PROGRAMME: THREE-YEAR
B.Sc - Mathematics, Physics, Chemistry

SYLLABUS & REGULATIONS

(with effect from the batch admitted in the academic year 2026-27)
CHOICE BASED CREDIT SYSTEM (CBCS) Regulations-2016

Dr B.R. Ambedkar Open University
Eluru - Andhra Pradesh, India
www.drbraouap.org

Dr B.R. Ambedkar Open University

Eluru - Andhra Pradesh, India

PROGRAMME: Three-Year B.Sc

(with effect from the batch admitted in the academic year 2026-27)

CHOICE BASED CREDIT SYSTEM (CBCS) Regulations-2016

B.Sc - Botany, Chemistry, Zoology

SEMESTER – I

Sl.No.	Course	Name of the Subject	Total Marks	Mid Sem	Sem End	Teaching Hours	Credits
1.	First Language	English	100	25	75	4	3
2.	Second Language	Telugu	100	25	75	4	3
3.	Skill Skills		50	---	50	2	2
4.	Skill Development Courses		50	---	50	2	2
5.	1B	Microbial Diversity of Lower Plants - I	100	25	75	5	4
6.	1C	Inorganic and Organic Chemistry	100	25	75	5	4
7.	1Z	Biology of Invertebrates and Cell Biology	100	25	75	5	4
		Total	**600**	**125**	**475**	**27**	**22**

B.Sc - Botany, Chemistry, Zoology

SEMESTER – II

Sl.No.	Course	Name of the Subject	Total Marks	Mid Sem	Sem End	Teaching Hours	Credits
1.	First Language	English	100	25	75	4	3
2.	Second Language	Telugu	100	25	75	4	3
3.	Skill Skills		50	---	50	2	2
4.	Skill Development Courses -1		50	---	50	2	2
	Skill Development Courses -2		50	---	50	2	2
5.	2B	Microbial Diversity of Lower Plants - II	100	25	75	5	4
6.	2C	Physical and General Chemistry	100	25	75	5	4
7.	2Z	Biology of Chordates, Embryology, Ecology and Zoogeography	100	25	75	5	4
		Total	**650**	**125**	**525**	**29**	**24**

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Eluru - Andhra Pradesh, India

B.Sc - Botany, Chemistry, Zoology

SEMESTER – III

Sl.No.	Course	Name of the Subject	Total Marks	Mid Sem	Sem End	Teaching Hours	Credits
1.	First Language	English	100	25	75	4	3
2.	Second Language	Telugu	100	25	75	4	3
3.	Skill Skills - 1		50	---	50	2	2
	Skill Skills - 2		50	---	50	2	2
4.	Skill Development Courses		50	---	50	2	2
5.	3B	Plant Physiology and Metabolism	100	25	75	5	4
6.	3C	In-Organic, Physical, Organic Chemistry	100	25	75	5	4
7.	3Z	Animal Physiology, Genetics & Evolution	100	25	75	5	4
		Total	**650**	**125**	**525**	**29**	**24**

B.Sc - Botany, Chemistry, Zoology

SEMESTER – IV

Sl.No.	Course	Name of the Subject	Total Marks	Mid Sem	Sem End	Teaching Hours	Credits
1.	4B1	Physiology, Biotechnology, Seed Technology and Horticulture	100	25	75	5	4
2.	4B2	Mathematics - **Elective**	100	25	75	5	4
3.	4C1	Chemistry & Industry	100	25	75	5	4
4.	4C2	Chemistry - **Elective**	100	25	75	5	4
5.	4Z1	Applied Zoology	100	25	75	5	4
6.	4Z2	Zoology- **Elective**	100	25	75	5	4
		Total	**600**	**150**	**450**	**30**	**24**

Dr B.R. Ambedkar Open University

Eluru - Andhra Pradesh, India

B.Sc - Botany, Chemistry, Zoology

SEMESTER – I

Paper 1B : Microbial Diversity of Lower Plants -I

UNIT - I

1. Brief account of Archaebacteria, Actinomycetes.
2. Cyanobacteria: General characters, cell structure, thallus organisation and their significance as biofertilizers with special reference to *Oscillatoria, Nostoc* and *Anabaena.*
3. Lichens: Structure and reproduction; ecological and economic importance.

UNIT- II

4. Viruses: Structure, replication and transmission; plant diseases caused by viruses and their control with reference to Tobacco Mosaic and Rice Tungro.
5. Bacteria**:** Structure, nutrition, reproduction and economic importance. An outline of plant diseases of important crop plants caused by bacteria and their control with reference to Angular leaf spot of cotton and Bacterial blight of Rice.
6. General account of Mycoplasma with reference to Little leaf of brinjal and Papaya leaf curl

UNIT-III

7. General characters, structure, reproduction and classification of algae (Fritsch) and thallus organization in algae.
8. Structure and reproduction of the following: Chlorophyceae- *Volvox, Oedogonium* and*Chara.*

   Phaeophyceae-*Ectocarpus*

   Rhodophyceae- *Polysiphonia.*
9. Economic importance of algae in Agriculture and Industry.

UNIT-IV

10. General characters and classification of fungi (Ainsworth).

11. Structure and reproduction of the following:

    (a)Mastigimycotina- *Albugo*

    (b) Zygomycotina- *Mucor*

    (c) Ascomycotina- *Saccharomyces* and *Penicillium.*

    (d) Basidiomycotina- *Puccinia*

    (e) Deuteromycotina- *Cercospora.*

12. Economic importance of fungi in relation to mycorrhizae and mushrooms. General account of mushroom cultivation.

PAPER - 1C: Inorganic and Organic Chemistry

INORGANIC CHEMISTRY

UNIT –I

1. P-block elements–I

Group-13: Synthesis and structure of diborane and higher boranes

(B_4H_{10} and B_5H_9), boron-nitrogen compounds ($B_3N_3H_6$ and BN)

Group - 14: Preparation and applications of silanes and silicones.

