecular Structure

Ionic Bonding :General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding :VB Approach :Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combination of atomic orbitals, non-bonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO⁺. Comparison of VB and MO approaches.

Section B: Organic Chemistry-1

(30 Periods)

Unit 3. Fundamentals of Organic Chemistry

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive intermediates: Carbocations, Carbanions free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Huckel's rule.

Unit 4. Stereochemistry

Conformations w.r.t. ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newman, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; cis - trans nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).

Unit 5. Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes:(Upto 5 Carbons). Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.

Alkenes: (Upto 5 Carbons) Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. KMnO_4) and trans-addition (bromine). Addition of HX (Markownikoff's and anti-Markownikoff's addition). Hydration, Ozonolysis, oxymecuration-demercuration, hydroboration-oxidation.

Alkynes: (Upto 5 Carbons) Preparation: Acetylene from CaC_2 and conversion into higher alkynes; bydehalogenation of tetrahalides dehydrohalogenation of vicinal-dihalides. Reactions: formation of metal acetylides, addition of bromine and alkaline KMnO_4 , ozonolysis and oxidation with hot alk. KMnO_4 .

SUGGESTED READINGS

Section A:

1. J. D. Lee (2008) A new Concise Inorganic Chemistry, 5th edition E L. B. S.
2. James E. Huheey, Ellen Keiter and Richard Keiter(2009) Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Publication.

Section B:

1. I. L. Finar (1971) Organic Chemistry (Vol. I & II), E. L. B. S.
2. RT Morrison, RN Boyd, (1966) Organic Chemistry. 2nd ed., Allyn and Bacon, Boston
3. Arun Bahl and B. S. Bahl(1987) Advanced Organic Chemistry, S. Chand
4. Peter Sykes(1986) A Guide Book to Mechanism in Organic Chemistry, Orient Longman.

PRACTICALS

Marks: 50

Section A: Inorganic Chemistry - Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with KMnO_4 .
3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO_4 .
4. Estimation of Fe(II) ions by titrating it with $\text{K}_2\text{Cr}_2\text{O}_7$ using internal indicator.
5. Estimation of Cu(II) ions iodometrically using $\text{Na}_2\text{S}_2\text{O}_3$.

Section B: Organic Chemistry

1. Detection of extra elements (N,S,Cl,Br,I) in organic compounds (containing upto two extra elements).
2. Separation of mixtures by Chromatography: Measure the R_f value in each case (combination of two compounds to be given)
 - (a) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography
 - (b) Identify and separate the sugars present in the given mixture by paper chromatography.

Suggested Readings

1. Vogel's Qualitative Inorganic Analysis, A.I. Vogel , Prentice Hall ,7th Edition.
2. Vogel's Quantitative Chemical Analysis, A.I. Vogel , Prentice Hall ,6th Edition.
3. Textbook of Practical Organic Chemistry, A.I. Vogel , Prentice Hall, 5th edition.
4. Practical Organic Chemistry, Mann F. G. & Saunders B. C, Orient Longman, 1960.

THEORY Marks: 100

Unit 1. Biological systems, evolution and biodiversity

a. Introduction to concepts of biology (Ch 1 Campbell) (4 Periods) Themes in the study of biology; A closer look at ecosystem; A closer look at cell; The process of Science; Biology and everyday life

b. Evolutionary history of biological diversity (Ch 25 Campbell) (6 Periods) Early earth and the origin of life; Major events in the history of life; Mechanism of Macroevolution; Phylogeny and the tree of life

c. Classifying the diversity of life (Ch 25 Raven) (8 Periods)

Kingdoms of Life –Prokaryotes, Eukaryotes, Archaea

d. Darwinian view of life and origin of species (Ch22, 24 Campbell) (10 Periods)

Darwin's theory of evolution; The evolution of populations; Concepts of species; Mechanism of Speciation

e. Genetic approach to Biology (Ch 1 Griffiths) (8 Periods)

Patterns of inheritance and question of biology; Variation on Mendel's Law; The molecular basis of genetic information; The flow of genetic information from DNA to RNA to protein; Genetic Variation; Methodologies used to study genes and gene activities; Developmental noise; Detecting macromolecules of genetics; Model organisms for the genetic analysis; Distinction between Phenotype and Genotype

Unit 2. Chemical context of living systems

a. Chemistry of life (Ch 2 Campbell) (6 Periods)

The constituents of matter; Structure of an atom; The energy level of electron; The formation and function of molecules depend on chemical bonding between atoms; Chemical reaction make or break chemical bonds

b. Water and life (Ch 3 Campbell) (5 Periods)

The water molecule is polar; Properties of water; Ionization of water

c. Carbon and life (Ch 4 Campbell) (5 Periods)

Organic chemistry-the study of carbon compounds; What makes carbon special? Properties of organic compounds

d. Structure and function of biomolecules (Ch 5 Campbell) (8 Periods)

Most macromolecules are Polymers; Carbohydrates act as fuel and building materials; Lipids are group of hydrophobic molecules; Protein have diverse structures and functions; Nucleic acids store and transmit hereditary information

SUGGESTED BOOKS

1. Campbell, N.A. and Reece, J. B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
2. Raven, P.H et al (2006) Biology 7th edition Tata McGrawHill Publications, New Delhi
3. Griffiths, A.J.F et al (2008) Introduction to Genetic Analysis, 9th edition, W.H. Freeman & Co.NY

LSPP 101- BIOLOGY-I (INTRODUCTION TO BIOLOGY)

PRACTICALS

Marks: 50

1. To learn a) use of microscope b) principles of fixation and staining.
2. Preparation of Normal, molar and standard solutions, phosphate buffers, serial dilutions
3. Use of micropipettes
4. Separation of A) amino acids B) chloroplast pigments by paper chromatography.
5. To perform gram staining of bacteria.
6. To study the cytochemical distribution of nucleic acids and mucopolysaccharides with in cells/tissues from permanent slides.
7. To perform quantitative estimation of protein using the Lowry's method. Determine the concentration of the unknown sample using the standard curve plotted.
8. To separate and quantify sugars by thin layer chromatography.
9. To raise the culture of *E. coli* and estimate the culture density by turbidity method. Draw a growth curve from the available data.
10. Isolation of genomic DNA from *E. coli*.

BIOLOGY-I (INTRODUCTORY BIOLOGY AND CROP SCIENCE)

THEORY

Marks: 100

Unit 1. Biological Systems, Ecosystem and Biomolecules

Introduction to concepts of biology; physiological systems;

Approaches to ecology; the ecosystem energy and nutrient relationships, water and life, properties of water, biogeochemical cycles

General biochemistry: an introduction to the structure of chemicals of life - carbohydrates, lipids amino acids, protein and nucleic acids.

Unit 2. Introduction to Crop Science

Crop-genetic variability: wild gene- pool, hybrids, crop improvement.

Weeds and weed control methods- some commonly occurring weeds, herbicide selectivity, absorption and translocation, modes of herbicides action, herbicides detoxification. Weed resistance to herbicides, Integrated pest management.

SUGGESTED READINGS

1. Campbell, N.A. and Reece, J. B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
2. Raven, P.H et al (2006) Biology 7th edition Tata McGrawHill Publications, New Delhi.
3. Griffiths, A.J.F et al (2008) Introduction to Genetic Analysis, 9th edition, W.H. Freeman & Co. NY.
4. Kochhar, S.L. (2009) Economic Botany in Tropics. Macmillan and Co. New Delhi.
5. Subramanian, S., A. Mohamed Ali and R. Jayakumar, (1993) All about Weed control. Kalyani Publishers.

PRACTICALS

Marks: 50

1. Study of some weeds by specimens /photographs.
2. To evaluate effect of herbicides on seed germination and seedling growth of weeds.
3. Study of Economic characters of following species: Rice, Wheat, Cotton, Mustard, Tea, Rubber, Clove and Black Pepper. (no food tests)
4. To Study variation between seedlings of two varieties of *Phaeolus* bean and to calculate mean, standard deviation and variance.
5. Separation of Amino Acids by paper chromatography technique.
6. To study the cytochemical distribution of nucleic acids with in the cells/tissues from permanent slides.
7. To perform quantitative estimation of protein using the Lowry's method. Determine the concentration of the unknown sample using the standard curve plotted.

8. To perform test for reducing and non reducing sugars.
9. To conduct field trip to study terrestrial and aquatic ecosystem.
10. To estimate the RBC & WBC counts in human blood.

SUGGESTED READINGS

1. David Plummer (2010) An Introduction to Practical Biochemistry by TATA McGraw-Hill
2. Subramanian, S., A. Mohamed Ali and R. Jayakumar, (1993) All about Weed control. Kalyani Publishers.
3. Kochhar, S.L. (2009) Economic Botany in Tropics. Macmillan and Co. New Delhi

PAPER -3 MACT 303-MATHEMATICS AND STATISTICS

Marks: 100

Unit 1.

Sets. Functions and their graphs: polynomial, sine, cosine, exponential and logarithmic functions. Motivation and illustration for these functions through projectile motion, simple pendulum, biological rhythms, cell division, muscular fibres etc. Simple observations about these functions like increasing, decreasing and, periodicity. Sequences to be introduced through the examples arising in Science beginning with finite sequences, followed by concepts of recursion and difference equations. For instance, the Fibonacci sequence arising from branching habit of trees and breeding habit of rabbits. Intuitive idea of algebraic relationships and convergence. Infinite Geometric Series. Series formulas for e^x , $\log(1+x)$, $\sin x$, $\cos x$. Step function. Intuitive idea of discontinuity, continuity and limits. Differentiation.

Conception to be motivated through simple concrete examples as given above from Biological and Physical Sciences. Use of methods of differentiation like Chain rule, Product rule and Quotient rule. Second order derivatives of above functions. Integration as reverse process of differentiation. Integrals of the functions introduced above.

Unit 2.

Points in plane and space and coordinate form. Examples of matrices inducing Dilation, Rotation, Reflection and System of linear equations. Examples of matrices arising in Physical, Biological Sciences and Biological networks. Sum and Produce of matrices upto order 3.

Unit 3.

Mesures of central tendency. Measures of dispersion; skewness, kurtosis. Elementary Probability and basic laws. Discrete and Continuous Random variable, Mathematical Expectation, Mean and Variance of Binomial, Poisson and Normal distribution. Sample mean and sampling variance. Hypothesis testing using standard normal variate. Curve Fitting. Correlation and Regression.

