SYLLABUS

BACHELOR OF SCIENCE

CHEMISTRY BOTANY ZOOLOGY

JODHPUR NATIONAL UNIVERSITY

JODHPUR

BACHELOR OF SCIENCE (Chemistry, Botany, Zoology)

YEAR 1

Compulsory
Paper I General English
Paper II General Hindi

Chemistry
Paper III Inorganic Chemistry
Paper IV Organic Chemistry
Botany
Paper V Diversity of Microbes
Paper VI Cell Biology
Zoology
Paper VII Animal Diversity Part
Paper VIII Genetics and Biotechnology

YEAR 2
Chemistry
Paper I Inorganic Chemistry
Paper II Organic Chemistry
Botany
Paper III Diversity of Seed Plants
Paper IV Systematics of Angiosperms
Zoology
Paper V Structure and Functions of Invertebrate Types
Paper VI Immunology, Microbiology and Biotechnology

YEAR 3
Chemistry
Paper I Inorganic Chemistry
Paper II Organic Chemistry
Botany
Paper III Plant Physiology and Biochemistry
Paper IV Genetics and Biotechnology of Plants
Zoology
Paper V Structure and Functions of Chordates
Paper VI Applied Zoology, Ethology and Biostatistics

Paper VII Industry Based Environmental Studies

YEAR 1

PAPER I GENERAL ENGLISH

1. Comprehension and vocabulary
2. Composition
A. Letter/application writing
B. Paragraph writing/ precis writing
C. Report writing
3. Translation
A. Elements of a sentence
B. Transformation of sentence
C. Modals
D. Tense usage
E. Determiners
F. Common errors in English
G. Phrasal verbs

Books recommended

1. A.J. Thomson and : A Practical English Grammar A.V. Martinet (Oxford Paper Back)
2. S.Pit Corder : Intermediate English Practice Book (Orient Longman)
3. Bhaskaran and : Strengthen Your English Hordburgh (OUP 1973)
4. T.l.h. Smith – Pearce : The English Errors Of Indian Students (OUP)
5. I.K. Sharma and : A Practical Course of English (Ramesh Book V.D. Singh Depot, Jaipur)

पेपर 2 सामा य ह द

(अ भाग)

ग एवं प संकलन क व वधवधाएं मशः

1. एक या याओं से स बंधित मशः
2. डॉ॰ प रचया मक पा य पु तक से

(ब भाग)

1. श द शु
2. वा य शु
3. पा रभा षक श दावली (अं `जी श द के ह द समानाथ क श द)
4. सं `पण

5. प लवन
6. वा यांश के लिये साथ क श द
7. ा प
8. श द यु म : अभेद
9. निबंध

ग -संकलन

1. ामो थाननानाजी देशमुख ,द नदयाल शोध सं थानचि कूट
2. पया वरणऔर सनातन छगन मेहता ,सं ांतिऔर सनातनता ,संकलन से वागदेवी काशन बीकानेर
3. ठठुरता हुआ गणतं) यं य(ह रशंकर परसा ,तिरछ रेखाएं ,वाणी काशन द ली
4. लछमा रेखाचि (महादेवी वमा ,अतीत के चलचि ,वाणी काशन द ली
5. अ का उड़ान प र छेद
6. ए .पी .जे .अ दुल कलाम भात काशन,नई द ली
7. भेड़ाघाट :माब लरॉ सौरधुँआधार - अमृत लाल बेगड़ ,अमृत यनम दा ,थ म य देश काकादमी ,भोपाल ,म य देश
8. आवाज का नीलाम) एकांक (धम वीरभारती ग - भा- डॉ .नवल कशोर, पंचशील काशन,जयपुर
9. ावचेती वजयदान देथा ,आठटलुक प का.10.05
10. ह दभाषा और उसक वरासत: डॉ . व ानिवास मि , ह दसा ह य का पुनरावलोकन , व ानिवास मि , भा काशन, द ली
11. सुसंग-कुसंग -सीताराम मह ष कृ ण कुट रतनगढ़ ,चु) राज.
12. ये ह ोफ़ेसर शशांक - डॉ . व णुकांत शा ी- मरण को पाथेय बनने दो 'सं ह लोक भारती ,इलाहाबाद)) उ .)
13. तुलसी के का य म कुराज और सुराज-' ोसूय साद ,सा ह य क ,54निराला नगर ,लखनऊ) उ .

प संकलन

1. गंगावतरण ,भारत दह र ' भारत दसम 'संपादक ,हेमंत शमा ह द काशन्सं थान्वाराणसी)
2. गोवध नधारण ,ह रऔध य वास 'महाका य ह दसा ह यकुट र वाराणसी उ .)
3. भारत वंदना ,मैथिली शरण गु ' मंगल घट 'का य श्ला ह)यनीला बर प रधान्सदन ,चिरगाँव ,झाँसी
4. समर शेष है ,रामधार सिंह दनकर,परशुराम क ती 'ा श्ये ,राजपाल एंड स स् द ली
5. वीर का कैसा हो बसंत ,सुभ कुमार चौहान' ,सुभ कुमार चौहान 'संपादक सुधा चौहान सा ह आकादमी ,नई द ली
6. चल पड़े जधर्दो डग ,सोहन लाल वेदरा ीयगीत सं हसा ह आकादमी, नई द ली
7. म्दयाकृ ण वजय मधरा 'अच ना काशन्अजमेर
8. भारती क साधना ,इ ुशेखर त पु 'षहमारा कोणमा रका5/70 ' मानसरोवर ,जयपुर ,राज.