Group - 15: Preparation and reactions of hydrazine, hydroxylamine.

UNIT-II

1. P-block elements -II

Group - 16: Classifications of oxides based on (i) Chemical behaviour and

(ii) Oxygen content.

Group-17: Inter halogen compounds and pseudo halogens.

2. Organometallic Chemistry

Definition - classification of Organometallic compounds - nomenclature, preparation, properties and applications of alkyls of Li and Mg.

ORGANIC CHEMISTRY

UNIT-III

1. Structural theory in Organic Chemistry

Types of bond fission and organic reagents (Electrophilic, Nucleophilic, and free radical reagents including neutral molecules like H_2O,NH_3 & $AlCl_3$).

Bond polarization : Factors influencing the polarization of covalent bonds, electro negativity - inductive effect. Application of inductive effect (a) Basicity of amines (b) Acidity of carboxylic acids (c) Stability of carbonium ions. Resonance or Mesomeric effect, application to (a) acidity of phenol, and (b) acidity of carboxylic acids. Hyper conjugation and its application to stability of carbonium ions, Free radicals and alkenes, carbanions, carbenes and nitrenes.

Types of Organic reactions : Addition - electrophilic, nucleophilic and free radical. Substitution - electrophilic, nucleophilic and free radical. Elimination- Examples.

UNIT-IV

5. **Acyclic Hydrocarbons**

Alkenes - Preparation of alkenes. Properties: Addition of hydrogen - heat of hydrogenation and stability of alkenes. Addition of halogen and its mechanism. Addition of HX, Markonikov's rule, addition of H_2O, HOX, H_2SO_4 with mechanism and addition of HBr in the presence of peroxide (anti - Markonikov's addition). Dienes - Types of dienes, reactions of conjugated dienes - 1,2 and 1,4 addition of HBr to 1,3 - butadiene and Diel's - Alder reaction.

Alkynes - Preparation by dehydrohalogenation of dihalides, dehalogenation of tetrahalides, Properties; Acidity of acetylenic hydrogen (formation of Metal acetylides). Preparation of higher acetylenes, Metal ammonia reductions, Physical properties. Chemical reactivity - electrophilic addition of X_2, HX, H_2O (Tautomerism), Oxidation with $KMnO_4$, OsO_4, reduction and Polymerisation reaction of acetylene.

6. **Alicyclic hydrocarbons (Cycloalkanes)**

Nomenclature, Preparation by Freunds method, Wislicenus method. Properties - reactivity of cyclopropane and cyclobutane by comparing with alkanes, Stability of cycloalkanes - Baeyer's strain theory, Sachse and Mohr predictions and Pitzer's strain theory. Conformational structures of cyclobutane, cyclopentane, cyclohexane.

UNIT-V

1. Benzene and its reactivity

Concept of resonance, resonance energy. Heat of hydrogenation, heat of combustion of Benzene, mention of C-C bond lengths and orbital picture of Benzene. Concept of aromaticity - aromaticity (definition), Huckel's rule - application to Benzenoid (Benzene, Naphthalene) and Non - Benzenoid compounds (cyclopropenyl cation, cyclopentadienyl anion and tropylium cation)

Reactions - General mechanism of electrophilic substitution, mechanism of nitration, Friedel Craft's alkylation and acylation. Orientation of aromatic substitution - Definition of ortho, para and meta directing groups. Ring activating and deactivating groups with examples (Electronic interpretation of various groups like NO_2 and Phenolic). Orientation of (i) Amino, methoxy and methyl groups (ii) Carboxy, nitro, nitrile, carbonyl and sulphonic acid groups (iii) Halogens

(Explanation by taking minimum of one example from each type)

PAPER - 1C: Biology of Invertebrates and Cell Biology

1.0 Protozoa to Annelida

1.1. Phylum Protozoa: General characters and outline classification up to classes. Type study: *Paramecium.*

1.2. Phylum Porifera : General characters and outline classification up to classes. Type study: *Sycon*; Canal system in Sponges.

1.3. Phylum Coelenterata: General characters and outline classification up to classes. Type study: *Obelia*; Polymorphism in Coelenterates; Corals and Coral reef formation.

1.4. Phylum Platyhelminthes: General characters and outline classification up to classes. Type study: *Fasciola hepatica*.

1.5. Phylum Nemathelminthes: General characters and outline classification up to classes. Type study: *Ascaris lumbricoides*.

1.6. Phylum Annelida: General characters and outline classification up to classes Type study: Leech; Coelom and coelomoducts in Annelids**.**

2.0 Arthropoda to Hemichordata

2.1. Phylum Arthropoda: General characters and outline classification of up to classes Type study: Prawn; Crustacean larvae; *Peripatus*- Characters and Significance

2.2. Phylum Mollusca: General characters and outline classification of up to classes Type study: *Pila*; Pearl formation in Molluscs.

2.3. Phylum Echinodermata: General characters and outline classification of up to classes. Type study: Star fish.

2.4. General characters of Hemichordata : Structure and affinities of *Balanoglossus.*

3.0 Cell Biology

3.1. Cell theory

3.2. Ultra structure of Animal cell

3.3. Structure of Plasma membrane - Fluid-mosaic model. Transport functions of Plasma membrane- Passive transport, active transport (Antiport, symport and uniport) and bulk transport.

3.4. Structure and functions of Endoplasmic reticulum Golgi body, Ribosomes, lysosomes and Mitochondrion.

3.5. Chromosomes - nomenclature types and structure. Giant chromosomes – Polytene and Lampbrush chromosomes.

3.6. Cell division - Cell-cycle stages (G_1, S, G_2, and M phases), Cell-cycle check points and regulation. Mitosis; Meiosis - and its significance.