Emphasis on examples from Biological Sciences.

SUGGESTED READINGS

1. H. S. Bear: *Understanding Calculus*, John Wiley and Sons (Second Edition); 2003.
2. E. Batschelet : *Introduction to Mathematics for Life Scientists*, Springer Verlag, International Student Edition, Narosa Publishing House, New Delhi (1971, 1975).
3. Edmondson and D. Druce : *Advanced Biology Statistics*, Oxford University Press; 1996.
4. W. Danial : *Biostatistics : A foundation for Analysis in Health Sciences*, John Wiley and Sons Inc; 2004.

Note: It is desirable that softwares should be used for demonstrating visual, graphical and application oriented approaches.

**PAPER -4/8 ENAT 101/201-TECHNICAL WRITING AND
COMMUNICATION IN ENGLISH**

Marks: 100

Unit 1

Communication: Language and communication, differences between speech and writing, distinct features of speech, distinct features of writing.

Unit 2

Writing Skills; Selection of topic, thesis statement, developing the thesis; introductory, developmental, transitional and concluding paragraphs, linguistic unity, coherence and cohesion, descriptive, narrative, expository and argumentative writing.

Unit 3

Technical Writing: Scientific and technical subjects; formal and informal writings; formal writings/reports, handbooks, manuals, letters, memorandum, notices, agenda, minutes; common errors to be avoided.

SUGGESTED READINGS

1. M. Frank. Writing as thinking: *A guided process approach*, Englewood Cliffs, Prentice Hall.
2. L. Hamp-Lyons and B. Heasley: *Study Writing; A course in written English*. For academic and professional purposes, Cambridge Univ. Press.
3. R. Quirk, S. Greenbaum, G. Leech and J. Svartik: *A comprehensive grammar of the English language*, Longman, London.
4. Daniel G. Riordan & Steven A. Panley: "*Technical Report Writing Today*" - Biztaantra.
5. Daniel G. Riordan, Steven E. Pauley, Biztantra: *Technical Report Writing Today*, 8th Edition (2004).
6. *Contemporary Business Communication*, Scot Ober, Biztantra, 5th Edition (2004).

PAPER -5

CHPT 202- Chemistry-2 (Thermodynamics, Equilibria & Functional Group Organic Chemistry-1)

THEORY

Marks: 100

Section A: Physical Chemistry-1

(30 Lectures)

Unit 1. Chemical Thermodynamics

What is thermodynamics? State of a system, state variables, intensive and extensive variables, concept of heat and work, thermodynamic equilibrium, thermodynamic properties, various types of systems and processes. First Law of thermodynamics.

Calculation of work (w), heat (q), changes in internal energy (ΔU) and enthalpy (ΔH) for expansion or compression of ideal gases under isothermal and adiabatic conditions for both reversible and irreversible processes. Calculation of w , q , ΔU and ΔH for processes involving changes in physical states.

Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.

Various statements of Second Law of thermodynamics, concept of entropy, Gibbs free energy and Helmholtz energy, Calculations of entropy change and free energy change for reversible and irreversible processes under isothermal and adiabatic conditions. Criteria of spontaneity. Gibbs – Helmholtz equation. Maxwell's relations.

Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

Unit 2. Chemical Equilibrium

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG^\ominus , Le Chatelier's principle. Relationships between K_p , K_C and K_x for reactions involving ideal gases.

Unit 3. Ionic Equilibria

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect, Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts –applications of solubility product principle.

Section B: Organic Chemistry-2

(30 Lectures)

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Unit 4. Aromatic hydrocarbons

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.

Reactions : (Case benzene) : Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation). (Upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (Upto 4 carbons on benzene).

Unit 5. Alkyl and Aryl Halides

Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution (SN₂, SN₁ and SN_i) reactions.

Preparation: from alkenes and alcohols.

Reactions: hydrolysis, nitrite & nitro formation, nitrile & iso-nitrile formation. Williamson's ether synthesis: Elimination vs substitution.

Aryl Halides *Preparation*: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions. *Reactions* (*Chlorobenzene*): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH₂/NH₃ (or NaNH₂/NH₃). Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

Unit 6. Alcohols, Phenols and Ethers (Upto 5 Carbons)

Alcohols: *Preparation:* Preparation of 1^o, 2^o and 3^o alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.

Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. KMnO₄, acid. dichromate, con. HNO₃). Oppeneauer oxidation

Diols: (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case) *Preparation:* Cumene hydroperoxide method, from diazonium salts.

Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer - Tiemann Reaction, Gattermann-Koch Reaction, Houben – Hoesch Condensation, Schotten – Baumann Reaction **Ethers (aliphatic and aromatic):** Cleavage of ethers with HI.

Unit 7. Aldehydes and ketones (aliphatic and aromatic): (Formaldehyde, acetaldehyde, acetone and benzaldehyde) *Preparation:* from acid chlorides and from nitriles. *Reactions –* Reaction with HCN, ROH, NaHSO₃, NH₂-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Ponndorf Verley reduction.

SUGGESTED READINGS

Section A:

- 1 Barrow, G. M. (2007). *Physical Chemistry* Tata McGraw Hill
2. Castellan, G. W. (2004). *Physical Chemistry* 4th Ed. Narosa publishing House.
3. Mahan, B. H. (1998). *University Chemistry* 3rd Ed. Narosa publishing House.

Section B:

1. I. L. Finar (1971) *Organic Chemistry* (Vol. I & II), E. L. B. S.
2. RT Morrison, RN Boyd, (1966), *Organic Chemistry*. II ed., Allyn and Bacon, Boston, MA, 560
3. Arun Bahl and B. S. Bahl (1987) *Advanced Organic Chemistry*, S. Chand and Co.
4. Peter Sykes (1986) *A Guide Book to Mechanism in Organic Chemistry*, Orient Longman.

PRACTICALS

Marks: 50

Section A: Physical Chemistry

Thermochemistry

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO_3 , NH_4Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of ΔH .

Section B: Organic Chemistry

1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2. Criteria of Purity: Determination of melting and boiling points.
3. Preparations: Mechanism of various reactions involved to be discussed.
Recrystallisation, determination of melting point and calculation of quantitative yields to be done.
 - (a) Bromination of Phenol/Aniline
 - (b) Benzoylation of amines/phenols
 - (c) Oxime and 2, 4- dinitrophenylhydrazone of aldehyde/ketone

Suggested Readings

1. Textbook of Practical Organic Chemistry, A.I. Vogel, Prentice Hall, 5th edition.
2. , Mann F. G. & Saunders B. C, (1960) Practical Organic Chemistry. Orient Longman,
3. B.D.Khosla, Senior Practical Physical Chemistry, S. Chand & Co

THEORY

Marks: 100

Unit 1. Techniques in Biology

Principles of microscopy; Light Microscopy; Phase contrast microscopy; Fluorescence microscopy; Electron microscopy (EM)-Scanning EM and Scanning Transmission EM (STEM);

Unit 2. Cell as a unit of Life

The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components

Unit 3. Cell Organelles

- **Mitochondria:** Structure, marker enzymes, composition; mitochondrial biogenesis; Semiautonomous nature; Symbiont hypothesis; Proteins synthesized within mitochondria; mitochondrial DNA
- **Chloroplast:** Structure, marker enzymes, composition; semiautonomous nature, chloroplast DNA
- **ER, Golgi Body & Lysosomes:** Structures and roles. Signal peptide hypothesis, N-linked glycosylation, Role of golgi in Olinked glycosylation. Cell secretion, Lysosome formation.
- **Peroxisomes and Glyoxisomes:** Structures, composition, functions in animals and plants and biogenesis
- **Nucleus:** Nuclear Envelope- structure of nuclear pore complex; chromatin; molecular organization, DNA packaging in eukaryotes, euchromatin and heterochromatin, nucleolus and ribosome structure.

Unit 4. Cell Membrane and Cell Wall The functions of membranes; Models of membrane structure; The fluidity of membranes; Membrane proteins and their functions; Carbohydrates in the membrane; Faces of the membranes; Selective permeability of the membranes; Cell wall.

Unit 5. Cell Cycle: Interphase, Mitosis and Meiosis Role of Cell division; Overview of Cell cycle; Molecular controls; Meiosis

SUGGESTED BOOKS

1. Campbell, N.A. and Reece, J. B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
2. Raven, P.H et al (2006) Biology 7th edition Tata McGrawHill Publications, New Delhi.
3. Sheeler, P and Bianchi, D.E. (2006) Cell and Molecular Biology, 3rd edition, John Wiley & Sons NY.

PRACTICALS

Marks: 50

1. To learn use of microscope and principles of fixation and staining.
2. Study of the photomicrographs of cell organelles; nuclear pore complex (photograph)
3. To study the structure of plant cell through temporary mounts.
4. To study the structure of animal cells by temporary mounts-squamous epithelial cell and nerve cell.
5. Preparation of temporary mounts of striated muscle fiber.
6. To prepare temporary stained preparation of mitochondria from striated muscle cells /cheek epithelial cells using vital stain Janus Green B.
7. To prepare temporary stained squash from root tips of *Allium cepa* and to study the various stages of mitosis.
8. Study the effect of temperature, organic solvent on semi permeable membrane.
9. Demonstration of dialysis of starch and simple sugar.
10. Study of plasmolysis and deplasmolysis on *Rhoeo* leaf.
11. Measure the cell size (either length or breadth/diameter) by micrometry.

SUGGESTED BOOKS

1. S.S. Lal, Practical Zoology, Volume 3. Rastogi-Publications
2. Campbell, N.A. and Reece, J. B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
3. Gerald Karp, Cell Biology, John Wiley & Sons Inc. Feb. 2007
4. De Roberties, The Cell and Molecular Biology, Lippincott Williams & Wilkins
5. Moore TC (1981) Research Experiences in Plant Physiology. Springer-Verlag,
6. Karp, B. (2002). Cell and Molecular Biology. 3rd Edition. John Wiley and Sons, Inc., New York.

PAPER-7 SOILS AND FERTILIZERS

THEORY

Marks: 100

Soils and fertilizers

Soils: Formation, nature, origin, composition, classification. Characteristics, acidity, salinity, and alkalinity of soils. Chemistry of weathering of materials soils and clay minerals.