CHEMISTRY

PAPER – III INORGANIC CHEMISTRY

Unit- I

A. Atomic Structure

Idea of de Brogile matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of ø and ø2, quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s. p, d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Electronic configuration of the elements, effective nuclear charge.

B. Chemical Bonding

Covalent Bond – Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH3, H3O+, SF4, CIF3, ICl- 2, and H2O, MO theory,

homonuclear and heteronuclear (CO and NO) diatomic molecules, multicentre bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference.

Unit- II

A. Periodic Properties

Atomic and ionic radii, ionization energy, electron affinity and electronegativity- definition, methods of determination and trends in periodic table, applications in predicting and explaining the chemical behaviour.

B. s-Block Elements Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems, and introduction to alkyls and aryls. C. p-Block Elements

Comparative study (including diagonal relationship) of groups 13-17 elements, compounds like hydrides, oxides and halides of groups 13- 16, hydrides of boron-diborane and higher boranes, borazine, properties borohydrides.

Unit- III

A. Ionic Solids- Ionic structures, radius ratio and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born-Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond- free electron, valence bond and band theories.

B. Weak Interactions- Hydrogen bonding, van der Waals forces.

C. Fullerenes, carbides, flurocarbons, silicates (Structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides.

D. Chemistry of Noble Gases Chemical properties of the noble gases, chemistry of xenon, structure and bonding in xenon compounds.

PAPER –IV ORGANIC CHEMISTRY

UNIT-I

A. Structure and Bonding Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bond, van der Waals interactions, inclusion compounds, clatherates, charge transfer complexes, resonance, hyperconjugation, aromaticity, inductive and field effects, hydrogen bonding.

B. Mechanism of Organic Reactions Curved arrow notation, drawing electron movements with arrows, halfheaded and double headed arrows, homolytic and heterolytic bond breaking. Types of reagents-electrophiles and nucleophiles. Types of organic reactions. Energy considerations. Reactive intermediatescarbocations, carbanions, free radicals, carbenes, arynes and

nitrenes (with example). Assigning formal charges on intermediates and other ionic species.

C. Stereochemistry of Organic Compounds Concept of isomerism. Types of isomerism. Optical isomerism-elements of symmetry, molecular chirality, enatiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres, diastereomers, threo and erythro diastereomers, meso compounds, resolution of ennantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. Geometric isomerism-determination of configuration of geometric isomers. E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism- conformational analysis of ethane and nbutane; conformations of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivatives. Newman projection and Sawhorse formulae, Fischer and flying wedge formulae. Difference between configuration and conformation.

UNIT-II

A. Alkanes and Cycloalkanes IUPAC nomenclature of branched and unbranched alkanes, the alkyl group, classification of carbon atoms in alkanes. Isomerism in alkanes, sources, methods of formation (withspecial reference to Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids), physical properties and chemical reactions of alkanes. Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity Cycloalkanes- nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations. Ring strain in small rings(cyclopropane and cyclobutane), theory of strainless rings. The case of cyclopropane ring: banana bonds.

B.Alkenes Nomenclature of alkenes, methods of formation, mechanism of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff rule, Hofmann , physical properties and relative stabilities of alkenes. Chemical reactions of alkenes-mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff 's rule, hydroboration-oxidation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration hydroxylation and oxidation with KMnO4.
Polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene.

C. Cycloalkenes, Dienes and Alkynes Methods of formation, conformation and chemical reactions of cycloalkenes. Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes. Structure of allenes and butadiene, methods of formation, polymerization. Chemical reactions-1,2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes. Methods of formation. Chemical reactions of alkynes, acidity of

alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroborationoxidation, metal-ammonia reductions, oxidation and polymerization.

UNIT-III

A. Arenes and aromaticity Nomenclature of benzene derivatives. The aryl group. Aromatic nucleus and side chain. Structure of benzene: molecular formula and Kekule structure. Stability and carbon- carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: the Huckle rule, aromatic ions.

B. Aromatic electrophilic substitution- general pattern of the mechanism, role of _ and _ Complexes. Mechanism of nitration, halogenation, ulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives. Birch reduction.

C. Methods of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl.

D. Alkyl and Aryl Halides Nomenclature and classes of alkyl halides, Methods of formation, chemical reaction. Mechanisms of nucleophilic substitution reactions of alkyl halides, SN2 and SN1 reactions with energy profile diagrams. Polyhalogen compounds: chloroform, carbon tetrachloride. Methods of formation of aryl halides, nuclear and side chain reactions. The addition elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions. Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides. Synthesis and uses of DDT and BHC.

