BIOLOGY (863)

Aims:

1. To enable candidates to acquire the knowledge and to develop an understanding of biological terms, concepts, facts, principles, formulae, etc.
2. To develop the ability to apply the knowledge of biology in unfamiliar situations.
3. To develop experimental skills required in biology practical work.
4. To create awareness about the problems of the environment and the manner in which these problems can be overcome.
5. To develop the ability to appreciate biological phenomena in nature and the contribution of biology to human welfare.
6. To develop interest in plants and animals and in their respective environments.
7. To develop scientific attitude towards biological phenomena.
8. To create awareness of the fundamentals of human biology, food, health, nutrition and population control.

CLASS XI

There will be two papers in the subject.

Paper I: *Theory:*	*3 hours*	*... 70 marks*
Paper II*: Practical:*	*3 hours*	*... 20 marks*
Project Work		*… 7 marks*
Practical File		*… 3 marks*

PAPER I –THEORY – 70 Marks

There will be one paper of 3 hours duration divided into two parts.

Part I (20 marks) *will consist of compulsory short answer questions, testing knowledge, application and skills relating to elementary/fundamental aspects of the entire syllabus.*

Part II (50 marks) *will be divided into three Sections A, B and C. Candidates will be required to answer* ***two*** *out of* ***three*** *questions from Section A (each carrying 5 marks),* ***two*** *out of* ***three*** *questions from Section B (each carrying 10 marks) and* ***two*** *out of* ***three*** *questions from Section C (each carrying 10 marks). Therefore a* ***total of six*** *questions are to be answered in Part II.*

Note: All structures (internal and external) are required to be taught along with diagrams.

SECTION – A

1. Diversity of Life

(i) Taxonomy and phylogeny, three domains of life; taxonomical hierarchies, binomial nomenclature.

Need for classification should be discussed. Definition and explanation of the terms taxonomy and phylogeny should be given for a clear understanding; the three systems of classification – artificial, natural and phylogenetic; *three domains of life – definition and features (archaea, bacteria, eukarya); major taxonomical hierarchies (phylum, class, order, family, genus, species): definition and example with reference to classification of one angiosperm and a mammal; rules of binomial nomenclature and advantages of using scientific names, Aids for study of taxonomy — a very brief idea of museum and herbaria.*

(ii) Five-kingdom classification: salient features, characteristics and examples.

Five-kingdom system of classification and characteristics of different kingdoms with examples.

(a) Kingdom Monera: Bacteria - Classification of bacteria according to shape, nutrition and mode of respiration; differences between gram +ve and gram –ve bacteria; economic importance with reference to role of bacteria in sewage treatment, antibiotics, energy production and house hold products (curd and cheese only); archaebacteria - A brief idea of the role of different types of archaebacteria (methanogens, halophiles and thermoacidophils in their extreme environments). Virus (characteristic features – link between living and non-living, structure of TMV and bacteriophage and contribution of

the following scientists: D.J. Ivanowsky, M.W. Beijerinek, W.M. Stanley) and Viroid (definition only).

(b) General characteristics of Kingdom Protista – Only two general characteristics and two examples of subgroups: (i) Chrysophytes (ii) Dinoflagellates, (iii) Euglenoids, (iv) Slime moulds, (v) Protozoans (to be studied under rhizopods, flagellates, ciliates and sporozoans with two characteristics including modes of locomotion and two examples of each).

(c) Kingdom Fungi: general characteristics of each (including types of spores). Zygomycetes, Ascomycetes, Basidomycetes, Deuteromycetes - two characteristics with two examples of each. Role of fungi in the field of medicine, bakery and environmental decomposition. Definition of lichens and mycorrhiza (ecto and endo).

Life cycles not required.

(d) Plant Kingdom: Algae – Two characteristics and two examples of Chlorophyceae, Phaeophyceae, Rhodophyceae; Economic importance of algae – any five.

Bryophyta – Characteristics, classification into liverworts and mosses; Life cycle of Funaria with reference to alternation of generations. ***(Emphasis should be laid on gametophyte and sporophyte stages).***

Pteridophyta, Gymnosperms and Angiosperms – five Characteristics and two examples of each. Graphic outline of life cycles of pteridophyta and gymnosperm only.