Macro and Micro-nutrients of Soils

Types of fertilizers: Various nitrogen fertilizers and their soil reaction. Fate of NO_3 and NH_4 ions in soils, denitrification, nitrogen fixation by legumes.

Phosphate fertilizers: Phosphate in soil, pH, microbes and available phosphorus and its control. Potassium availability in soil, nutrient availability in soil, soil fertility evaluation, law of minimum and law of diminishing return, diagnostic techniques.

Soil fertility and nutrients, recycling of nutrients, chelation and soil management

Biofertilizer.

SUGGESTED READINGS:

1. Chopra, S.L., and Kanwar, J.S., (1976), Analytical Agricultural Chemistry, Kalyani Publishers, Ludhiana, New Delhi.
2. Jackson, M.L. 1969. Soil chemical analysis - advanced course (2nd edition).
3. Handbook of agriculture by I. C. A. R. Publication.
4. Jain. (1988). Textbook of agricultural biochemistry.
5. Yawalker, K.S., Agrawal, J.P. and Bokde, S. (1992). Manures and Fertilizers, Agricultural Publishing House, Nagpur (Maharashtra).

PRACTICALS

Marks: 50

1. Preparation and preservation of soil sample in laboratory.
2. To measure the pH of some given soil samples.
3. To determine organic carbon from soil sample.
4. To estimate the carbonate content in the given soil samples.
5. Determination of water holding capacity of soil.
6. Estimation of nitrogen in an organic compound (pesticides) by Kjeldahl method.
7. To measure the conductance of some given soil samples.
8. To perform the qualitative test for nitrogen fertilizers (NH_4^+ , NO_3^- , Urea), phosphorus fertilizers (PO_4^{3-}) and potash fertilizers (K^+)

SUGGESTED READINGS:

1. Dr. Sarvesh Kumar Dubey and Dr. Asha Arora.(2011) A Practical Book on Soil, Plant, Water and Fertilizer Analysis .
2. Ravi. (1999) Soil analysis
3. Dr. HLS Tandon (2008) Fertilizers and Their Composition, Characteristics, Quality, Transformations and Applications.
4. Langdon R. Elsworth and Walter O. Paley. (2008) Fertilizers: Properties, Applications and Effects , Nova Science Pub.

THEORY

Marks: 100

Computer Fundamentals (12 Periods)

Introduction to Computers: Characteristics of Computers, Uses of computers, Types and generations of Computers

Basic Computer Organization - Units of a computer, CPU, ALU, memory hierarchy, registers, I/O devices

User Interface with the Operating System, System Tools

Data Representation (8 Periods)

Binary representation of integers and real numbers, 1's Complement, 2's Complement, Addition and subtraction of binary numbers, BCD, ASCII, Unicode;

Networks terminology (4 Periods)

Types of networks, router, switch, server-client architecture

Multimedia (4 Periods)

Introduction, Characteristics, Elements, Applications

Problem Solving (10 Periods)

Notion of algorithms, stepwise methodology of developing an algorithm, developing macros in spreadsheet

General Awareness (4 Periods)

IT Act, System Security (virus/firewall) I-Tax, Reservations, Banking

SUGGESTED BOOKS

1. V Rajaraman, **Fundamentals of Computers**, Fourth Edition, PHI.

Note: Use of Open Office/Star Office is recommended, as they are freely downloadable. Reference manual for Open Office available at:

<http://www.openoffice.org>

Star Office available at: <http://www.sun.com/software/staroffice/>

PRACTICALS

Marks: 50

1. Defined projects will be done by the students and evaluated by the instructor.
2. Document Preparation
3. Presentation Software
4. Familiarizing with the Operating System, Control Panel, Networking Configuration
5. Firewall setting
6. Spreadsheet Handling, Working with worksheets, Creating a spreadsheet, entering and formatting information, basic functions and formulas, creating charts, tables and graphs.

PAPER -9

CHPT 303-Chemistry-3(Solutions, Conductance, Electrochemistry and Functional Group Chemistry-2)

THEORY

Marks: 100

Section A: Physical Chemistry

30 Lectures

Unit 1. Solutions

Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapor pressure-composition and temperature-composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes.

Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids. Principle of steam distillation. Nernst distribution law and its applications, solvent extraction.

Unit 2. Phase Equilibrium

Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius – Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver, $\text{FeCl}_3\text{-H}_2\text{O}$ and Na-K only).

Unit 3. Conductance

Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions.

Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only acid-base).

Unit 4. Electrochemistry

Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: ΔG , ΔH and ΔS from EMF data. Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction

potential and salt bridge.

pH determination using hydrogen electrode and quinhydrone electrode. Potentiometric titrations - qualitative treatment (acid-base and oxidation-reduction only).

Section B: Organic Chemistry-3

30 Lectures

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Unit 5. Carboxylic acids and their derivatives

Carboxylic acids (aliphatic and aromatic) *Preparation:* Acidic and Alkaline hydrolysis of Esters.

Reactions: Hell – Vohlard - Zelinsky Reaction.

Carboxylic acid derivatives (aliphatic): (Upto 5 carbons) *Preparation:* Acid chlorides, Anhydrides, Esters and Amides from acids and their inter-conversion.

Reactions: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation.

Unit 6. Active methylene compounds:

Preparation : Claisen ester condensation. Keto-enol tautomerism

Reactions: Synthetic uses of ethylacetoacetate (preparation of non-hetero molecules having upto 6 carbon).

Unit 7. Amines and Diazonium Salts

Amines (Aliphatic and Aromatic): (Upto 5 carbons)

Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction.

Reactions: Hofmann Vs Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO₂, Schotten

– Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination,

sulphonation. **Diazonium salts:** *Preparation:* from aromatic amines. *Reactions:* conversion to benzene, phenol, dyes.

Unit 8. Carbohydrates: Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disacharrides (sucrose, cellobiose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation.

SUGGESTED READINGS

1. Barrow, G. M. *Physical Chemistry* Tata McGraw-Hill (2007).
2. Castellan, G. W. *Physical Chemistry* 4th Ed. Narosa (2004).
3. Kotz, J. C., Treichel, P. M. & Townsend, J. R. *General Chemistry* Cengage Learning India Pvt. Lt d.: New Delhi (2009).
4. Mahan, B. H. *University Chemistry* 3rd Ed. Narosa (1998).
5. Petrucci, R. H. (1985) *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
6. T. W. Graham Solomon's :*Organic Chemistry*, John Wiley and Sons.
7. R. T. Morrison & R. N. Boyd :*Organic Chemistry*, Prentice Hall.
8. I. I. Finar :*Organic Chemistry (Vol. I & II)*E. L. B. S.
9. Jerry March :*Advanced organic Chemistry*, John Wiley & Sons
10. Peter Sykes :*A Guide Book to Mechanism in Organic Chemistry*, Orient Longman.
11. Arun Bahl and B. S. Bahl : *Advanced Organic Chemistry*, S. Chand

PRACTICALS

Marks: 50

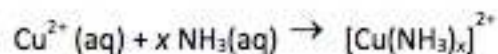
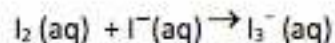
Section A: Physical Chemistry

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

- (i) Sodium acetate-acetic acid
(ii) Ammonium chloride-ammonium hydroxide
2. Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Distribution

3. Study of the equilibrium of one of the following reactions by the distribution method:



Section B: Organic Chemistry

Preparations: Mechanism of various reactions involved to be discussed.

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

- (a) Nitration of Nitrobenzene
- (b) Preparation of carboxylic acid by alkaline hydrolysis of ester/amide.
- (c) Oxidation of alcohol/aldehydes/hydrocarbons to carboxylic acid
- (d) Osazone from glucose/fructose
- (e) Amides and anilides from carboxylic acid.
- (f) Preparation of methyl orange.

PAPER- 10 BIOLOGY OF LIFE FORMS

THEORY

Marks: 100

(60 Lectures)

Unit 1 Classifying the diversity of life: Kingdoms of Life –Eubacteria, Archaea and Eukaryotes.

Unit 2. Viruses :Discovery; Physiochemical and biological characteristics; Classification Replication, Lytic and Lysogenic cycle; Structure of DNA virus (bacteriophage T4), RNA virus (TMV), economic importance.

Unit 3. Bacteria: Discovery of bacteria; Ecology and distribution; General structure; Comparison of Archaea and Eubacteria; Wall-less forms (L-forms, Mycoplasma, Protoplasts and Sphaeroplasts) Nutrition; Reproduction–vegetative, asexual and recombination; Economic importance.

Unit 4 Algae: Diagnostic features of identification; morphology, reproduction and classification with special reference to *Nostoc*, *Volvox*, and *Spirogyra*. Economic importance (a general account).

Unit 5 Fungi: Diagnostic features of identification; morphology, reproduction and classification with special reference to *Rhizopus*, *Penicillium*, *Agaricus* and *Alternaria*; Lichens (a general account), and economic importance of lichens and fungi.

Unit 6 Archegoniate: Characteristic features of identification, classification and reproduction of Bryophytes and Pteridophytes with special reference to *Marchantia*, *Funaria*, and *Pteris*; economic importance of bryophytes and pteridophytes.

Unit 7 Gymnosperms: Characteristic features, classification, study of vegetative structures and reproduction of gymnosperms, economic importance of gymnosperms. *Pinus*: detailed account.

Unit 8 Angiosperms: Anatomy of root, stem, leaf.

Suggested Readings:

1. Alexopoulos, C.J., C.W. Mims and Blackwell, (1996) *Introductory Mycology*. 4th ed., John Wiley and Sons Inc.
2. Bhatnagar, S. P. & Moitra, A, (1996) *Gymnosperms*. New Age Int. Publ. House, New Delhi.
3. Rashid, A. (1999) *An introduction to Pteridophytes*, 2nd ed. Vikas Publ. House Pvt. Ltd., New Delhi.