BOTANY

Paper V DIVERSITY OF MICROBES (VIRUSES, BACTERIA, ALGAE AND FUNGI)

Unit-I

Viruses and Bacteria: Structure, multiplication and transmission of viruses. Bacteria- structure, nutrition, reproduction and economic importance. Gram's staining. General account of cyanobacteria. Cell structure and reproduction in *Nostoc* and *Oscillatoria*. Structure and economic importance of mycoplasma.

Algae: General characters, thallus organisation, pigments, and reserve food material in algae, classification (Fritsch's classification) and economic importance.

Unit II
Important features and life history of:
Chlorophyceae-*Volvox, Oedogonium* and *Coleocheate*
Xanthophyceae-*Vaucheria*
Phaeophyceae- *Ectocarpus* and *Saragassum*
Rhodophyceae- *Polysiphonia.*

Unit-III
Fungi: General characters, Classification (Alexopoulos and Mims, 1979) and economic importance. Important features and life history of Mastigomycotiona: *Pythium*, *Phytophthora,* Zygomycotina: *Mucor*. Important features and life history of Ascomycotina: *Saccharomyces*, *Eurotium, Chaetomium, Peziza*. Basidiomycotina: *Puccinia, Agaricus.* Deuteromycotina: *Cercospora, Colletotrichum.* General account of lichens.

Suggested Readings:
Smith, G.M. 1971. Cryptogamic Botany. Vol. 1 Algae & Fungi. Tata McGraw Hill Publishing Co, New Delhi.
Sharma, O.P. 1992. Text Book of Thallophytes. McGraw Hill Pub. Co.
Sharma, P.D. 1991. The Fungi. Rastogi & Co., Meerut.
Dube, H.C. 1990. An Introduction to Fungi. Vikas Pub. House Pvt. Ltd. Delhi.
Clifton A. 1985. Introduction of the Bacteria. McGraw Hill & Co. New York.

PAPER VI CELL BIOLOGY

Unit-I
The cell envelopes: Structure and function of Plasma membrane, bilayer lipid structure. Structure and function of cell wall.
Structure and function of cell organelles: Golgi body, endoplasmic reticulum, peroxisomes, vacuoles, mitochondria, and chloroplast.

Unit-II
Structure and function of nucleus: ultrastructure, nuclear membrane and nucleolus.
Chromosome organisation: Morphology, centromere and telomere. Chromosome alterations: deletions, duplications, translocations, inversions, variations in chromosome number-aneuploidy, polyploidy. Sex chromosomes.

Unit-III

DNA the genetic material: DNA structure, replication. DNA- protein interaction: the nucleosome model, genetic code, satellite and repetitive DNA.
Extranuclear genome: Presence and function of mitochondrial and plastid DNA. Plasmids.
Cell Division: Mitosis and meiosis. Significance of mitosis and meiosis.

Suggested Readings:
Alberts, B., Bray, D., Lewis J.Raff., M., Roberts K. and Watson I.D. 1999. Molecular Biology of cell. Garland Pub. Co., Inc., New York, USA.
Gupta P.K. 1999 A text book of cell and Molecular Biology Rastogi Publications. Meerut.India.
Kleinsmith, L.J. and Kish. V.M. 1995. Principles of Cell and Molecular Biology (2nd edition) Harper Collins College Publishers. New York.USA.
Wolfe, S.L. 1993. Molecular and Cellular Biology. Wadsworth Publishing Co. California USA

ZOOLOGY

Paper VIII Animal Diversity Part (Protozoa to Annelida)

Unit –I
Taxonomy: - Classification of Protozoa. Porifera, Coelenterata, Platyhelminthes and Nematoda up to order with examples. Fundamentals of body organization emphasizing symmetry, metamerism, coelome and levels of structura l organization.

Unit –II
Protozoa: - Study of structural organization and life history of Trypanosoma and paramecium. Study of locomotion, osmoregulation, nu trition and reproduction in protozoa. Parasitism, pathogenecity and control in protozoans with special reference to Entamoeba, Giardia, Leishmania, Trichomonas and Plasmodium.

Unit-III
Porifera: - Habit, habitat, structure and function of Sycon. Types of canal system. Coelenterata: - Habit, habitat, structure, function and life history y of Aurelia. Polymorphism in coelenterata, coral reef. Ctenophora - Structural organization and affinities.

Unit IV

Platyhelminthes: - Structural organization and life history of Dugesia & Fasciola. Parasitic adaptation in Helminthes. Nematyhelminthes:
- Study of structure and life history of Dracunculu s medinensis Nematode parasites and human diseases.

Unit-V
Classification of Annelida (up to subclass); metameris m and coelome in Annelida General account and types of Annelida (earthworm) str uctural organization, Physiology & life history of Hirudinaria, Trochophore larva.

Paper VII Genetics and Biotechnology

Unit-I
Mendelian Genetics: - Mendel's laws of inheritance. Monohybrid and dihybr id cross. Dominance. Incomplete dominance. Current status of Me ndelism. Genetic variation: Variation in chromosome number (Euploidy and Aneupl oidy).

Unit-II
Genetic disorders in Human beings (Down's, Turner's, Klinefelter's and Edward's syndrome) Types of chromosomal mutations. Molecular basis of gene mutation, mutagens, crossing over and linkage.