4.0 Biomolecules of the Cell

4.1. Carbohydrates

4.1.1. Classification of Carbohydrates

4.1.2. Structure of Monosaccharides (Glucose and Fructose)

4.1.3. Structure of Disaccharides (Lactose and Sucrose)

4.1.4. Structure of Polysaccharides (Starch, Glycogen and Chitin)

4.2. Proteins

4.2.1. Amino acids: General properties, nomenclature, classification and structure.

4.2.2. Classification of proteins based on functions, chemical nature and nutrition, peptide bond and structure (Primary, secondary, tertiary and quaternary structures)

4.3. Lipids

4.3.1. Classification. Structure of Fatty acids (Saturated and unsaturated).

4.3.2. Triacylglycerols, Phospolipids (Lecithin and cephalin) and Steroids (Cholesterol).

4.4. Nucleic Acids

4.4.1. Structure of purines, pyrimidines, ribose and deoxyribose sugars.

4.4.2. Watson and Crick model of DNA- Nucleoside, Nucleotide, Chargaff's rule. Structure of RNA, Types of RNA - rRNA, tRNA and mRNA.

B.Sc - Botany, Chemistry, Zoology

SEMESTER – II

Paper 2B : Microbial Diversity of Lower Plants -II

UNIT - I

1. Brief account of Archaebacteria, Actinomycetes.
2. Cyanobacteria: General characters, cell structure, thallus organisation and their significance as biofertilizers with special reference to *Oscillatoria, Nostoc* and *Anabaena.*
3. Lichens: Structure and reproduction; ecological and economic importance.

UNIT- II

4. Viruses: Structure, replication and transmission; plant diseases caused by viruses and their control with reference to Tobacco Mosaic and Rice Tungro.
5. Bacteria**:** Structure, nutrition, reproduction and economic importance. An outline of plant diseases of important crop plants caused by bacteria and their control with reference to Angular leaf spot of cotton and Bacterial blight of Rice.
6. General account of Mycoplasma with reference to Little leaf of brinjal and Papaya leaf curl

UNIT-III

7. General characters, structure, reproduction and classification of algae (Fritsch) and thallus organization in algae.
8. Structure and reproduction of the following: Chlorophyceae- *Volvox, Oedogonium* and*Chara.*

   Phaeophyceae-*Ectocarpus*

   Rhodophyceae- *Polysiphonia.*
9. Economic importance of algae in Agriculture and Industry.

UNIT-IV

10. General characters and classification of fungi (Ainsworth).
11. Structure and reproduction of the following:

    (a)Mastigimycotina- *Albugo*

(b) Zygomycotina- *Mucor*

(c) Ascomycotina- *Saccharomyces* and *Penicillium.*

(d) Basidiomycotina- *Puccinia*

(e) Deuteromycotina- *Cercospora.*

12. Economic importance of fungi in relation to mycorrhizae and mushrooms. General account of mushroom cultivation.

Paper 2C : Physical and General Chemistry

PHYSICAL CHEMISTRY

UNIT-I

1. **Solidstate:** Symmetry in crystals. Law of constancy of interfacial angles. The law of rationality of indices. The law of symmetry. Definition of lattice point, space lattice, unit cell. Bravis lattices and crystal systems. X-ray diffraction and crystal structure. Bragg's law. Defects in crystals. Stoichiometric and non-stoichiometric defects.

UNIT-II

1. **Gaseous State:** Compression factors, deviation of real gases from ideal behavior. Vander Waal's equation of state. P-V Isotherms of real gases, Andrew's isotherms of carbon dioxide, continuity of state. Critical phenomena. The vander Waal's equation and the critical state. Law of corresponding states.Relationship between critical constants and vander Waal's constants. Joule Thomson effect.
2. **Liquid State**: Structural differences between solids, liquids and gases. Liquid crystals, the mesomorphic state. Classification of liquid crystals into Smectic and Nematic. Differences between liquid crystal and solid/liquid. Application of liquid crystals as LCD devices.

UNIT-III

3. **Solutions:** Liquid-liquid - ideal solutions, Raoult's law. Ideally dilute solutions, Henry's law. Non-ideal solutions. Vapour pressure - composition and vapour pressure- temperature curves. Azeotropes-HCl-H_2O, ethanol-water systems and fractional distillation. Partially miscible liquids-phenol-water, trimethylamine-water, nicotine-water systems. Effect of impurity on consulate temperature. Immiscible liquids and steam distillation.

   Nernst distribution law. Calculation of the partition coefficient. Applications of distribution law.

GENERAL CHEMISTRY

UNIT-IV

l. **Surface Chemistry:** Definition of colloids. Solids in liquids(sols), preparation, purification, properties - kinetic, optical, electrical. Stability of colloids, Hardy-Schulze law, protective colloid.

   Liquids in liquids (emulsions) preparation, properties, uses. Liquids in solids (gels) preparation, uses. Adsorption: Physical adsorption, chemisorption. Freundlisch, Langmuir adsorption isotherms. Applications of adsorption

2. **Chemical Bonding:** Valence bond theory, hybridization, VB theory as applied to ClF_3, $Ni(CO)_4$, Molecular orbital theory - LCAO method, construction of M.O. diagrams for homo-nuclear and hetero-nuclear diatomic molecules (N_2, O_2, CO and NO).

UNIT-V

Stereochemistry of Carbon Compounds: Molecular representations- Wedge, Fischer, Newman and Saw-Horse formulae. Optical isomerism: Optical activity- wave nature of light, plane polarised light, optical rotation and specific rotation. Chiral molecules- definition and criteria(Symmetry elements)- Definition of enantiomers and diastereomers – Explanation of optical isomerism with examples Glyceraldehyde, Lactic acid, Alanine, Tartaric acid, 2,3-dibromopentane. D,L and R,S configuration methods and E,Z- configuration with examples.