4. Raven, P.H., Evert, K.F., and Eichhorn, S.E. (1999) *Biology of Plants* (5th edition). W.H. Freeman and Co. Worth Publishers, New York.
5. Black J.G. (2005) *Microbiology: Principles and Exploration* 6th edition, John Wiley & Sons.
6. Kumar, H.D. 1999. *Introductory Phycology*. Aff. East-west Press Pvt Ltd., Delhi.
7. Pelczar, M.J. (2001) *Microbiology*, 5th edition, Tata Mc Graw-Hill Co, New Delhi.
8. Kochhar, S.L. 2009 *Economic Botany in Tropics*. Macmillan and Co. New Delhi

PRACTICALS

MARKS: 50

1. **Viruses:** EM of TMV and Bacteriophage, study specimens of virus infected plants (any two)
2. **Bacteria:** Types through permanent slides/photographs, specimens of infected plants (any two).
3. **Algae:** Study of permanent slides and classification of (a) *Nostoc* (b) *Volvox*, (c) *Spirogyra*.
4. **Fungi:** Mount material to study, and classification, thallus and reproductive structures in (a) *Rhizopus*, (b) *Penicillium* and (c) *Alternaria*. Study from the permanent slides or specimen along with classification: (d) *Agaricus*. Lichens morphology along with classification.
5. **Bryophytes:** Study of (a) *Marchantia* from specimen and permanent slides only, (b) *Funaria*: detailed study and classification from W.M. rhizoids, leaf, operculum, peristome, spores and permanent slides of archegonia, antheridia and capsule.
6. **Pteridophytes:** Study of (through temporary/permanent slides) and classification of (a) *Pteris*: detailed study of T. S. of rachis, V.S. of sporophyll and W.M. of sporangium.
7. **Gymnosperms:** Study of *Pinus* from specimens and permanent slides only.
8. **Angiosperms:** Study of the following tissues from permanent slides or by maceration; Parenchyma, Collenchyma, Sclerenchyma, Xylem and Phloem. Study of anatomy of root, stem and leaf through permanent slides.
9. A brief account of some important crops –
Wheat, Rice, Pulses, Cotton, Jute, Mustard, Spices, Tea and Rubber.

SUGGESTED BOOKS

1. Bendre & Kumar, (2004)“*A Textbook Of Practical Botany* Vol I Rastogi publications Meerut.
2. Black J.G. (2005) *Microbiology: Principles and Exploration* 6th edition, John Wiley & Sons.
3. Evert, Ray Franklin. (2006), *Esau’s Plant Anatomy: Meristems, Cells, And Tissues of the Plant Body: Their Structure, Function, and Development*, John Wiley & Sons, Inc., Hoboken, New Jersey.

PAPER – 11 BIOLOGY OF ANIMALS: FORM STRUCTURE AND FUNCTION

Theory

Marks – 100

(60 Lectures)

Unit I. General characteristics and outline classification of different animal groups (upto classes for non-chordates and upto orders for chordates)

Unit II. Acoelomates

Locomotion and reproduction in Protista; Canal system in Porifera; Metagenesis and polymorphism in Cnidarians; Parasitic adaptations in Platyhelminthes.

Unit III. Schizocoelomates

Metamerism in Annelida; Vision in Arthropods; Shell and Pearl formation in molluscs.

Unit IV. Enterocoelomates

Water Vascular system in Echinodermata; Osmoregulation in Fishes; Respiration in Amphibians; Terrestrial Adaptation in Reptiles; **Flight** adaptations in Birds; Integument in Mammals.

Unit V. Tissues and Glands

Different types of tissues in man-Epithelial, Connective, Muscular and Nervous; Types of Glands.

Unit VI. Tissue Physiology

Molecular mechanism of Muscular Contraction.

Unit VII. Digestion & absorption of food

Mechanical and Chemical digestion of food.

Unit VIII. Respiration & Renal physiology

Transport of oxygen & carbon dioxide in blood. Functional anatomy of kidney, counter-current mechanism and urea cycle.

Unit IX. Human Circulatory System

Circulatory body fluids; Conduction of Heart beat.

Unit X. Endocrine system and reproduction

Types of endocrine glands and their hormones; Physiology of male and female reproduction.

SUGGESTED BOOKS

1. Barnes, R.D. (1992). Invertebrate Zoology. Saunders College Pub. USA.
4. Ruppert, Fox and Barnes (2006) Invertebrate Zoology. A functional Evolutionary Approach 7th Edition, Thomson Books/Cole
5. Campbell & Reece (2005). Biology, Pearson Education, (Singapore) Pvt. Ltd.

6. Kardong, K. V. (2002). Vertebrates Comparative Anatomy. Function and Evolution. Tata McGraw Hill Publishing Company. New Delhi.
7. Raven, P. H. and Johnson, G. B. (2004). Biology, 6th edition, Tata McGraw Hill Publications. New Delhi.
8. Widmaier E.P., Raff, H., Strang, K.T. (2004) 9th edn. Vander's Human Physiology, McGraw-hill
9. Tortora, G.J. and Grabowski, S. (2001) Principles of anatomy and physiology. Harper and Collins.

PRACTICALS

Marks:- 50

Non-Chordata

1. Study of following specimens:
Euglena, Noctiluca, Paramecium, Sycon, Physalia, Tubipora, Metridium, Taenia, Ascaris, Nereis, Aphrodite, Leech, Peripatus, Limulus, Hermitcrab, Daphnia, Millipede, Centipede, Beetle, Chiton, Dentalium, Octopus, Asterias, and Antedon
2. Study of Permanent Slides:
Cross section of Sycon; T. S. of arm of Starfish.
3. Dissections
Digestive and nervous system of Cockroach.
4. Temporary mounts
Septal & pharyngeal nephridia and ovary of earthworm.

Chordata

5. Study of following specimens
Balanoglossus, Amphioxus, Petromyzon, Pristis, Hippocampus, Labeo, Ichthyophis/ Uraeotyphlus, Salamander, Rhacophorus Draco, Uromastix, Naja, Viper, model of Archaeopteryx, any three common birds-(Crow, duck, Owl), Squirrel and Bat.
6. Dissections
Afferent Branchial System of *Scoliodon*
7. Temporary mounts
Unstained mounts of Placoid scales; Nerve cell.
8. Preparation of haemin and hemochromogen crystals.
9. Estimation of Haemoglobin using Haemoglobinometer.

10. Histological slides- Examination of sections of mammalian skin, oesophagus, ileum, rectum, liver, pancreas, spleen, trachea, lung, kidney, pituitary, adrenal, thyroid, ovary, testis

SUGGESTED BOOKS

9. P.S. Verma, A Manual of Practical Zoology: Invertebrates. S. Chand & Company.
10. P.S. Verma, A Manual of Practical Zoology: Vertebrates. S. Chand & Company.
11. S.S. Lal, Practical Zoology, Volume 1, 2 & 3. Rastogi-Publications

PAPER 12-HERBICIDES

Theory

Marks: 100

60 lectures

Herbicides: Classification, selectivity and uptake of herbicides, discovery, synthesis, structure-activity relationship (SAR), mode of action and uses of the following classes with special reference to the individual compounds mentioned:

(a) **Aryl Alkanoic Acids:** 2, 4 D, MCPA, dicamba, dichlorobenzil, and dalapon.

(b) **Aromatic carbamates:** barban and asulam.

(c) **Triazines:** Simazine.

(d) **Bipyridiniums, paraquat and glyphosate**

(e) **Sulfonylurea:** Chlorosulfuron

(f) **Uracils:** Bromacil

(g) **Ureas:** Monuron and Isoproturon

Suggested Readings

1. A. S. Crafts. *Chemistry and mode of action of herbicides*, John Wiley.

PRACTICALS

Marks : 50

1. To carry out market survey of potent herbicides with details as follows:

- a) Name of Herbicide
- b) Chemical name and structure of herbicide
- c) Chemical class of herbicides
- d) Type of formulation available
- e) Manufacturer's name
- f) Useful information on label of packaging regarding
 - i. Toxicity
 - ii. LD 50 ("Lethal Dose, 50%")
 - iii. Side effects
 - iv. Antidotes

2. Methods and modes of application of herbicides.

3. Preparation of 2,4D (2,4-Dichlorophenoxyacetic acid) and MCPA (2-methyl-4-chlorophenoxyacetic acid).

4. Analysis of 2,4D (2,4-Dichlorophenoxyacetic acid) and MCPA (2-methyl-4-chlorophenoxyacetic acid).

SUGGESTED READINGS:

1. Agrochemicals preparation and mode of action by R. J. W. Cremllyn.
2. Herbicides and Environment by Andreas Kortekamp.
3. Herbicides, Theory and Applications by Sonia Soloneski and Marcelo L. Larramendy.
4. Solving Weed Problems: How to Identify and Eradicate Weeds Effectively from Your Lawn and Garden by Peter Loewer, H. Peter Loewer.

Paper 13

CHPT 404: Chemistry-4 (Chemistry of s & p block elements, States of Matter and Phase equilibrium)

THEORY**Marks: 100**

Section A: Inorganic Chemistry-2

(30 Lectures)

Unit 1. General Principles of Metallurgy

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon as reducing agent. Hydrometallurgy. Methods of purification of metals (Al, Pb, Ti, Fe, Cu, Ni, Zn): electrolytic, oxidative refining, Kroll process, Parting process, van Arkel-de Boer process and Mond's process.

Unit 2. s- and p- Block

Elements

Periodicity in s- and p- block elements, w.r.t. electronic configuration, atomic and ionic size, ionization enthalpy, electronegativity (Pauling, Mullikan, and Alred-Rochow scales). Allotropy in C, S, and P.

Oxidation states with reference to elements in unusual and rare oxidation states like carbides and nitrides), inert pair effect, diagonal relationship and anomalous behaviour of first member of each group.

Unit 3. Compounds of s- and p- Block Elements

Hydrides and their classification (ionic, covalent and interstitial), structure and properties with respect to stability of hydrides of p- block elements. Concept of multicentre bonding (diborane). Structure, bonding and their important properties like oxidation/reduction, acidic/basic nature of the following compounds and their applications in industrial, organic and environmental chemistry.

Hydrides of nitrogen (NH_3 , N_2H_4 , N_3H , NH_2OH)

Oxoacids of P, S and Cl

Halides and oxohalides: PCl_3 , PCl_5 , SOCl_2 and SO_2Cl_2

Section B: Physical Chemistry-3

(30 Lectures)

Unit 1. Kinetic Theory of Gases

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Deviation of real gases from ideal behaviour, compressibility factor. Causes of deviation. van der Waals equation of state for real gases. Boyle temperature derivation not required). Critical phenomena, critical

constants and their calculation from van der Waals equation. Andrews isotherms of CO₂. Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance. Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).

Unit 2. Liquids

Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only)

Unit 3. Solids

Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X-Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals. Glasses and liquid crystals.