Unit- III
Sex-determination XX-XY. XO-XY and WZ mechanisms. Sex-linked inheritance (X-and Y-linked) Color blindness. Haemophilia.Gene interact ions. Supplementary, complementary, epistasis and inhibitory. Multiple alle le-ABO, Rh and MN blood groups and their inheritance, polymorphic genes.

Unit-IV
Molecular genetics: Nucleic acids, structure, funct ion and type of DNA. Structure, function and types of RNA, genetic code. Transcription, protein synthesis. Gene structure (Recon. muton, cistron) and regulation of gene (lac operon: inducible and repressible system). Bacterial genetic transformation, Transduction and conjugation. Lytic and lysogenic cycle. Elementary idea about eugenics. Elementary idea about genetic engineering. Gene cloning and recombinant DNA techn ology (Vectors for gene transfers. Plasmids and phages). Restriction enzymes.

Unit V

Introduction. Historical prospective animal cell hybr idoma, major areas and future prospects of biotechnology. Medicines and Biotechnology: Microbes in medicine, antibiotics, vaccine, antibodies, antigens. Enviornmental Biotechnology: use of micro organisms in metal and petroleum recovery pest control. Waste treatment, Processing of industrial waste. Degradation of Xenophobic compounds including pesticides and surfactants. Surfactants, Surfactants and oil pollutants, Food and drink biotechnology, Ferment food dairy products. Food preservation microbial spoilage, alcoholic beverages, Vinegar. Monoclonal antibodies and their applications.

YEAR 2

CHEMISTRY

PAPER I INORGANIC CHEMISTRY

Unit I

A. Coordination Compounds

Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.

B. Chemistry of Lanthanide Elements Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds.

Unit II

Chemistry of Actinides General features and chemistry of actinides, chemistry of separation ofNp, Pu and Am from U, similarities between the later actinides and the later lanthanides. Oxidation and Reduction Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, Latimer and Pourbaix diagrams. Principles involved in the extraction of the elements.

Unit III

Acids and Bases Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. Non-aqueous Solvents Physical

properties of a solvent, types of solvents and their general characteristics reactions in non-aqueous solvents with reference to liquid NH3 and liquid SO2.

PAPER II ORGANIC CHEMISTRY

Unit I

A. Electromagnetic Spectrum: Absorption Spectra Ultraviolet (UV) absorption spectroscopy- absorption laws (Beer-Lambert law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome. Bathchoromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated enes and enones. Infrared (IR) absorption spectroscopymolecular vibrations, Hooke's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, characteristic absorption of various functional groups and interpretation of IR spectra of simple organic compounds.
B. Ethers and Epoxides Nomenclature of ethers and methods of their formation, physical properties. Chemical reactions- cleavage and autoxidation, Ziesel's method. Synthesis of epoxides. Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides.

Unit II

Classification and nomenclature. Monohydric alcohols-nomenclature, methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding. Acidic nature. Reactions of alcohols. Dihydric alcohols-nomenclature, methods of formation ,chemical reactions of vicinal glycols, oxidative cleavage [Pb(OAc)4 and HIO4] and pinacolpinacolone rearrangement. Trihydric alcohols- nomenclature and methods of formation, chemical reactions of glycerol. Phenols Nomenclature, structure and bonding. Preparation of phenols, physical properties and acidic character. Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols-electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben- Hooesch reaction, Lederer-Manasse reaction and Reimeer-Tiemann reaction. Carboxylic Acids Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids. Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides. Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of formation and chemical reactions of halo acids.Hydroxy acids: malic, tartaric and citric acids. Methods of formation and chemical reactions of unsaturated

monocarboxylic acids. Dicarboxylic acids: methods of formation and effect of heat and dehydrating agents. Carboxylic Acid Derivatives Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substituion. Preparation of carboxylic acid derivatives, chemical reactions. Mechanisms of esterfication and hydrolysis (acidic and basic).

Unit III

A. Aldehydes and Ketones Nomenclature and structure of carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acid. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations. Condensation with ammonia and its derivatives. Witting reaction. Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-villiger oxidation of ketones, Cannizzaro reaction. MPV, Clemmensen, Wolff-kishner, LiAIH4 and NaBH4 reductions, Halogenation of enolizable ketones. An introduction to á,â unsaturated aldehydes and ketones. B. Organic Compounds of Nitrogen Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanisms of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media. Picric acid. Halonitroarenes: reactivity. Structure and nomenclature of amines, physical properties.Stereochemistry of amines. Separation of a mixture of primary, secondary and teritary amines. Structural features effecting basicity of amines. Amines salts as phase-transfer catalysts. Preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles),reductive amination of aldehydic and ketonic compounds. Gabriel-phthalimide reaction, Hofmann bromamide reaction. Reaction of amines, electrophilic aromatic substitution in aryl amines, reaction of amines with nitrous acid. Synthetic transformation of aryl diazonium salts, azo coupling.

BOTANY

PAPER-III DIVERSITY OF SEED PLANTS

Unit-I

Characteristics of seed plants; Evolution of the seed habit, Seed Plants with fruits (angiosperms) and with out fruits (gymnosperms), fossil and living seed plants.
Angiosperms: Origin and evolution. Some examples of primitive angiosperms. Diversity in plant form in annuals, biennials and perennials, Convergence of evolution of tree habit in gymnosperms, monocotyledons and dicotyledons trees-largest and longest lived organisms.