Paper 2Z : Biology of Chordates, Embryology, Ecology and Zoogeography

UNIT I

Protochordata to Amphibia

Protochordates: Salient features of Urochordata and Cephalochordata Structure and life-history of Herdmania, Significance of retrogressive Metamorphosis-General organization of Chordates-General characters of Cyclostomes-General characters of fishes, classification up to sub-class level with examples-Type study - Scoliodon : Morphology, respiratory system, circulatory system, excretory system, nervous system and sense organs- Migration in fishes and types of scales-General characters and classification of Amphibia up to order level- Type study - Rana : Morphology, digestive system, respiratory system, circulatory system, excretory system, nervous system and reproductive system. Parental care in amphibians

UNIT II

Reptilia to Mammalia

General characters and classification of Reptilia up to order level. Type study – Calotes : Morphology, digestive system, respiratory system, circulatory system, urinogenital system and nervous system. General characters and classification of Aves up to order level with examples. Type study - Pigeon (Columbia livia) : Exoskeleton, respiratory system, circulatory system and excretory system. Significance of migration in birds. Flight adaptation in birds-General characters and classification of Mammalia up to order levelwith examples. Dentition in Mammals.

UNIT III

Embryology

Spermatogenesis, Oogenesis and Fertilization. Types of eggs, Types of cleavages, Development of frog up to gastrulation and formation of primary germ layers, Foetal membranes and their significance, Placenta : types and functions, Regeneration with reference to Turbellarians and Lizards

UNIT IV

Ecology

Biogeochemical cycles or nutrient cycles - Gaseous cycles of Nitrogen and Carbon; Sedimentary cycle- phosphorus. Definition of Community- Habitat and ecological niche

Community interactions: Brief account on Competition, predation, mutualism,commensalism and parasitism.Ecological succession: Primary and secondary, seral stages, climax community with examples. Population ecology : Density and dispersions of animal populations - Growth curves and growth of animal populations- r-selected and k-selected species -Population regulation mechanisms – both biotic and abiotic-Growth of human population and its control -Future of human population.

B.Sc - Botany, Chemistry, Zoology

SEMESTER – III

Paper 3B : Plant Physiology and Metabolism

UNIT – I: Plant – Water Relations

1. Physical properties of water, Importance of water to plant life.
2. Diffusion, imbibition and osmosis; concept & components of Water potential.
3. Absorption and transport of water and ascent of sap.
4. Transpiration –Definition, types of transpiration, structure and opening and closing mechanism of stomata.

UNIT –II: Mineral Nutrition & Enzymes

1. Mineral Nutrition**:** Essential elements (macro and micronutrients) and their role in plant metabolism, deficiency symptoms.
2. Mineral ion uptake (active and passive transport).
3. Nitrogen metabolism- biological nitrogen fixation in *Rhizobium*, outlines of protein synthesis (transcription and translation).
4. Enzymes**:** General characteristics, mechanism of enzyme action and factors regulating enzyme action.

UNIT –III: Photosynthesis

1. Photosynthesis: Photosynthetic pigments, photosynthetic light reactions, photophosphorylation, carbon assimilation pathways: C3, C4, and CAM (brief account)
2. Photorespiration and its significance.
3. Translocation of organic solutes: mechanism of phloem transport, source-sink relationships.

UNIT – IV: Plant Metabolism

1. Respiration: Glycolysis, anaerobic respiration, TCA cycle, electron transport system. Mechanism of oxidative phosphorylation.
2. Lipid Metabolism**:** Types of lipids, Beta-oxidation.

UNIT –V: Growth and Development

1. Growth and development: definition, phases and kinetics of growth.

2. Physiological effects of phytohormones - Auxins, Gibberellins, Cytokinins, ABA, Ethylene and Brassinosteroids.
3. Physiology of flowering -photoperiodism, role of phytochrome in flowering; Vernalization.
4. Physiology of Scenescence and Ageing.

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Paper 3C: In-Organic, Physical, Organic Chemistry

Unit – I (Inorganic Chemistry-III)

1. Coordination Chemistry

IUPAC nomenclature, bonding theories – review of Werner's theory and Sidgwick's concept of coordination, Valence bond theory, geometries of coordination numbers 4-tetrahedral and square planar and 6-octahedral and its limitations, crystal filed theory, splitting of d-orbitals in octahedral, tetrahedral and square-planar complexes – low spin and high spin complexes – factors affecting crystal-field splitting energy, merits and demerits of crystal-field theory. Isomerism in coordination compounds – structural isomerism and stereo isomerism, stereochemistry of complexes with 4 and 6 coordination numbers.

2. Spectral and Magnetic properties of Metal Complexes

Electronic absorption spectrum of $[Ti(H_2O)_6]^{3+}$ ion. Types of magnetic behavior, spin-only formula, calculation of magnetic moments, experimental determination of magnetic susceptibility Gouy method.

3. Reactivity of Metal Complexes

Labile and inert complexes, ligand substitution reactions S_N1 and S_N2, substitution reactions of square planar complexes Trans effect and applications of trans effect.

4. Stability of Metal Complexes

Thermodynamic stability and kinetic stability, factors affecting the stability of metal complexes, chelate effect, determination of composition of complex by Job's method and mole ratio method.

5.Hard and soft acids bases (HSAB)

Classification, Pearson's concept of hardness and softness, application of HSAB principles Stability of compounds / complexes, predicting the feasibility of a reaction.

6. Bioinorganic Chemistry

Essential elements, biological significance of Na, K, Mg, Ca, Fe, Co, Ni, Cu, Zn and chloride (Cl^-). Metalloporphyrins hemoglobin, structure and function, Chlorophyll, structure and role in photosynthesis.