Unit 4. Chemical Kinetics

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half-life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation.

Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).

SUGGESTED READINGS

1. Barrow, G. M. *Physical Chemistry* Tata McGraw-Hill (2007).
2. Castellan, G. W. *Physical Chemistry* 4th Ed. Narosa (2004).
3. Kotz, J. C., Treichel, P. M. & Townsend, J. R. *General Chemistry* Cengage Learning India Pvt. Ltd.: New Delhi (2009).

4. Mahan, B. H. *University Chemistry* 3rd Ed. Narosa (1998).
5. Petrucci, R. H. (1985) *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York
6. J. D. Lee :*A New Concise Inorganic Chemistry*, E.L.B.S.
7. F.A. Cotton & G. Wilkinson :*Basic Inorganic Chemistry*, John Wiley.
8. D. F. Shriver and P. W. Atkins : *Inorganic Chemistry*, Oxford University Press.
9. Gary Wulfsberg : *Inorganic Chemistry*, Viva Books Pvt. Ltd.

PRACTICALS

Marks: 50

Section A: Inorganic Chemistry

Semi-micro qualitative analysis using H₂S of mixtures not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following:

Cations : NH₄⁺, Pb²⁺, Ag⁺, Bi³⁺, Cu²⁺, Cd²⁺, Sn²⁺, Fe³⁺, Al³⁺, Co²⁺, Cr³⁺, Ni²⁺, Mn²⁺, Zn²⁺, Ba²⁺, Sr²⁺, Ca²⁺, K⁺,

Anions : CO₃²⁻, S²⁻, SO₃²⁻, S₂O₃²⁻, NO₃⁻, CH₃COO⁻, Cl⁻, Br⁻, I⁻, NO₃⁻, SO₄²⁻, PO₄³⁻, BO₃³⁻, C₂O₄²⁻, F⁻

(Spot tests should be carried out wherever feasible.)

Section B: Physical Chemistry

(I) Surface tension measurement (use of organic solvents excluded)

- a) Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.
- b) Study of the variation of surface tension of a detergent solution with

concentration.

(II) Viscosity measurement (use of organic solvents excluded)

- a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.
- b) Study of the variation of viscosity of an aqueous solution with concentration of solute.

(III) Phase equilibria

- a) Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.
- b) Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it.
- c) Study of the variation of mutual solubility temperature with concentration for the phenol water system and determination of the critical solubility temperature.

Suggested Readings

1. Vogel's Qualitative Inorganic Analysis, A.I. Vogel, Prentice Hall, 7th Edition.
2. Vogel's Quantitative Chemical Analysis, A.I. Vogel, Prentice Hall, 6th Edition.
3. Senior Practical Physical Chemistry, B.D.Khosla, R. Chand & Co.

PAPER- 14

AGRICULTURAL BOTANY AND PLANT PATHOLOGY

THEORY

Marks: 100

Unit A: Agricultural Botany

Seed physiology: Seed dormancy, types, factors causing dormancy, mechanism and methods for breaking seed dormancy, seed viability, seed vigor, hormonal regulation of seed dormancy and germination.

Role of physical factors in growth of plants: response to light photomorphogenesis, role of phytochrome and cryptochrome, photoperiodism, response to temperature vernalization.

Physiology of growth and yield: Principal of growth analysis, source-sink relationship, factors affecting growth, dry matter partitioning and yield, crop simulations and modeling,.

Chemical regulation of growth and development: Role of hormones in plant growth and development, commercial applications of growth regulators, growth retardant and its usefulness.

Unit B: Plant pathology

Introduction to plant pathology: Importance, concepts and types of plant disease symptoms, causes and classification of diseases, Host-plant interaction.

Fungal diseases: causal organism, symptomatology, disease cycle, prevention and control of the fungal diseases: e.g.

- White rust of crucifers
- Late blight of potato
- Downy mildews
- Rust of wheat
- Loose smut of wheat

Bacterial diseases: causal organism, symptomatology, disease cycle, prevention and control of bacterial diseases e.g.

- Citrus canker
- Angular leaf spot of cotton

Viral Diseases: causal organism, symptomatology, disease cycle, prevention and control of the following viral diseases

- Tobacco mosaic
- Yellow vein mosaic of Bhindi
- Control – Transmission and control of plant diseases

Unit C Allelopathy: A general account.

Suggested Readings:

1. Taiz, L. & Zeiger, E. 2006 Plant Physiology. (4th edition) Sinauer Associates, Inc. Sunderland,
2. M.A.W.G. Hopkins, Introduction to plant physiology, John Wiley and Sons Inc USA.
3. Mandal, R.C., Weeds, weedicides and weed control: Principle and Practice Agro Botanical Publishers, Delhi
4. Subramanian, S. All about weed control, Kalayani publishers.
5. Ashton and Monaco, T.J. Weed science: Principles and Practices
6. George N Agrios (1997) 5th edition Plant Pathology, Academic press USA
7. Singh R S, (2000) Plant Diseases Oxford and IBH.
8. S. J. H. Rizvi, V. Rizvi, 1992 Allelopathy: Basic and Applied Aspects Chapman and Hall.
9. Sharma P.D. (2006) plant pathology Narosa Publishing house, New Delhi.
10. Sambamurty, A.V.V.S (2006) A text book of plant pathology I.K. International Pvt Ltd. New Delhi.

PRACTICALS

Marks: 50

1. To study the effect of ethylene on shelf life of cut flowers.
2. To study the effect of cytokinin on leaf senescence.
3. To study effect of heavy metals on growth and development.
4. To test the viability of seeds/ Pollen grains.
5. To study some common fungal diseases of crop plants as mentioned in theory.

SUGGESTED BOOKS

1. Bendre A. and Ashok Kumar, (2004) "A textbook of practical botany Vol. I and Vol.II Rastogi publications.
2. George N Agrios (1997) 5th edition Plant Pathology Academic press USA.
3. Moore TC (1981) Research Experiences in Plant Physiology. Springer-Verlag,
4. Sharma P.D.(2006) plant pathology Narosa Publishing house, New Delhi.

5. Sambamurthy, A.V.V.S (2006) A text book of plant pathology I.K. International Pvt Ltd.
New Delhi.

PAPER- 15

IMMUNOLOGY, MOLECULAR BIOLOGY AND DEVELOPMENT BIOLOGY

Marks:100

Theory

(60 Lectures)

Unit I Immunology

Overview of immune system- innate, acquired immunity.

Generation of immune response- Antigens, immunogens and haptens, factors influencing immunogenicity, recognition of antigens, properties of B-cell and T-cell epitopes, antigen-antibody interactions, Vaccines, AIDS.

Unit II Biomolecules

Carbohydrates: Structure and functional significance of mono-di-and polysaccharides; Lipids: structure and functional significance of fatty acids, triglycerides, phospholipids, glycolipids and steroids, Amino acids and Protein: structural properties and functions. Nucleic acids-DNA and RNA types and structure.

Unit III Metabolism

Carbohydrate metabolism: glycolysis, citric acid cycle, pentose phosphate pathway, gluconeogenesis; Lipids metabolism: beta oxidation of fatty acids, Protein metabolism: Overview of Protein degradation, catabolism of amino acids, transamination, oxidative deamination.

Unit IV Enzymes

Classification, kinetics, mechanism of action, and inhibition.

Unit V Molecular Biology

Genetic code; central dogma, nature of genetic code, DNA replication; mechanism of DNA replication, mechanism of transcription and translation in protein synthesis.

Unit VI Developmental Biology (Animals)

Gametogenesis and fertilization: types of eggs, Embryonic Development: Cleavage, blastulation and gastrulation in Amphibia, Chick and Mammal. Fate of germ layers, Placenta–types and function.

SUGGESTED BOOKS

1. Davenport. An Outline of Animal Development, Addison-Wesley.
2. Stryer, L. (1995). Biochemistry. 4th ed. W.H. Freeman.
3. Richard, A.G. Kndit, T.J., Osborne, B.A. and Rodwell, V.W. (2003)
4. Roitt, I.M. (2001). Essential Immunology. Blackwell Scientific Publications.
5. Russel, P.J. (1998). Genetics. The Benjamin/Cumings Puplishing Co.Inc., USA.
6. Gilbert, S.F. (1991). Developmental Biology. Sinauer Associates Inc.Publishers.
7. Hames, B.D. Hopper, N.M. and Hougton, J.D. (1898). Instant notes in Biochemistry. Viva Books Pvt. Ltd.
8. Karp, B. (2002). Cell and Molecular Biology. 3rd Edition. John Wiley and Sons, Inc., New York.
9. Lehninger, A.L. Nelson, D.K. and Cox, M.M. (1993). Principles of Biochemistry, CBS Publishers and Distributors.
10. Bruce, A. et al. (2002). Molecular Biology of the Cell. Garland Publishing Company, New York and London.

Practicals

Marks: 50

Unit I Molecular Biology

1. Temporary preparation of Barr bodies.
2. Study of inherited characters in human: colour blindness and PTC test.
3. Demonstration of dialysis (glucose and starch). Study of plasmolysis and deplasmolysis using red onion peel/Rhoeo.
4. Study of effect of temperature, pH on heavy metals on the action of Urease, Catalase.
5. Separation and identification of amino acids by paper chromatography.
6. Preparation of temporary slides to study different stages of mitosis and meiosis (*Allium* roots and buds) and meiosis in grasshopper testis.

Unit II Developmental Biology (Animals)

1. Study of developmental stsges in frogs-whole mounts and sections (permanent slides), cleavage stages, blastula, gastrula, neural, tail bud tadpole.

2. Study of whole mounts and sections of chick embryo at different stages, primitive streak (24, 28, 33, 48, 72 and 96 hours).

Unit III Immunology

1. Isolation, staining and counting of mononuclear cells from peripheral blood.
2. Demonstration of Primary (Bone marrow & Thymus) and secondary immune organs (spleen, Lymph nodes) in rat.
3. Determination of ABO blood groups and Rh-factor

SUGGESTED BOOKS

1. S. S.Lal, Practical Zoology, Volume 3, Rastogi-Publications
2. De Roberties, (2009) The Cell and Molecular Biology, Lippincott Williams & Wilkins
3. Roitt, I.M. (2001). Essential Immunology. Blackwell Scientific Publications.
4. P.S. Verma, A Manual of Practical Zoology: Invertebrates, Rastogi Publications

PAPER 16-FUNGICIDES

Theory

Marks:100

(60 lectures)

Types of fungicides, Mode of action; Chemistry of the following compounds:

Copper and mercury derivatives

Dithiocarbamates: Thiram, Ziram, Nabam,

Dinitro phenols: 2, 4-Dinitro o-Cresol (DNOC) Karathane

Quinines: Dichlone

Benzimidazoles: Benomyl.