Unit-II
General features of gymnosperms and their classification: Evolution and diversity of gymnosperms; Geological time scale. Fossilization and fossil gymnosperms.

Unit- III
Morphology of vegetative and reproductive parts: Anatomy of root, stem and leaf, repoductive parts and life cycle of Pinus, Cycas and Ephedra. Significance of seed- suspended animation: Ecological adaptation, unit of genetic recombination and replenishment, dispersal strategies. Vegetative reproduction: Vegetative reproduction, grafting economic aspects.

Suggested Readings:
Bhatnagar,S.P. and Moitra, a. 1996. Gymnosperms.New Age international limited,New Delhi.
Gifford.E.M.and Faster.A.S.1988. Morphology and evolution of vascular plants. W.H.freeman & Company, New Yark.
Sporne.K.R. 1965. The morphology of Gymnosperms. Hutchinson & Co. (Publishers) Ltd. London.
Stewart,W.M.1983. Paleobotany and the evolution of plants. Cambridge University Press, Cambridge.

PAPER-IV SYSTEMATICS OF ANGIOSPERMS

UNIT-I
Angiosperm taxonomy : Brief history, aims and fundamental concepts (Alpha taxonomy, omega taxonomy, holotaxonomy). Identification keys, taxonomy literature. Herbarium technique, important herbaria and botanical garders of India. Botanical Nomenclature: Principles and rules, taxonomic ranks, Type concept, principle of priority. Major contribution of cytology, Phytochemistry and taximetrics to taxonomy.

Unit-II

Classification of Angiosperms : Salient features of systems proposed by Benthom & Hooker, Engler & Prantl. Diversity of flowering plants as illustrated by members of the families-Ranunculaceae, Brassicaceae, Malvaceae, Rutaceae, Fabaceae.

Unit –III

Diversity of flowering plants as illustrated by members of the families-Apiaceae, Acanthaceae, Apocynaceae, Asclepiodaceae & Solanaceae. Diversity of flowering plants as illustrated by members of the families- Lamiaceae, Chenopodiaceae, Euphorbiaceae, Liliaceae & Poaceae.

Suggested Readings

Davis, P.H.and Heywood, V.H. 1963, Principles of Angiosperm Taxonomy. Oliver and boyd, London.

Heywood,V.H. and moore, D.M. (cds) 1984 . Current concepts in plant 'Taxonomy", Academic press, London.

Jeffrey,C,1982, An Introduction to plant Taxonomy, Cambridge University press Cambridge, London.

Jones,S.B Jr. and Luchsinger, A.E. 1986.Plant Systematics (2nd odition) McGrawHill Book Co.. New York.

ZOOLOGY

PAPER V STRUCTURE AND FUNCTIONS OF INVERTEBRATE TYPES

UNIT I

Structural and functional organisation of vital systems of nonchordates as examplified by Amoeba, Paramecium, Euglena, Obelia, Sycon, Fasciola, Taenia, Nereis, Hirudinaria, Palaemon, Lamellidens, Pila and Asterias :

1 Locomotion : Pseudopodial (Amoeba), ciliary (Paramecium) and flagellar (Euglena), parapodial (Nereis), pedal muscular foot (Pila) and tube feet (Asterias).

2 Skeleton : Endoskeleton (spicules of Sycon), exoskeleton, chitinous (Palaemon), calcareous (Corals, Pila, Lamellidens, Asterias), siliceous (Radiolaria).

3 Nervous System : Sensory and nerve cells (Obelia); brain ring and longitudinal nerves (Fasciola and Taenia), brain and ventral nerve cord (Nereis, Palaemon), nervous system of Pila and Lamellidens.
4. Sense-organs : Statocyst and osphradium (Lamellidens and Pila), compound eye (Palaemon) and simple eye (Nereis, Pila), tactile and olfactory organs (Palaemon), nuchal organs (Nereis).

UNIT II

1 Food, Feeding, Digestive structures and Digestion: Autotrophic (Euglena), heterotrophic: through food vacuole (Paramecium) and in hydroid and medusoid zooids (Obelia), parasitic (Fasciola, Taenia, Hirudinaria), predatory (Nereis, Palaemon, Asterias), filter feeding (Lamellidens)
2 Respiration : Aquatic general body surface (Euglena, Nereis, Hirudinaria), dermal branchiae (Asterias), parapodia (Nereis), gills (Palaemon, Lemellidens, Pila), aerial, pulmonary sac (Pila), trachea (Insect), anaerobic (Fasciola, Taenia).
3 Excretion : General body surface (Protozoa, Sycon, Obelia), protonephridial system and flame cells (Fasciola, Taenia), nephridia (Nereis, Hirudinaria), malpighian tubules (insect); organ of Bojanus (Lamellidens, Pila).
4 Circulation : Cyclosis (Euglena, Paramecium), diffusion (Sycon, Obelia, Fasciola, Taenia), open circulatory system (Hirudinaria, Palaemon, Lamellidens, Pila, Asterias), closed circulatory system (Nereis).