UNIT – II (Organic Chemistry – III)

1. Nitrogen Compounds

Nitro hydrocarbons: Nomenclature and classification nitro hydrocarbons structure. Tautomerism of nitroalkanes leading to aci and keto form. Preparation of Nitroalkanes. Reactivity halogenation, reaction with HONO (Nitrous acid), Nef reaction and Mannich reaction leading to Michael addition and reduction.

Amines (Aliphatic and Aromatic): Nomenclature, Classification into 1^0, 2^0, 3^0 Amines and Quarternary ammonium compounds. Preparative methods -1. Ammonolysis of alkyl halides 2. Gabriel synthesis 3. Hoffman's bromamide reaction (mechanism).

Reduction of Amides and Schmidt reaction. Physical properties and basic character – Comparative basic strength of Ammonia, methyl amine, dimethyl amine, trimethyl amine and aniline – comparative basic strength of aniline, N-methylaniline and N,N-dimethyl aniline (in aqueous and non-aqueous medium), steric effects and substituent effects. Use of amine salts as phase transfer catalysts. Chemical properties: a) Alkylation b) Acylation c) Carbylamine reaction d) Hinsberg separation e) Reaction with Nitrous acid of 1^0, 2^0, 3^0 (Aliphatic and aromatic amines). Electrophilic substitutions of Aromatic amines – Bromination and Nitration. oxidation of aryl and 3^0 Amines. Diazotization

Cyanides and isocyanides: Nomenclature (aliphatic and aromatic) structure. Preparation of cyanides from a) Alkyl halides b) from amides c) from aldoximes. Preparation of isocyanides from Alkyl halides and Amines. Properties of cyanides and isocyanides, a) hydrolysis b) addition of Grignard reagent iii) reduction iv) oxidation.

2. Heterocyclic Compounds

Introduction and definition: Simple 5 membered ring compounds with one hetero atom Ex. Furan. Thiophene and pyrrole. Importance of ring system presence in important natural products like hemoglobin and chlorophyll. Numbering the ring systems as per Greek letter and Numbers. Aromatic character 6- electron system (four-electrons from two double bonds and a pair of non-bonded electrons from the hetero atom). Tendency to undergo substitution reactions.

Resonance structures: Indicating electron surplus carbons and electron deficient hetero atom. Explanation of feebly acidic character of pyrrole, electrophillic substitution at 2 or 5 position, Halogenation, Nitration and Sulphonation under mild conditions. Reactivity of furan as 1,3-diene, Diels Alder reactions (one example). Sulphonation of thiophene purification of Benzene obtained from coal tar). Preparation of furan, Pyrrole and thiophene from 1,4,- dicarbonyl compounds only, Paul-Knorr synthesis, structure of pyridine, Basicity Aromaticity Comparison with pyrrole one method of preparation and properties Reactivity towards Nucleophilic substitution reaction chichibabin reaction.

3. Carbohydrates

Monosaccharides: All discussion to be confined to (+) glucose as an example of aldo hexoses and (-) fructose as example of ketohexoses. Chemical properties and structureal elucidation: Evidences for straight chain pentahydroxy aldehyde structure (Acetylation, reduction to n-hexane, cyanohydrin formation, reduction of Tollen's and Fehling's reagents and oxidation to gluconic and saccharic acid). Number of optically active isomers possible for the structure, configuration of glucose based on D-glyceraldehyde as primary standard (no proof for configuration is required). Evidence for cyclic structure of glucose (some negative aldehydes tests and mutarotation). Cyclic structure of glucose. Decomposition of cyclic structure (Pyranose structure, anomeric Carbon and anomers). Proof for the

ring size (methylation, hydrolysis and oxidation reactions). Different ways of writing pyranose structure (Haworth formula and chair conformationa formula). Structure of fructose: Evidence of 2 – ketohexose structure (formation of penta acetate, formation of cyanohydrin its hydrolysis and reduction by HI to give 2-Carboxy-n-hexane). Same osazone formation from glucose and fructose, Hydrogen bonding in osazones, cyclic structure for fructose (Furanose structure and Haworth formula).

Interconversion of Monosaccharides: Aldopentose to aldo hexose eg: Arabinose to D-Glucose, D-Mannose (Kiliani Fischer method). Epimers, Epimerisation Lobry de bruyn van Ekenstein rearrangement. Aldohexose to Aldopentose eg: D-glucose to D-arabinose by Ruff'f degradation. Aldohexose (+) (glucose) to ketohexose (-) (Fructose) and Ketohexose (fructose) to aldohexose (Glucose)

4. Amino Acids and Proteins

Introduction: Definition of Amino acids, classification of Amino acids into alpha, beta, and gama amino acids. Natural and essential amino acids – definition and examples, classification of alpha amino acids into acidic, basic and neutral amino acids with examples. Methods of synthesis: General methods of synthesis of alpha amino acids (specific examples Glycine, Alanine, valine and leucene) by following methods: a) from halogenated carboxylic acid b) Malonic ester synthesis c) strecker's synthesis.

Physical properties: Optical activity of naturally occurring amino acids: L-configuration, irrespective of sign rotation, Zwitterion structure – salt like character - solubility, melting points, amphoteric character , definition of isoelectric point.

Chemical properties: General reactions due to amino and carboxyl groups – lactams from gamma and delta amino acids by heating peptide bond (amide linkage). Structure and nomenclature of peptides and proteins.

5. Mass Spectrometry

Basic principles Molecular ion / parent ion, fragment ions / daughter ions. Theory formation of parent ions. Representation of mass spectrum. Identification of parent ion, (M+1), (M+2), base peaks (relative abundance 100%) Determination of molecular formula – Mass spectra of ethylbenzene, acetophenone, n-butyl amine and 1- proponal.