Organo phosphorus fungicides: Kitazine

Phenyl amides: Metalaxyl

Triazoles: Propiconazole

Thiophanates: Thiophanates.

Role of Fumigants and fumigation techniques.

Nematicides, Molluscicides and Rodenticides.

Suggested Readings

1. Agrochemicals preparation and mode of action by R. J. W. Cremlyn 1991.
2. Pesticides: Preparation and Mode of Action by R. J. W. (Richard James William) Cremlyn (Oct 10, 1979)

PRACTICALS

MARKS: 50

1. To carryout market survey of potent fungicides with details as follows:
 - a) Name of fungicides
 - b) Chemical name and structure of fungicides
 - c) Chemical class of fungicides
 - d) Type of formulation available
 - e) Manufacturer's name
 - f) Useful information on label of packaging regarding
 - i. Toxicity
 - ii. LD 50,
 - iii. Side effects
 - iv. Antidotes
2. Methods and modes of application of fungicides.

3. Preparation and use of Thiram, Ziram, Nabam etc.
4. Efficacy of some fungicides on plant growth.
5. To determine the active ingredient contents of some fungicide formulations.
6. To demonstrate the fumigation technique.

SUGGESTED READINGS:

1. Agrochemicals preparation and mode of action by R. J. W. Cremlyn
2. Fungicides by Odile Carisse.
3. Fungi and fungicides; a practical manual, concerning the fungous diseases of cultivated plants and the means of preventing their ravages by Clarence Moore.

PAPER -17

CHPT 505- Chemistry-5 (Chemistry of d-block elements, Quantum Chemistry and Spectroscopy)

THEORY

Marks: 100

Section A: Inorganic Chemistry-3

(30 Lectures)

Unit 1. Transition Elements (3d series)

General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu.

Lanthanides and actinides: Electronic configurations, Oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only).

Unit 2. Coordination Chemistry

Valency Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6. Drawbacks of VBT. IUPAC system of Nomenclature.

Unit 3. Crystal Field Theory

Crystal field effect, Octahedra symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of Δ . Spectrochemical series. Comparison of CFSE for O_h and T_d complexes, Tetragonal distortion of octahedral geometry. Jahn-Teller distortion. Square planar coordination.

Unit 4. Quantum Chemistry & Spectroscopy

Spectroscopy and its importance in chemistry. Wave-particle duality. Link between spectroscopy and quantum chemistry. Electromagnetic radiation and its interaction with matter. Types of spectroscopy. Difference between atomic and molecular spectra. Born-Oppenheimer approximation: Separation of molecular energies into translational, rotational, vibrational and electronic components.

Postulates of quantum mechanics, quantum mechanical operators.

Free particle. Particle in a 1-D box (complete solution), quantization, normalization of wavefunctions, concept of zero-point energy.

Rotational Motion: Schrödinger equation of a rigid rotator and brief discussion of its results (solution not required). Quantization of rotational energy levels. Microwave (pure rotational) spectra of diatomic molecules. Selection rules. Structural information derived from rotational

spectroscopy. *Vibrational Motion*: Schrödinger equation of a linear harmonic oscillator and brief discussion of its results (solution not required). Quantization of vibrational energy levels. Selection rules, IR spectra of diatomic molecules. Structural information derived from vibrational spectra. Vibrations of polyatomic molecules. Group frequencies. Effect of hydrogen bonding (inter- and intramolecular) and substitution on vibrational frequencies. *Electronic Spectroscopy*: Electronic excited states. Free Electron model and its application to electronic spectra of polyenes. Colour and constitution, chromophores, auxochromes, bathochromic and hypsochromic shifts.

Unit 5. Photochemistry

Laws of photochemistry. Lambert-Beer's law. Fluorescence and phosphorescence. Quantum efficiency and reasons for high and low quantum yields. Primary and secondary processes in photochemical reactions. Photochemical and thermal reactions. Photoelectric cells.

SUGGESTED READINGS

1. Barrow, G. M. *Physical Chemistry* Tata McGraw-Hill (2007).
2. Castellan, G. W. *Physical Chemistry* 4th Ed. Narosa (2004).
3. Kotz, J. C., Treichel, P. M. & Townsend, J. R. *General Chemistry* Cengage Learning India Pvt. Ltd.: New Delhi (2009).
4. Mahan, B. H. *University Chemistry* 3rd Ed. Narosa (1998).
5. Petrucci, R. H. (1985) *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York
7. J. D. Lee :*A New Concise Inorganic Chemistry*, E.L.B.S.
8. F.A. Cotton & G. Wilkinson :*Basic Inorganic Chemistry*, John Wiley.
9. D. F. Shriver and P. W. Atkins : *Inorganic Chemistry*, Oxford University Press.
10. Gary Wulfsberg :*Inorganic Chemistry*, Viva Books Pvt. Ltd.

PRACTICALS

Marks: 50

Section A: Inorganic Chemistry

1. Estimation of the amount of nickel present in a given solution as Bis (dimethylglyoximato) nickel(II) or aluminium as oxinate in a given solution gravimetrically.
2. Estimation of (i) Mg^{2+} or (ii) Zn^{2+} by complexometric titrations using EDTA.
3. Estimation of total hardness of a given sample of water by complexometric titration.
4. To draw calibration curve (absorbance at λ_{max} vs. concentration) for various concentrations of a given coloured compound and estimate the concentration of the same in a given solution.
5. Determination of the composition of the Fe^{3+} - salicylic acid complex / Fe^{2+} - phenanthroline complex in solution by Job's method.
6. Determination of concentration of Na^{+} and K^{+} using Flame Photometry.

Section B: Physical Chemistry

(I) Potentiometric measurements

- (a) Strong acid with strong base
- (b) Weak acid with strong base
- (c) Mohr's salt with potassium dichromate

(II) Conductometric measurements.

- (a) Determination of the cell constant.
- (b) Study of the variation of molar conductivity of a strong electrolyte (KCl) and of a weak electrolyte (acetic acid) with concentration.
- (c) Conductometric titrations for the following systems
 - (i) Strong acid - strong base
 - (ii) weak acid - strong base

(III) Kinetic studies

Study of the kinetics of the following reactions by integrated rate method:

- a. Acid hydrolysis of methyl acetate with hydrochloric acid,

volumetrically or conductometrically.

b. Iodide-persulphate reaction.

Suggested Readings

1. Vogel's Qualitative Inorganic Analysis, A.I. Vogel , Prentice Hall ,7th Edition.
2. Vogel's Quantitative Chemical Analysis, A.I. Vogel , Prentice Hall ,6th Edition.
3. Senior Practical Physical Chemistry, B.D.Khosla, R. Chand & Co.

PAPER- 18

GENETICS, BIOTECHNOLOGY AND DEVELOPMENTAL BIOLOGY (PLANTS)

THEORY

Marks: 100

Unit I Genetics and biotechnology:

(60 Lectures)

Transmission Genetics — Mendel's laws of inheritance, allelic and non-allelic interactions, modified dihybrid ratios, polygenic inheritance, multiple alleles, extra nuclear inheritance.

Physical and Molecular Organization of Genetic Material — chromosomes, chromosome morphology, karyotype, idiogram, polytene and lampbrush chromosomes, nucleosome, DNA/RNA as genetic material, Watson and Crick's model, RNA types.

Mutations — spontaneous and induced mutations, mechanism of mutation, genomic mutations (aneuploidy, euployploidy), chromosomal aberrations.

Linkage and Crossing Over — complete and incomplete linkage, two-point and three-point test cross, cytological basis of crossing over, Molecular basis of recombination; sex-linked inheritance.

Biotechnology: Recombinant DNA technology, GM plants, resistance to pathogens, pests, stress tolerance; microbial and industrial biotechnology for production of antibiotics, alcohol, single cell proteins, enzymes, gene therapy.

Ethics and Biosafety — public perception of biotechnology, intellectual property rights, patenting, ethical and biosafety issues.

Unit III Developmental Biology (Plants)

Meristems and derivatives- structural organization of shoot and root apices; vascular cambium and its derivatives, periderm; functions of vascular cambium;

Structural organization of flower Anther: structure and development, microsporogenesis, pollen development; structure of pollen wall

Ovule: structure and types, megasporogenesis and megagametogenesis, mature embryo sac

Fertilization: pollination, double fertilization; sexual compatibility- basic concepts

Seed development

Types and function of endosperm, embryogenesis, polyembryony and apomixis.

Suggested Readings:

1. Benjamin, P.A.B. (2002) *Genetics: A Conceptual Approach*. W.H.Freeman & Co. New York.

2. Brown, T.A. *Genome*. John Wiley & Sons (Asia) PTE Ltd.
3. Brown, T.D. (1999) *Gene cloning and DNA analysis*. Blackwell Science.
4. Hartl, D.L. and E.W. Jones. (1998) *Genetics: Principles and Analysis*. John and Bartlett, USA.
5. Russel, P.J. (1998) *Genetics*. The Benjamin/Cummings Publishing Co. Inc., USA.
6. Bhojwani, S.S. & Bhatnagar, S.P. (1999) *Embryology of Angiosperms*. 4th ed. Vikas Publ. House Pvt. Ltd., New Delhi.
7. Charles B. Beck (2010) *An Introduction to Plant Structure and Development Plant Anatomy for the Twenty-First Century* 2nd Edition Cambridge University Press The Edinburgh Building, Cambridge, UK
8. Evert, Ray Franklin. (2006), *Esau's Plant anatomy: meristems, cells, and tissues of the plant body: their structure, function, and development*, John Wiley & Sons, Inc., Hoboken, New Jersey.
9. Fahn, A. 1974 *Plant Anatomy*. Pergmon Press, USA and UK.