UNIT III

1 Reproduction : Asexual (Paramecium, Euglena, Sycon), alternation of generation (Obelia), sexual (Fasciola, Taenia, Nereis, Lamellidens, Pila, Hirudinaria, Asterias).
2 Salient Features of Hemichordata
3 Evolution of canal system of sponges
4 Parasitic adaptations in helminthes and arthropods
5 Social organisation in termites and Bees
6 Direct and indirect development in insects
7 Water vascular system of starfish.

PAPERVI IMMUNOLOGY,MICROBIOLOGYAND BIOTECHNOLOGY

UNIT I

Immunology

1 Immunology : Definition, types of immunity, innate and acquired, humoral and cell mediated.
2 Antigen : Antigenicity of molecules, haptens
3 Antibody : Definition (IgG, IgM, IgD, IgA and IgE) outline idea of properties and function of ech class of immunoglobulin.
4 Antigen-antibody reactions : Precipitation reaction, agglutination reaction, neutralizing reaction, complement and lytic reactions and phagocytosis.
5 Cells of Immunity ; Macrophages, lymphocytes (B and T types), T - Helper cells, T-killer cells, plasma cells and memory cells.
6 Mechanism of humoral or antibody mediated immunity.

UNIT II

Microbiology

1. Brief introduction to the history of microbiology : work of Antony Van Leuwenhock, theory of spontaneous generation, Germ theory of fermentation and disease, Works of Louis Pasteur, John Tyndal, Robert-Koch and Jenner.
2. The Prokaryota (Bacteria)

Structural organization :

i) Size, shapes and patterns

ii) Structural organization

Slime layer (capsule), cell envelopes cytoplasmic membrane (inner membrane) cell wall (outer membrane) of Gram negative and Gram positive bacteria, mesosomes, cytoplasmic organization cell projections, flagella and pili.

3. Genetic material of bacteria.

i) Chromosome (ii) Plasmids (iii) replication of bacterial DNA.

4 Reproduction in Bacteria , asexual re-production: binary fission, budding, endospore formation, exospore and cyst formation, sexual reproduction, conjugation.

5 Microbial nutrition culture of Bacteria

a) Carbon and energy source

b) Nitrogen and minerals

c) Organic growth factors

d) Environmental factors : Temperature, hydrogen-ion concentration

6 Bacteria of medical importance

i) Gram positive

a) Cocci: Staphylococci, Streptococci

b) Bacilli : Diphtheria, Tetanus

ii) Gram-negative

a) Cocci : Gonorrhea, Meningitis

b) Bacilli : Diarrhea

iii) Mycobacteria : Tuberculosis, Leprosy.

7 AIDS and Hepatitis (with emphasis on B)

i) The causative agents

ii) Transmission
iii) Pathogenicity
iv) Laboratory diagnosis, treatment and prevention.

UNIT III

Biotechnology

1. History, scope, significance of Biotechnology. Major areas of Biotechnology, Biotechnology industries in India.
2. Vectors for gene transfer (plasmids and phages). Basic concepts of cell and tissue culture. Hybridoma technology.
3. Monoclonal antibodies and their applications.
4. Protoplast fusion in Prokaryotes and Eukaryotes.
5. Recombinant DNA technology and its application.
6. Bacteria and genetic engineering (outline idea only), benefits of genetic engineering, potential hazards and regulations of genetic engineering.
7. Transgenic animals and their uses in biotechnology.
8. Brief account of cloning; genomic research its advantages and disadvantages.
9. Biotechnology in Medicine, P.C.R., Antibiotics, Vaccines, Enzymes, Vitamins, Steroids.
10. Environmental Biotechnology: Metal and petroleum recovery, pest control, waste water treatment.
11. Food and drink and dairy microbiology (outline idea only): Fermented food production: dairy products, alcoholic beverages and vinegar, microbial spoilage and food preservation.

YEAR III

PAPER- I INORGANIC CHEMISTRY

Unit-I

A. Metal-ligand Bonding in Transition Metal Complexes Limitations of valence bond theory, an elementary idea of crystal-field theory, crystal field splitting in octahedral , tetrahedral and square planar complexes, factors affecting the crystal-field parameters. B. Thermodynamic and Kinetic Aspect of Metal Complexes A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, substitution reactions of square planar and octahedral complexes. C. Magnetic Properties of Transition Metal Complexes Types of magnetic behaviour, methods of determining magnetic susceptibility, spin-only formula. L-S coupling, correlation of ìs and ìeff values, orbital

contribution to magnetic moments, application of magnetic moment data for 3d-metal complexes.

Unit-II

A. Electronic Spectra of Transition Metal Complexes Types of electronic transition, selection rules of d-d transitions, spectroscopic ground state, spectrochemical series. Orgel-energy level diagram for d1and d9 states, discussion of the electronic spectrum of [Ti(H2O)6]3+ complex ion. B. Organometallic Chemistry Definition, nomenclature and classification of organometallic compounds. Preparation, properties, bonding and applications of alkyls and aryls of Li, Al, Hg, Sn and Ti, a brief account of metal-ethylenic complexes and homogeneous hydrogenation, mononuclear carbonyls and the nature of bonding in metal carbonyls.