Unit-III (physical chemistry-III)

1. Chemical Kinetics

Rate of reaction, factors influencing the rate of a reaction-concentration, temperature, pressure, solvent, light, catalyst. Experimental methods to determine the rate of reaction. Definition of order and molecularity. Derivation of rate constants for first, second, third and zero order reactions and examples. Derivation for time half change. Methods to determine the order of reactions. Kinetics of complex reactions (first order only): opposing reactions, parallel reactions, consecutive reactions and

chain reactions. Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy. Theories of reaction rates- collision theory-derivation of rate constant for bimolecular reaction. The transition state theory (elementary treatment).

2. Photochemistry

Difference between thermal and photochemical processes. Laws of photochemistry-Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence. Quantum yield. Ferrioxalate actinometry. Photochemical hydrogen- chlorine, hydrogen-bromine reaction. Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing). Photosensitized reactions- energy transfer processes (simple example)

3. Thermodynamics

The first law of thermodynamics-statement, definition of internal energy and enthalpy. Heat capacities and their relationship. Joule's law-Joule-Thomson coefficient. Calculation of w, q, dU and dH for the expansion of perfect gas under isothermal and adiabatic conditions for reversible processes. State function.

Temperature dependence of enthalpy of formation-Kirchoff's equation. Second law of thermodynamics. Different Statements of the law. Carnot cycle and its efficiency. Carnot theorem. Thermodynamic scale of temperature. Concept of entropy, entropy as a state function, entropy changes in cyclic, reversible, and irreversible processes and reversible phase change. Calculation of entropy changes with changes in V & T and P&T. Entropy of mixing inert perfect gases. Entropy changes in spontaneous and equilibrium processes.

The Gibbs (G) and Hlmholtz (A) energies. A & G as criteria for thermodynamic equilibrium and spontaneity-advantage over entropy change. Gibbs equations and the Maxwell relations.
Variation of G with P, V and T.

Paper 3Z: Animal Physiology, Genetics & Evolution

UNIT I

1.0. Physiology of Digestion

1.1 Definition of digestion and types of digestion – extra and intracellular.

1.2 Digestion of Carbohydrates, proteins, lipids and cellulose digestion.

1.3 Absorption and assimilation of digested food materials.

1.4 Gastrointestinal hormones- control of digestion.

2.0 Physiology of Respiration

2.1. Types of respiration – external and internal respiration.

2.2. Structure of mammalian lungs and gaseous exchange.

2.3. Transport of oxygen – formation of oxyhaemoglobin and affinity of haemoglobin for Oxygen, Oxygen dissociation curves.

2.4. Transport of CO_2 – Chloride shift, Bohr effect.

2.5. Cellular respiration – Main steps of glycolysis, Kreb's cycle, electron transport, Oxidative phosporylation and ATP production (Chemosmotic theory).

3.0. Physiology of Circulation

3.1. Open and closed circulation.

3.2. Structure of mammalian heart and its working mechanism- Heartbeat and cardiac cycle. Myogenic and neurogenic hearts.

3.3. Regulation of heart rate – Tachycardia and Bradycardia.

4.0. Physiology of Excretion

4.1. Definition of excretion.

4.2. Forms of nitrogenous waste material and their formation; classification of animals on the basis of excretory products.

4.3. Gross organization of mammalian excretory system and structure of kidney.

4.4. Structure and function of Nephron – Counter current mechanism.

UNIT II

1.0. Physiology of muscle contraction

1.1 General structure and types of muscles.

1.2. Ultra structure of skeletal muscle.

1.3. Sliding filament mechanism of muscle contraction.

1.4. Chemical changes during muscle contraction – role of calcium, ATP utilization and its replenishment.

2.0. Physiology of nerve impulse

2.1. Structure of nerve cell.

2.2. Nature of nerve impulse – resting potential and action potential. Properties of nerve impulse – threshold value, refractory period, all or none response.

2.3. Conduction of nerve impulse along an axon – local circuit theory and saltatory conduction theory.

2.4. Structure of synapse, mechanism of synaptic transmission – electrical and chemical transmissions.

3.0 Physiology of Endocrine System

3.1. Relationship between hypothalamus and pituitary gland.

3.2. Hormones of hypothalamus.

3.3. Hormones of Adenohypophysis and Neurohypophysis.

3.4. Hormones of pineal gland, thyroid gland, parathyroid, thymus, adrenal and pancreas.

3.5. Endocrine control of mammalian reproduction – Male and female hormones – Hormonal control of menstrual cycle in humans.

4.0. Physiology of Homeostasis

4.1. Concept of Homeostasis and its basic working mechanism.

4.2. Mechanism of Homeostasis – giving three illustrations viz., Hormonal control of glucose levels, Water and ionic regulation by freshwater and marine animals and temperature regulation in man.

UNIT III

1.0 Genetics

1.1 Mendel's laws – Law of segregation and independent assortment; Genetic interactions Incomplete dominance, codominance and epistasis.

1.2. Identification of DNA as the genetic material –Griffith's experiment and Hershey – Chase experiment.

1.3. Central dogma of molecular biology – Brief account of DNA replication (Semi-conservative method), Replication fork (Continous and discontinous synthesis); Transcription– Brief account of initiation, elongation and termination in eukaryotes; Translation; Genetic code; gene regulation as exemplified by lac operon.

1.4. Human karyotyping, barr bodies and Lyon hypothesis and Amniocentesis chromosomal disorders – Autosomal and sex chromosomes.

2.0. Organic Evolution

2.1. Genetic basis of Evolution, Gene pool and gene frequencies, Hardy-Weinberg's, Law, Force of destabilization, natural selection, genetic drift, Mutation, Isolation and Migration.