PRACTICALS

Marks: 50

1. Study of gene interaction/deviations from the Mendelian ratios using seed Samples in ratio of 9:7, 9:4:3, 9:6:1 and 12:3:1.
2. To study of the karyotype of diploid and polyploidy of the same genus through photographs; and aneuploids (Down's, Turner's and Klinefelter's Syndrome).
3. Preparation of karyotype and idiogram from the given photograph of somatic metaphase chromosomes (*Allium* and Human).
4. Study of the organization of DNA in the eukaryotic chromosome (through illustration).
5. Study of salivary gland and lampbrush chromosomes,
6. Study of banding patterns (Q,C,G) through photographs.
7. To study the sex chromosomes of *Melandrium/Coccinia* (Permanent slide/Photographs).
8. Pollen germination by Hanging drop culture.
9. Study of structure of anther, types of ovules and embryo sac development (monosporic) (through photographs/permanent slides).

10. Endosperm types, stages of embryo development — through photographs/ permanent slides.

SUGGESTED BOOKS

1. Karp, B. (2002). Cell and Molecular Biology. 3rd Edition. John Wiley and Sons, Inc., New York.
2. Russel, P.J. (1998) *Genetics*. The Benjamin/Cummings Publishing Co. Inc., USA.
3. Bhojwani, S.S. & Bhatnagar, S.P. (1999) *Embryology of Angiosperms*. 4th ed. Vikas Publ. House Pvt. Ltd., New Delhi.
4. Evert, Ray Franklin. (2006), Esau's Plant anatomy: meristems, cells, and tissues of the plant body: their structure, function, and development , John Wiley & Sons, Inc., Hoboken, New Jersey.

PAPER – 19 Applied Entomology

Theory

(60 Lectures)

Marks: 100

UNIT –I Fundamental of Entomology

Class insect: Salient features; classification of insects up to orders (with special reference to economically important orders); morphology of antenna, wings, legs and mouth parts.

Elementary knowledge of collection, preservation and culture techniques of insects.

UNIT –II Bionomics and control of the following crop pests:-

Rice pests (*Leptocorisa acuta*); Wheat pest (*Sesamia interens*); Pulse pest (*Helicoverpa armigera*); Sugarcane pests (*Scirpophaga nivella*, *Pyrilla perpusilla*); Cotton pests (*Earias vitella*, *Pectinophora gossypiella*); Vegetable pest (*Raphidopalpa faveicollis*); Fruit pest (*Papilio demoleus*)

UNIT-III Bionomics and management of the following stored grain pests:

Sitophilus oryzae

Corcyra cephalonica

Trogoderma granarium

Callosobruchus chinensis

Safe storage of grains and storage structures

UNIT-IV Bionomics and management of the following medically important pests:-

Fleas, mosquitoes, houseflies, sandflies, cockroaches, lice

UNIT-V

Locusts : Life cycle, phases and control measures

Termites : Castes, Biology, termitaria and control measures.

UNIT-VI Useful insects

Honey bees (Apiculture); Silk moths (Sericulture); Lac insect (Lac culture)

PRACTICALS

Marks: 50

Collection, dry mounting, labeling and preservation of insects

Culture of two insects of economic importance (including one crop pest) and submission of culture report.

Identification of insects up to orders (with special reference to economically important orders)

Economic importance of the following insect pests based on identification of their adult:

Leptocorisa acuta, *Tryporyza incertulas*, *Sesamia inferens*, *Helicoverpa armigera*, *Scirpophaga nivella*, *Earias vitella*, *Pectinophora gossypiella*, *Raphidopalpa faveicollis*, *Sitophilus oryzae*, *Corcyra cephalonica*, *Trogoderma granarium*, *Callosobruchus chinensis*, *Papilio demoleus*, locust, termites, flea, mosquitoes and louse.

Study of the life history of 4 different insect pests (two life cycles, drawn from culture to be submitted)

Damage caused by the commonly occurring insect pests.

Study of beneficial insects, their life stages and products.

Field trips to entomological institutes, museums, laboratories etc

Suggested Readings

1. Atwal, A.S. Agricultural pest of India and south East Asia. Kalyani Pub., N.Delhi. 1993
2. Dennis, S. Hill. Agricultural Insect pests of the tropics and their management, Cambridge university press.2005

Paper- 20 CONVENTIONAL AND BIOLOGICAL INSECTICIDES

THEORY

Marks:100

UNIT I - Conventional Insecticides:

Carbamate insecticides

Preparations and pesticidal properties of following carbamate insecticides: Carbaryl, Methomyl.

Mode of action of carbamate insecticides.

Organophosphorus insecticides Nomenclature and structural diversities of organophosphorus compounds;, Mode of action of organophosphorus insecticides.

Organochlorine Insecticides

Preparation and properties of organophosphorus insecticides

The chlorinated cyclodienes and their stereochemistry:

Chloridane, heptachlor, aldrin, dieldrin endosulfan.

Mode of action of organochlorine insecticides.

UNIT II Biological Insecticides

(No structure elucidation or synthesis is required for the following compounds):

Alkaloids: Nicotine and its analogs

Pyrethrum Properties of Natural pyrethroids

Synthetic analogs of Pyrethroids: Allethrin, fenvalerate, decamethrin.

Mode of action of pyrethroids.

Azadirachtin

Novel insect-control chemicals

Repellants, chemosterilants, antifeedants

Sex attractants

Suggested Readings:

1. Perry, A.S., Yamamoto, I., I. Shaaya and R. Perry, *Insecticides in Agriculture and Environment*, Narora Publishing House.
2. R.J. Kuhr, H.W. Derough, *Carbamate Insecticides, Chemistry, Biochemistry and Toxicology*, CRC Press.

3. R.L. Metcalf *Organic Insecticides, their Chemistry and mode of action*.
4. O'Brien, R.D., *Insecticide, Action and Metabolism*, Academic Press, New York and London.

PRACTICALS

Marks: 50

Methods and modes of application of insecticides (demonstration).

1. Preparation and Purification of simple carbamates.
2. Hydrolysis of a synthetic Pyrethroid / Organophosphorus compounds.
3. Preparation of simple
DDT
Methoxychlor
DDD
Carbaryl, Melathion etc.
5. To determine the active ingredient contents of some insecticide formulations.
6. Dehydrochlorination reaction of DDT / Methoxychlor.
7. Use of thin layer chromatography technique for the detection of organophosphorus and organochlorine insecticides

SUGGESTED READINGS:

1. Chemical Pesticides: Mode of Action and Toxicology by Jorgen Stenersen (CRC, 2004)
2. The Chemistry of Organophosphorus Pesticides: Reactivity, Synthesis, Mode of Action, Toxicology by C. Fest, K.-J Schmidt. 1973. Springer- Verlag, New York.
3. Natural Products in Plant Pest Management by edited by N K Dubey.(2011)
4. Vickery, ML and Vickery, B. (1981). Secondary plant metabolism. Macmillan, London.
5. I. L Finar, Organic Chemistry Vol:2 The English language book society and Longman group Ltd, London. (Latest edition).
6. [[Koul, O. and Dhaliwal, GS (eds) Phytochemical Biopesticides. Harwood Academic Publishers, Amsterdam

PAPER -21

CHPT 606- Chemistry-6 (Organometallics, Bio-inorganic Chemistry, Proteins and UV-IR Spectroscopy)

THEORY

Marks: 100

Section A: Inorganic Chemistry-4

(30 Lectures)

Unit 1. Chemistry of 3d metals

Oxidation states displayed by Cr, Fe, Co, Ni and Co. A study of the following compounds (including preparation and important properties).

Peroxo compounds of Cr, $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, sodium nitroprusside, $[Co(NH_3)_6]Cl_3$, $Na_3[Co(NO_2)_6]$.

Unit 2. Organometallic Compounds

Definition and Classification with appropriate examples based on nature of metal-carbon bond (ionic, σ , π and multicentre bonds). Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals. π - acceptor behaviour of carbon monoxide. Synergic effects (VB approach). (MO diagram of CO can be referred to for synergic effect to IR frequencies).

Unit 3. Bio-Inorganic Chemistry

A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na^+ , K^+ and Mg^{2+} ions: Na/K pump; Role of Mg^{2+} ions in energy production and chlorophyll. Role of Ca^{2+} in blood clotting, stabilization of protein structures and structural role (bones).

Section B: Organic Chemistry-4

(30 Lectures)

Unit 1. Polynuclear and Heteronuclear aromatic compounds: Properties of the following compounds with reference to electrophilic and nucleophilic substitution: Naphthalene, Anthracene, Furan, Pyrrole, Thiophene, and Pyridine.

Unit 2. Amino Acids, Peptides and Proteins:

Preparation of Amino Acids: Strecker synthesis, using Gabriel's phthalimide synthesis.

Zwitter ion, Isoelectric point and Electrophoresis.

Reactions of Amino acids: ester of $-COOH$ group, acetylation of $-NH_2$ group, complexation with Cu^{2+} ions, ninhydrin test.

Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins. Determination of Primary structure of Peptides by degradation Edmann degradation (N-terminal) and C-terminal (thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid-

phase synthesis.

Unit 3. Application of Spectroscopy to Simple Organic Molecules

Application of visible, ultraviolet and Infrared spectroscopy in organic molecules. Electromagnetic radiations, electronic transitions, λ_{\max} & ϵ_{\max} , chromophore, auxochrome, bathochromic and hypsochromic shifts. Application of electronic spectroscopy and Woodward rules for calculating λ_{\max} of conjugated dienes and α,β – unsaturated compounds.

Infrared radiations and types of molecular vibrations, functional group and Finger print region. IR spectra of alkanes, alkenes and simple alcohols (inter and intra molecular Hydrogen bonding), aldehydes, ketones, carboxylic acids and derivatives (effect of substitution on $>C=O$ stretching absorptions).

SUGGESTED READINGS

1. James E. Huheey, Ellen Keiter and Richard Keiter (1993) *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Publication.
2. G.L. Miessler and Donald A. Tarr, (2004) *Inorganic Chemistry*, Pearson Publication.
3. J.D. Lee (1979) *A New Concise Inorganic Chemistry*, E.L.B.S. Van Nostrand Reinhold Company Ltd., England,
4. F.A. Cotton & G. Wilkinson, (1995) *Basic Inorganic Chemistry*, John Wiley & Sons.
5. I. L. Finar (1986) *Organic Chemistry* (Vol. I & II). E.L.B.S. Longman,
6. John R. Dyer (1965) *Applications of Absorption Spectroscopy of Organic Compounds*, Prentice Hall.
7. R.M. Silverstein, G.C. Bassler and T.C. Morrill (1991) *Spectroscopic Identification of Organic Compounds*, John Wiley & Sons.
8. Peter Sykes (1968) *A Guide Book to Mechanism in Organic Chemistry*, Orient Longman.
9. Arun Bahl and B. S. Bahl (1987) *Advanced Organic Chemistry*, S. Chand.