Unit-III

A. Basics of Bioinorganic Chemistry Essential and trace elements in biological processes, metallporphyrins with special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Ca2+. Nitrogen fixation. B. Hard and Soft Acids and Bases(HSAB) Classification of acids and bases as hard and soft. Pearson's HSAB concept, acid base strength and hardness and softness. Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and softness. C. Silicones and Phosphazenes Silicones and phosphazenes as examples of organic polymers, nature of bonding in triphosphazenes.

PAPER-II ORGANIC CHEMISTRY

UNIT-I

Spectroscopy

A. Nuclear Magnetic resonance (NMR) spectroscopy. Proton magnetic resonance(1H NMR) spectroscopy, nuclear shielding and dishielding chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2,- tribromoethane, ethyl acetate, toluene and acetophenone. Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR spectroscopic techniques.

B. Organometallic Compounds Organomagnesium compounds: the Grignard reagents-formation, structure and chemical reaction. Organozinc compounds:formation and chemical reactions. Organolithium compounds: formation and chemical reactions.

UNIT-II

A. Organic Synthesis via Enolates Acidity of á-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate: the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate. Alkylation of 1,3-dithianes. Alkylation and acylation of enamines.

B. Carbohydrates Classification and nomenclature. Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erithro and threo diastereomers. Conversion of glucose into mannose. Formation of glycosides, ethers and esters, Determination of ring size of monosaccharides. Cyclic structure of D(+)- glucose. Mechanism of mutarotation. Structure of ribose and deoxyribose.

An introduction to disaccharides(maltose, sucrose and lactose) and Polysaccharides (starch and cellulose) without involving structure determination.

C. Amino Acids, Peptides, Proteins and Nucleic Acids Classification, structure and stereochemistry of amino acids. Acid base behavior, isoelectric point and electrophoresis. Preparation and reactions of áamino acids. Structure and nomenclature of peptides and proteins. Classification of proteins. Peptide structure determination, end group analysis, selective hydrolysis of peptides. Classical peptide synthesis, solid-phase peptide synthesis. Structures of peptides and proteins, level of protein structure. Proteins denaturation/ renaturation.

Nucleic acids: introduction, Constitution of nucleic acids. Ribnonucleosides and ribonucleotides. The double helical structure of DNA.

UNIT-III

A. Synthetic Polymers

Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers. Condensation or step growth polymerization. Polyesters, polyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes. Natural and synthetic rubbers.

B. Synthetic Dyes Colour and constitution (electronic concept). Classification of dyes. Chemistry and synthesis of Methyl orange, Congo red, malachite green, Crystal violet, Phenolphthalein, Fluorescein, Alizarin and indigo.

C. Fats, Oil and Detergents Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides, hydrogenation of unsaturated oils. Saponification value, iodine value, acid value. Soaps, synthetic detergents, alkyl and aryl sulphonates.

BOTANY

PAPER - III: PLANT PHYSIOLOGY AND BIOCHEMISTRY

Unit I

Plant - water relations: Importance of water to plant life; physical properties of water; diffusion and osmosis; absorption, transport of water and transpiration; physiology of stomata.

Transport of organic substances: Mechanism of phloem transport; source-sink relationship; factors affecting translocation.

Basics of enzymology: Discovery and nomenclautre; characteristics of enzymes; concept of holoenzyme, apoenzyme, coenzyme and cofactors; regulation of enzyme activity; mechanism of action.

Unit II

Photosynthesis : Significance; historical aspects; photosynthetic pigments; action spectra and enhancement effects; concept of two photosystems; Z-scheme; photophosphorylation; Calvin cycle; C4 pathway; CAM plants; photorespiration.

Mineral nutrition: Essential macro- and micro-elements and their role; mineral uptake; deficiency and toxicity symptoms.

Respiration : ATP - the biological energy currency; aerobic and anaerobic respiration; Kreb's cycle; electron transport mechanism (chemi-osmotic theory); redox potential; oxidative phosphorylation; pentose phosphate pathway.

Nitrogen and lipid metabolism : Biology of nitrogen fixation; importance of nitrate reductase and its regulation; ammonium assimilation; structure and function of lipids; fatty acid biosynthesis; _-oxidation; saturated and unsaturated fatty acids; storage and mobilization of fatty acids.

Unit III

Growth and development : Definitions; phases of growth and development; kinetics of growth; seed dormancy, seed germination and factors of their regulation; plant movements; the concept of photoperiodism; physiology of flowering; florigen concept; Vernalization, biological clocks; physiology of senescence, fruit ripening Plant hormones - auxins, gibberellins, cytokinins, abscisic acid and ethylene, discovery, structure, Bioassay, physiological role and application; photomorphogenesis; phytochromes their discovery, physiological role mechanism of action and HIR (High Irradiance Response).