(e) Animal Kingdom: animal construction - body plan (cell aggregate plan, blind-sac plan and tube-within-tube plan), symmetry (spherical, radial and bilateral symmetry), coelom development (diploblastic and triploblastic animals, acoelomate, pseudocoelomate, coelomate and haemocoelomate), segmentation.

Nonchordata - five distinguishing characters with two examples of Porifera, Coelenterata, Ctenophora, Platyhelminthes, Nematoda, Annelida, Mollusca, Arthropoda, Echinodermata.

Chordata – Sub-classification of Chordata with reference to notochord - Sub phyla Hemichordata, Urochordata, Cephalochordata with at least one example of each and Vertebrata (classes - pisces, amphibia, reptilia, aves and mammalia – three distinguishing characters with two examples of each).

(iii) Morphology and anatomy of different systems of cockroach (digestive, respiratory, circulatory, excretory, nervous and reproductive).

Only an ***elementary*** *knowledge of the above systems is required.*

SECTION B

2. Plant Physiology

(i) Mineral nutrition: macronutrients and micronutrients (role and deficiency symptoms); criteria for essentiality of elements, hydroponics; nitrogen nutrition in plants.

Criteria for essentiality of minerals, hydroponics, macro and micronutrients; role and deficiency symptoms (hunger signs) of various elements.

(ii) Plant growth: phases of growth, growth rate, measurement of growth, factors affecting growth, role of growth regulators, seed dormancy and germination, apical dominance, senescence and abscission.

A brief idea about differentiation, dedifferentiation and redifferentiation. Phases of growth in meristems, growth rate – definition; measurement of growth by direct method and use of auxanometer, factors affecting growth.

Brief idea of various theories leading to discovery of auxins by Went; role of growth regulators in development and growth of plants (such as auxins, gibberelins, cytokinins, ethylene and abscisic acid –four effects of each); definition of dormancy and

quiescence; causes and methods of breaking seed dormancy; definition of hypogeal, epigeal and viviparous germination with two examples of each; definition of apical dominance, senescence, abscission, applications of synthetic growth regulators (IAA and 2,4 - D).

(iii) Photomorphogenesis in plants.

A brief idea of short day, long day and day neutral plants; critical day length, definition and differences between photoperiodism and vernalisation.

3. Multicellularity: Structure and Functions of Plants and Animals

(i) Plant Tissues: types of plant tissues: Meristematic: Classification of Meristematic tissue. Permanent Tissues: Structure and function of simple tissues (parenchyma, collenchyma and sclerenchyma) and complex tissues (xylem and phloem), types of vascular bundles.

Characteristics of meristematic tissue; classification of meristems based on origin and location; structure, function and location of permanent tissues; simple and complex tissues; types of vascular bundles to be taught, difference between open and closed vascular bundles along with the help of diagrams.

(ii) Animal Tissues: epithelial; connective; muscular; nervous (location, structure and function).

Epithelial, connective, muscular and nervous tissues to be taught with the help of diagrams.

Location, structure and functions of epithelial tissues with examples, location and general structure of areolar tissue - functions of different types of cells; difference between collagen and elastin fibres; difference between bone and cartilage; T.S. of hyaline cartilage, T.S of bone, (to be taught with the help of diagrams); lymph and blood; different types of muscles and their functions; structure of a neuron.

(iii) Nutrition (human): Calorific value of carbohydrates, proteins and fats, Organs of digestive system (histology of individual organs not required), digestive process and disorders of the digestive system.

Calorific value of carbohydrates, proteins and fats per gram; Structure and functions of the digestive organs and their associated glands; diagram of the digestive system with correct position of the organs and the associated glands; diagrammatic representation of T.S. of gut showing the four layers - histology of individual organs not required; hormonal regulation of digestive juices; absorption of food; factors controlling the absorptive power and small intestine as principal site for absorption, assimilation of digested food; disorders of the digestive system – jaundice, constipation, diarrhoea, Protein Energy Malnutrition (PEM), vomiting and indigestion.