2.2. Speciation – Allopatry and sympatry.

B.Sc - Botany, Chemistry, Zoology

SEMESTER – IV

Paper 4B1: Physiology, Biotechnology, Seed Technology and Horticulture

Unit - I: Physiology

1. Water Relations: Importance of water to plant life, physical properties of water, diffusion, imbibition, osmosis; water, osmotic and pressure potentials; absorption, transport of water, ascent of sap; transpiration; Stomatal structure and movements.
2. Mineral Nutrition: Essential macro and micro mineral nutrients and their role; symptoms of mineral deficiency; absorption of mineral ions; passive and active processes.
3. Enzymes: Nomenclature, characteristics, mechanism and regulation of enzyme action, enzyme kinetics, factors regulating enzyme action.
4. Photosynthesis: Photosynthetic pigments, absorption and action spectra; Red drop and Emerson enhancement effect; concept of two photosystems; mechanism of photosynthetic electron transport and evolution of oxygen; photophosphorylation; Carbon assimilation pathways: C_3, C_4 and CAM; photorespiration.
5. Translocation of organic substances: Mechanism of phloem transport; source-sink relationships.

Unit - II: Physiology

6. Respiration: Aerobic and Anaerobic; Glycolysis, Krebs cycle; electron transport system, mechanism of oxidative phosphorylation, pentose phosphate pathway.
7. Nitrogen Metabolism: Biological nitrogen fixation, nitrate reduction, ammonia assimilation, amino acid synthesis and protein synthesis.
8. Lipid metabolism: Structure and functions of lipids; convertion of lipids to carbohydrates, -oxidation
9. Growth and Development: Definition, phases and kinetics of growth. Physiological effects of phytohormon- auxins, gibberellins, cytokinins, ABA, ethylene and brassinosteroids; Physiology of flowering and photoperiodism, role of phytochrome in flowering.
10. Stress Physiology: Concept and plant responses to water, salt and temperature stresses.

Unit - III: Biotechnology

11. Tissue culture: Introduction, sterilization procedures, culture media - composition and preparation; explants.
12. Callus culture; cell and protoplast culture, Somatic hybrids and cybrids.

13. Applications of tissue culture: Production of pathogen free plants and somaclonal variants, production of stress resistance plants, secondary metabolites and synthetic seeds.
14. Biotechnology: Introduction, history and scope.
15. rDNA technology: Vectors and gene cloning and transgenic plants.

Unit - IV: Seed Technology and Horticulture

16. Seed: Structure and types. Seed dormancy; causes and methods of breaking dormancy.
17. Seed storage: Seed banks, factors affecting seed viability, genetic erosion. Seed production technology; seed testing and certification.
18. Horticulture techniques: Introduction, Cultivation of ornamental and vegetable crops, Bonsai and landscaping
19. Floriculture: Introduction. Importance of green house, polyhouse, mist chamber, shade nets; Micro irrigation systems. Floriculture potential and its trade in India
20. Vegetative Propagation of plants: Stem, root and leaf cuttings. Layering and bud grafting. Role of plant growth regulators in horticulture.

Paper 4C1: Chemistry & Industry

UNIT-I: SEPARATION TECHNIQUES

Introduction, Solvent Extraction, Principles and Process, Batch Extraction, Continuous Extraction and Counter Current Extraction, Application and Determination of Iron (III).

Unit-II: SPECTROPHOTOMETRY

Introduction-Chromatography, Classification of Chromatography Methods-Principles of Differential Migration Adsorption Phenomenon, Adsorption Phenomenon, Nature of Adsorbents, Solvent Systems RF Values, Factors Effecting RF Values-Paper Chromatography, Principles of RF Values, Experimental Procedures, Choice of Paper and Solvent Systems, Developments of Chromatography Ascending, Descending and Radial, Two Dimensional Chromatography, Applications-Thin Layer Chromatography (TLC), Advantages, Principles, Factors Effecting Values, Experimental Procedures, Adsorbents and Solvents, Preparation of Plates, Development of the Chromatogram, Detection of the Spots, Applications-Column Chromatography, Principle, Experimental Procedures, Stationary and Mobile Phases, Separation Technique, Applications-High Performance Liquid Chromatography (HPLC) , Principles and Applications-Gas Liquid Chromatography (GLC), Principles and Applications.

Unit-III: MOLECULAR SPECTROSCOPY

General Features of Absorption Spectroscopy-Introduction-Beer Lambort's Law and its Limitations-Introduction- Transmittance-Absorbance and Molar Absorptivity-Single and Double Beam spectrophotometers-Application of Beer-Lambert Law for Quantitative Analysis.

Unit-IV: ELECTRONIC SPECTROSCOPY

Electronic Spectroscopy, Introduction to Molecular Spectroscopy, Interaction of Electromagnetic Radiation with Molecules and Types of Molecular Spectra-Potential Energy Curves for Bonding and Antibonding Molecular Orbitals, Introduction-Energy Levels of Molecules-Selection Rules for Electronic Spectra-Types of Electronic Transitions in Molecules Effect of Conjugation-Concept of Chromophore.

Unit-V: INFRA RED SPECTROSCOPY

Energy Levels of Simple Harmonic Oscillator, Introduction-Molecular Vibration Spectrum, Selection Rules-Determination of Force Constant-Qualitative Relation of Force Constant to Bond Energies-An harmonic Motion of Real Molecules and Energy Levels-Modes of Vibrations in Polyatomic Molecules-Characteristic Absorption Bands of Various Functional Groups-Finger Print Nature of Infrared Spectrum.

Unit-VI: RAMAN SPECTROSCOPY

Concept of Polarizability, Introduction, Selection Rules-Pure Rotational and Pure Vibrational Raman Spectra of Diatomic Molecules, Selection Rules.

Unit-VII: PROTON MAGNETIC RESONANCE SPECTROSCOPY

Principles of Nuclear Magnetic Resonance- Equivalent and Non-Equivalent Protons-Position of Signals and Chemical Shift-NMR Splitting of Signals, Spin-Spin Coupling, Coupling Constants-Applications of NMR.