Suggested Readings:

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

2. Lea, P.J. and Leegood, R.C. 1999 Plant Biochemistry and Molecular Biology. John Wiley & Sons, Chicheste England.

3. Salisbury, F.B. and Ross, C.W. 1992. Plant Physiology (4th Edition). Wadsworth Publishing Co., California, USA.
4. Taiz, L. and Zeiger, E. 1998. Plant Physiology (2nd Edition). Sinauer Associates, Inc., Publishers, Massachusett USA.
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PAPER - IV : GENETICS AND BIOTECHNOLOGY OF PLANTS

Unit I

Genetic inheritance: Mendelism; laws of segregation and independent assortment; linkage analysis; allelic and non-allelic interactions.

Gene expression : Structure of gene; transfer of genetic information; transcription, translation, protein synthesis; tRNA; ribosomes; regulation of gene expression in prokaryotes and eukaryotes; proteins, 1D, 2D and 3D structure.

Unit II

Genetic variations: Mutations: spontaneous and induced; transposable genetic elements; DNA damage and repair, Green revolution to Gene revolution with special reference to transgenic plants.

Genetic engineering: Tools and techniques of recombinant DNA technology; cloning vectors; genomic and cDNA library; transposable elements; techniques of gene mapping and chromosome walking.

Unit III

Biotechnology: Functional definition; basic aspects of plant tissue culture; cellular totipotency, differentiation and morphogenesis; biology of *Agrobacterium*, vectors for gene delivery and vectorless gene transfer; marker and reporter genes; salient achievements in crop biotechnology.

Suggested Readings:

1. Bhojwani, S.S. 1990. Plant Tissue Culture : Applications and Limitations. Elsevier Science Publishers, New York, USA
2. Vasil, I.K. and Thorpe, T.A. 1994. Plant Cell and Tissue Culture. Kluwer Academic Publishers, The Netherlands.

ZOOLOGY

PAPER V STRUCTURE AND FUNCTIONS OF CHORDATES

Unit I

1 Classification and characters of phylum chordata (excluding extinct forms) up to orders (up to subclass in mammals).
2 Habit, habitat, external features and anatomy of *Herdmania* (excluding development)
3 Ascidian's tadpole larva and its Metamorphosis.
4. Habit, habitat, external features and anatomy of *Branchiostoma* (excluding development)
5 Affinities of Hemichordata, Urochordata and Cephalochordata.
6 Habit, Habitat and Salient features of *Petromyzon*, Ammocoete larva.

UNIT II

Comparative study of Pisces, Amphibians, Reptiles, Aves and Mammals.
1 Integument including structure and development of placoid scales, feathers and hair.
2 Basic plan of vertebrate endoskeleton
3 Alimentary canal
4 Heart and aortic arches
5 Respiratory system
6 Urinogenital system
7 Brain

UNIT III

1. Pisces - Scales and fins, Migration, Parental care
2. Amphibia - Parental care
3. Reptilia - Poisonous and non-poisonous snakes, Poison apparatus
4. Aves - Flight adaptation, Bird migration
5. Mammals - Adaptive radiation, Dentition.

PAPER VI APPLIED ZOOLOGY, ETHOLOGY AND BIOSTATISTICS

UNIT I

Economic importance of:
1 Protozoa
2 Corals and Coral reefs
3 Helminthes
4 Arthropoda

i Crustacea and larvae
ii Insect pests and their management
5 Mollusca including an outline idea of Pearl culture
Principles and applications
6 Sericulture (Including Eri culture)
7 Lac culture
8 Apiculture
9 Poultry Keeping
10 Pisciculture
Ethology

UNIT II
1 Introduction and history of Ethology
2 Concepts of Ethology : fixed action pattern, sign stimulus, innate releasing mechanism, action specific energy, motivation, imprinting and learning.
3 Methods of studying behaviour: Neuroanatomical neurophysiological, neurochemical techniques.
4. Territory and Home range- Role of pheromones.
5. Social behaviour: Characteristics and advantages with special reference to honey bee, deer and monkey.
6. Neuro endocrinological control of behaviour.

UNIT III
Biostatistics
Introduction and understanding the concepts of descriptive and inferential statistics
1 Frequency distribution, t-test, graphical presentation
2 Mean, mode, median, Variance, Coefficient of correlation and Chi square test
3 Standard deviation, standard error.

Paper VII Industry Based Environmental Studies

UNIT – 1
Environment – Definition – Scope – Structure and function of eco system's procedures, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chain, food web and ecological pyramids - concepts of sustainable development.

UNIT – 2

Natural resources: Renewable – air, water, soil, land and wildlife resources. Non- renewable – mineral, coal, oil and gas. Environmental problems related to the extraction and use of natural resources.

UNIT – 3

Biodiversity – Definition – values – consumption use, productive social, ethical, aesthetic and option values threats to biodiversity – Hotspots of bio diversity – conservation of bio-diversity: In-situ Ex-situ. Bio-wealth – national and global level.

UNIT – 4

Environmental pollution : Definition – causes, effects and mitigation measures – Air pollution, Water pollution, Soil pollution, Noise pollution, Thermal pollution – Nuclear hazards – solid wastes acid rain – climate change and global warming environmental laws and regulations in India – Earth summit.

UNIT – 5

Population and environment – Population explosion – Environment and human health – HIV / AIDS – Women and child welfare – Resettlement and Rehabilitation of people, role of information technology in environmental health – Environmental awareness.