(iv) Respiration (human): Organs of respiratory system, breathing mechanism (inspiration and expiration), pulmonary gas exchange, transport of respiratory gases, pulmonary air volumes and lung capacities. Disorders of the respiratory system.

Organs involved in respiration; diagram of the respiratory tract and the associated organs. Mechanism of pulmonary gas exchange; breathing process should be explained showing the action of diaphragm and intercostal muscles; Transport of oxygen in the blood as dissolved oxygen and as oxyhaemoglobin; transport of CO_2 as carbonic acid, as bicarbonates and carbamino haemoglobin; Chloride shift, pulmonary air volumes and lung capacity must be taught. Disorders of respiratory system such as emphysema, asthma, occupational respiratory disorders.

(v) Circulation: closed and open vascular systems, structure of human heart, cardiac cycle, systemic and pulmonary circulation, portal system, arterial blood pressure, origin and conduction of heart beat, blood vessels (structure with the help of diagrams and adaptation), lymphatic system. ABO groups, coagulation of blood. Disorders of the Circulatory system.

Difference between closed and open vascular system should be discussed; advantages of closed vascular system; external and internal structure of heart to be taught with diagram to provide a clear idea; functions of different valves to be discussed; working of the heart and blood flow through the heart during different phases should be described under the following headings - auricular systole, auricular diastole, ventricular systole, ventricular diastole and joint diastole; brief idea of cardiac output; arterial blood pressure (systolic and diastolic), double circulation. The internal structure of artery, vein and capillary with the adaptations for their functions should be discussed. Importance of ABO groups in blood transfusion; clotting of blood to be taught briefly; lymphatic system – a brief idea of lymph, lymphatic capillaries and lymph nodes; Disorders of the Circulatory system such as hypertension, coronary artery disease, Angina pectoris and heart failure.

(vi) Excretion: ammonotelism, ureotelism, uricotelism, structure of human kidney (L.S.), structure of nephron, role of skin and lungs in excretion, physiology of urine formation, counter current system; functions of the kidney; homeostasis. Disorders of the excretory system.

Define, differentiate and explain the terms ammonotelism, ureotelism and uricotelism; external and internal structure of the kidney (L.S.) with functions of the various parts; structure of nephron; physiology of urine formation - ultra filtration, selective reabsorption and active (tubular) secretion. (Students are expected to know which product is reabsorbed in each part of uriniferous tubule and the type of mechanism). Counter current system, Regulation of urine formation, Renin-angiotensin, Atrial Natriuretic Factor. Functions of the kidney.

Role of skin and lungs in excretion. Homeostasis – definition. Disorders of the excretory system. (i) renal calculi, (ii) glomerulonephritis,(iii) uremia, (iv) renal failure.

(vii) Endocrine System (human): hormones of pituitary, pineal, thyroid, parathyroid, pancreas, adrenal glands and gonads; mechanism of hormone action; effect of hyposecretion and hypersecretion, feedback mechanism.

Brief idea of location of endocrine glands, tropic hormones of pituitary and their functions; feedback control of tropic hormones to be discussed giving examples for better understanding; role of hypothalamus; hormones secreted by different lobes of pituitary and their functions; hormones of pineal, thyroid, parathyroid, pancreas, adrenal glands and gonads; mechanism of hormone action (through CAMP and steroid hormones only); effects of hypo secretion and hyper secretion of various hormones of the above mentioned glands.

(viii) Nervous System (human): Central, autonomic and peripheral, structure of brain and spinal cord, reflex action, transmission of nerve impulse, saltatory conduction; sense organs (eye and ear). Receptors (mechanoreceptor, chemoreceptor, photoreceptor and thermoreceptors),

Nervous co-ordination: central, autonomic and peripheral nervous systems.

Structure and functions of various parts of the brain and spinal cord; differences between sympathetic and parasympathetic nerve fibres; conduction of nerve impulses through nerve fibre and through synapse; conduction of nerve impulse through a myelinated nerve fibre; reflex arc to be taught with diagram showing the pathway by means of arrows; physiology of reflex action, natural reflex and conditioned reflex - definition, examples and differences; Eye and Ear: structure and working to be done along with the help of a diagram.