Unit-VIII: SPECTRAL INTERPRETATION

Spectral Interpretation of Some Compounds, Phenylacetylene, Acetophenone, Cinnamic acid, Paranitroaniline.

Unit-IX: DRUGS

Introduction of Drug and Disease, Historical Evolution, Sources-plant, Animal Synthetic, Biotechnology and Human Genetherapy –Pharmacy, Pharmacology, Pharmacophore, Pharmacodynamics, Pharmacokinetics, Metabolites and Antimetabolities-Nomenclature, Classification Based on Structures and Therapeutic-Synthesis and TherapeuticActivity –Pencillin, Separation and Isolation-Drug Development of different pencillins-Drug Development of HIV-AIDS, Prevention of AIDS, Drugs Available, NNRTIS, NNRTIS, Monographs of Drugs.

Unit-X: FORMULATIONS

Need of Conversion of Drugs into Medicine, Additives used in Preparing the Dosage Form-Different Types of Formulation.

Unit-XI: PESTICIDES

Need of Conversion of Drugs into Medicine, Types of Pesticides-Rodenticides Plant Growth Regulators-Pheremones and Hormones-Synthesis of Pestcides.

Unit-XII: GREEN CHEMISTRY

Introduction, Definition of Green Chemistry , Need of Green Chemistry, Basic Principles of Green Chemistry-Green Synthesis, Evalution of the Type of the Reaction-Pericyclic Reactions (No By-Product)-Selection of Solvents, Green Catalysis, Microwave and Ultrasound Assisted Green Synthesis, Aldol Condensation, Connizaro Reaction, Diels-Alder Reaction, Strecker Synthesis, Willaimson Synthesis Williamson Synthesis, Dieckmann Condensation.

Unit-XIII: MACROMOLECULES

Classification of Polymers-Chemistry of Polymerization-Chain Polymerization-Step Polymerisation-Coordination Polymerization-Tacticity-Molecular Weight of Polymers, Number Average and Weight Average Molecular Weight-Degree of Polymerization-Determination of Molecular Weight of Polymers by Viscometry -Osmometry and Light Scattering Methods-Kinetic of Free Radical Polymerization, Derivation of Rate Law-Preparation and Indudtrial Application, Polyethylene, PVC and Teflon, Poly acrylonitrile, Terelene and Nylon 66-Introduction to Biodegradability

Unit-XIV: MATERIALS SCIENCE

Superconductivity, Characteristics of Superconductors, Meissner Effect, Types of Superconductors and Applications-Nanomaterials, Synthetic Techniques-Types of methods of Nanotechnology, Bottom-up-sol-gel Method, Top-down-Electrodeposition Method-Nanomaterials, Properties and Applications of Nanomaterials-Composites-Definition, General Characteristics-Particle Reinforce and Fiber Reinforce Composites and their Applications.

Unit-XV: CATALYSIS

Homogeneous and Hetrogeneous Catalysis-Kinetics of Specific Acid Catalyzed Reactions, Inversion of Cane Sugar-Kinetic of Specific Base Catalyzed Reactions, Base Catalyzed Conversion of Acetone to Discetone Alcohal-Acid and Base Catalyzed Reactions, Hydrolysis of Esters, Multarotation of Gulcose-Cataytic Activity at Surfaces-Mechanism of Hetrogenous Catalysis-Langmuir-Hinshelwood Mechanism-Enzyme catalysis: Classification and Characteristics of Eznzyme catalysis ,Significance of Michaelis Constant-Factors Affecting Enzyme Catalysis, Effect of Temperature, PH Concentration and Inhibitor-Catalytic Efficiency-Mechanism of Oxidation of Ethanol by Alcohol Dehydrogenase.

Paper 4Z1: Applied Zoology

UNIT I

1.0 Fisheries and Aquaculture

1.1 Capture fisheries – Introduction

1.2 Types of fisheries, Fishery resources from Freshwater, Brackish water and Marine habitats.

1.3 Finfish and shell fisheries.

1.4 Fishing gears and fishing crafts.

1.5 Freshwater, Brackish water and Mariculture.

1.6 Site selection criteria.

1.7 Aquaculture systems.

1.8 Induced breeding.

1.9 Hatchery design and Management

1.10 Larval rearing – Nursery ponds, rearing and grow out ponds

1.11 Shrimp and prawn culture

1.12 Hatchery systems, Seed transport, common diseases and control

1.13 Post-harvest technology

1.14 Preservation and processing – Freezing, solar drying, Canning, salting, smoking.

UNIT II

2.0 Clinical Science

2.1 Hematology

- 2.1.1 Blood composition and functions
- 2.1.2 Blood groups and transfusion problems
- 2.1.3 Blood diseases – Anemia, Leukemia, Leucocytosis, Leucopaenia
- 2.1.4 Biopsy and autopsy – clinical importance

2.2 Immunology

- 2.2.1 Types of immunity – Innate and acquired
- 2.2.2 Antigens – Haptenes and epitopes and their properties
- 2.2.3 Structure and biological properties of human immunoglobulin G (IgG)
- 2.2.4 Hypersensitivity – immediate and delayed

2.3 Important Human Parasites

- 2.3.1 Blood Parasites (Structure and Clinical significance of *Plasmodium*).

2.3.2 Intestinal parasites – Structure and clinical significance *Entamoeba*, *Giardia*, *Taenia solium, Ancylostoma, Enterobius*

UNIT III

3.0 Animal Biotechnology

3.1 Animal Biotechnology: Scope of Biotechnology, Cloning vectors - Characteristics of vectors, Plasmids.

3.2 Gene Cloning – Enzymatic cleavage of DNA, Restriction enzymes (Endonucleases) and Ligation.

3.3 Transgenesis and Production of transgenic animals (Fish and Goat).

3.4 Application of Stem Cell technology in cell based therapy (Diabetes and Parkinson's diseases)