PRACTICALS

Marks: 50

Section A: Inorganic Chemistry

1. Separation of mixtures by chromatography: Measure the R_f value in each case. (Combination of

two ions to be given)

Paper chromatographic separation of Fe^{3+} , Al^{3+} and Cr^{3+}

or

Paper chromatographic separation of Ni^{2+} , Co^{2+} , Mn^{2+} and Zn^{2+}

2. Preparation of any two of the following complexes and measurement of their conductivity:

(i) tetraamminecarbonatocobalt (III) nitrate

(ii) tetraamminecopper (II) sulphate

(iii) potassium trioxalatoferrate (III) trihydrate

Compare the conductance of the complexes with that of M/1000 solution of NaCl, MgCl_2 and LiCl_3 .

Section B: Organic Chemistry

Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, 1^o amines) and preparation of one derivative

Suggested Readings

1. Vogel's Qualitative Inorganic Analysis, A.I. Vogel, Prentice Hall, 7th Edition.
2. Vogel's Quantitative Chemical Analysis, A.I. Vogel, Prentice Hall, 6th Edition.
3. Textbook of Practical Organic Chemistry, A.I. Vogel, Prentice Hall, 5th edition.
4. Practical Organic Chemistry, Mann F. G. & Saunders B. C, Orient Longman, 196

PAPER- 22

PLANT SYSTEMATICS AND PHYSIOLOGY

THEORY

Marks: 100

Unit A: Systematics

Aims, fundamental components of systematics (description, identification, nomenclature, phylogeny, classification, advancement levels), biosystematics.

Systematics in Practices: Herbarium- Methods and their roles, role of computers and internet resources in identification, floras, monographs, manuals and journals.

Taxonomic Hierarchy- Concept of taxa, categories and hierarchy.

Botanical nomenclature- principles and rules; ranks and names, type method; author citation; valid publication; rejection of names, principle of priority and its limitations; names of hybrids and cultivars.

System of classification: An outline of Bentham and Hooker's and Engler and Prantl's systems of classification and their merits and Demrits.

Unit B: Physiology

Water relations: Absorption, transport and transpiration.

Nutrition: Essential elements, micro and macronutrients, physiological basis of mineral deficiency, transport of nutrients, biological nitrogen fixation.

Photosynthesis: photosynthetic pigments, mechanism of photosynthesis

(light and dark reaction):distinguishing features of C₃, C₄ and CAM pathways of Carbon fixation.

Respiration: Glycolysis, Krebs's cycle, electron transport chain, pentose phosphate pathway.

Phytohormones: Phytohormones Auxins, Gibberellins, Cytokinins, ABA, Ethylene, polyamines etc.

SUGGESTED READINGS:

1. Gurcharan Singh (2004) Plant Systematics — *Theory and Practice* (2nd Ed.) Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
2. Simpson, M.C. (2006). Plant Systematics. Elsevier, Amsterdam.
3. Tiaz and Zieger, Plant physiology, the Benjamin /Cumming publishing Co.
4. W.G. Hopkins, Introduction to plant physiology, John Wiley & Sons Inc USA.
5. Bhattacharyya, Bharati (2008) Systematic botany, narosa Publishing House
6. Sabamurty, A.V.V.S. (2005) Taxonomy of Angiosperms, I.K. International Pvt. Ltd New Delhi.
7. Stuessy, Tod F.(2009) Plant Taxonomy The systematic evolution of comparative Data Columbia Unv. Press., NY.

PRACTICALS

Marks:50

1. Use of internet in identification of plants.
2. Taxonomic study of characters of 2 plant from each of the following families:
 - (a) *Malvaceae*
 - (b) *Solanaceae*,
 - (c) *Asteraceae*
 - (d) *Poaceae*.

Classification according to the system of Bentham and Hooker.

3. To study the water potential using potato tuber.
4. Study of stomatal index, stomatal frequency of any plant.
5. To study the effect of light and wind on the rate of transpiration.
6. To study the rate of respiration in different parts of plants (any two).

SUGGESTED BOOKS

1. Moore TC (1981) *Research Experiences in Plant Physiology*. Springer-Verlag,
2. Ashok Bendre and Ashok Kumar, "A Textbook of Practical Botany" Rastogi publications
3. Gurcharan Singh (2004) *Plant Systematics — Theory and Practice* (2nd Ed.) Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
4. Simpson, M.C. (2006). *Plant Systematics*. Elsevier, Amsterdam.

PAPER – 23 Integrated Pest Management

Theory

Marks: 100

(60 Lectures)

Pest : Definition and its ecological validity; factors responsible for emergence of pest; pest resurgence; economic injury level; pest load; carrying capacity.

Insecticidal Classification of insecticide; insecticide adjuvants and formulations,

Pest Control Methods:-

Biological control: Principle; bio-control agents- Parasitoids, predators and pathogens; advantages and drawbacks.

Chemical control: conventional insecticides; control with reference to chlorinated hydrocarbons; organophosphates; carbamates; botanical; synthetic pyrethroids; fumigants; IGR compounds & pheromones

Genetic control: sterile insect techniques (SIT); radio-sterilization and chemo-sterilisation, hybrid sterility.

Regulatory control: quarantine laws

Recent advance pesticide development, role of biotechnology in plant protection

Cultural method and mechanical methods, resistant varieties

IPM: definition; principle, theory and advantages

SUGGESTED READINGS

1. Pedigo, L.P. 1996) Entomology and pest management, prentice hall, n. Delhi.
2. Rajeev k. Upadhyay, (2000) IPM system in Agriculture, Vol. 1. Aditya Books Pvt. Ltd. New Delhi, India
3. Raymond A. Cloyd , Philip L. Nixon and Nancy R. Pataky. 2004. IPM for Gardeners: A Guide to Integrated Pest Management, Timber Press
4. Horowitz, A.Rami and Ishaaya, Isaac. (2009) Insect Pest Management - Field and Protected Crops by
5. Mary Lou Flint and Robert van den Bosch, (1981). Introduction to Integrated Pest Management, New York: Plenum Press,
6. Robert F Norris, Edward P Caswell Chen, Marcos Kogan. (2003) Concepts in Integrated Pest Management Prentice Hall.
7. Gabrielle J Persley. (1996) Biotechnology and Integrated Pest Management by C.A.B. International.
8. Rajinder Peshin, & A. K. Dhawan(2009) Vol. I Integrated Pest Management: innovation-Development process, Springer.
9. Edward B Radcliffe, William D Hutchison, and Rafael E Cancelado. (2009) Integrated Pest Management, Cambridge University Press.

PRACTICALS

Marks: 50

1. **Trips** – IARI fields, CWC, FCI, Stored grain institutes (any two)
2. **Biological Agents**; (Pathogens – NPV); **Parasites** (*Trichogramma* etc); **Predators** (Gambusia fish, lady bird beetle etc.) [**Collection, preservations & Slide preparation**]
3. **Field Specimen** – Infested plant/plant parts
4. **Determination of LD₅₀ or LC₅₀ of insecticides based on the data provided**
5. **Instruments used in IPM**
6. **Bioefficacy of EPN**
7. **Dry Lab exercise for SIT efficacy**

SUGGESTED READINGS

1. Atwal, A.S. (1993) Agricultural pest of India and South East Asia. Kalyani Pub., New Delhi.
2. Dennis, S. Hill. (2005) Agricultural Insect pests of the tropics and their management, Cambridge University press.

PAPER- 24 PESTICIDE FORMULATION AND ANALYTICAL TECHNIQUES

THEORY

Marks: 100

Pesticide Formulations

Different types of formulations and their physio-chemical characteristics and important BSI specification.

Wettable powders

Solutions

Emulsifiable concentrates, Aerosols.

Dusts.

Granules.

Analytical Techniques involved in Pesticide Analysis

Principle underlying the following analytical techniques

Ultraviolet (UV) visible absorption spectroscopy

Infra Red (IR) spectroscopy

Nuclear magnetic resonance spectroscopy (nonmathematical treatment): spinning proton in magnetic field, precession frequency, NMR spectroscopy, Chemical shift, shielding-desielding effects, spin-spin coupling.

Mass spectroscopy (MS) introduction, basic principles, ionization methods, applications in characterization of simple organic molecules.

Suggested Readings

1. Franklin R. Hall, Paul D. Berger and Herbert M. Collins,(1995) *Pesticide Formulations and Application Systems* (v. 14)
2. Robert. M. Silverstein, Basseler, & Morrill (1991) *Spectrometric identification of Organic Compounds*, John Wiley and Sons. N.Y.
3. Kalsi, P. S. (2005).*Spectroscopy of Organic Compounds*, New Age international publishers, New Delhi.
4. F. D. Snell and C. T. Snell (1959) *Colorimetric Methods of analysis*, D. Van Nostrand Co., New York,
5. R. Wade, M. Dekker, (1973) *Pesticide Formulation*, Inc. New York,

PRACTICALS

Marks: 50

1. Recipes optimization of wettable powders and emulsifiable concentrated formulations.
2. Selection of solvent, diluents and carriers in pesticide formulations.
3. Determination of sorptivity, bulk density and compact density of most commonly used diluents and carriers.

4. Quality control analysis, i.e. acidity / alkalinity, suspendibility, shelf life, etc. of formulations as per BIS specifications.
5. To determine the concentration of pesticide samples spectrophotometrically.
6. Interpretation of Spectra (UV, IR, NMR and Mass) of organic compounds, particularly pesticides.

SUGGESTED READINGS:

1. Chester L. Foy, David W. Pritchard, (1996) *Pesticide Formulation and Adjuvant Technology*, CRC Press
2. D. Alan Knowles, (1998) *Chemistry and technology of agrochemical formulations*, Springer.
3. Frank Settle, (1997). *Handbook of Instrumental Techniques For Analytical Chemistry*, Prentice Hall PTR,
4. Jag Mohan,(2003) *Organic Analytical Chemistry: Theory and Practice*, Alpha Science International Ltd.