Types and functions of receptors: mechanoreceptor, chemoreceptor, photoreceptor and thermoreceptors.

(ix) Locomotion: joints, structure of skeletal muscle, sliding filament theory of muscle contraction, red and white muscles, summation, tetanus and rigor mortis. Disorders of muscular and skeletal system.

Locomotion: Basic aspects of human skeleton (axial and appendicular).

Functions of human skeleton; different types of joints - their location and function; diagram of synovial joint; general properties of muscles; structure of skeletal muscle - sliding filament theory of muscle contraction; chemical events during muscle contraction should be dealt with separately; definition of summation, tetanus, rigor mortis, differences between red and white muscles.

Disorders of muscular and skeletal system (i) Muscular dystrophy, (ii) Arthritis, (iii) Gout, (iv) Osteoporosis, (v) Tetany, (vi) Myasthenia gravis.

SECTION C

4. Units of Life

(i) Biomolecules: Outline classification and functions of Carbohydrates, proteins, lipids and nucleic acids.

Carbohydrates: general classification and functions of: monosaccharides (glucose, galactose and fructose), disaccharides (maltose, lactose and sucrose), polysaccharides (glycogen, starch, cellulose).

Proteins: Levels of structure (primary, secondary, tertiary and quaternary) and their functions, classification of proteins - simple, conjugated and derived.

Lipids – classification, structure and functions of fats and oils.

Nucleotides and Nucleic acids – Structure and function of DNA, types of RNA. Differences between DNA and RNA.

(ii) Enzymes: General properties, classification, mechanism of enzyme action, factors affecting enzyme activity.

General properties, nomenclature and classification of enzymes according to type of reactions, co-enzymes and co-factors; Lock and key hypothesis should be explained with diagram to give a clear concept of enzyme action. Factors affecting enzyme activity should be taught – temperature, pH, substrate concentration, competitive and non-competitive inhibitors.

(iii) Cell membranes: fluid mosaic model, membrane transport, passive and active transport, exocytosis and endocytosis. Facilitated diffusion.

Description of fluid mosaic model; Functions of the plasma membrane: active and passive transport, endocytosis and exocytosis should be explained. Brief explanation of facilitated diffusion (uniport, symport and antiport) with one example.

(iv) Cell structure: structure and functions of nucleus, mitochondria, plastids, endoplasmic reticulum, golgi complex, lysosomes, ribosomes, microfilaments, microtubules, cilia, flagella and centrioles (ultra structure and function);

Cell wall, vacuoles and cell inclusions. Prokaryotic cell and eukaryotic cell – a comparison.

Ultra structure and functions of all the above to be taught with diagrams.

General structure of eukaryotic cell; differences and similarities between prokaryotic cell and eukaryotic cell, plant and animal cell, microfilaments and microtubules, flagella and cilia.

(v) Cellular respiration: aerobic and anaerobic, fermentation, glycolysis, Krebs' cycle, oxidative phosphorylation and respiratory quotient. Amphibolic pathway.

Types of respiration; mechanism of respiration: glycolysis, oxidation of pyruvate, Krebs' cycle, ETS (only flowchart). Oxidative phosphorylation – definition; Brief idea of fermentation and Amphibolic pathway. Definition of respiratory quotient and RQ values of carbohydrates, proteins and fats.

(vi) Cell reproduction: cell cycle, mitosis and meiosis.

Different stages with diagrams should be explained to give a clear concept of the changes taking place at each step. Significance of mitosis and meiosis should be discussed.

5. Organisms and Environment

(i) Ecosystem: biotic and abiotic components, Productivity and decomposition, food chain, trophic levels, food webs, ecological pyramids, niche, biogeochemical cycles.

Brief idea about biotic and abiotic components. Productivity - Gross and net, primary productivity, secondary productivity. Decomposition – fragmentation, leaching, catabolism, humification and mineralization. Various types of food chains – grazing and detritus, food webs, trophic levels, ecological pyramids – energy, number and biomass. Niche – definition. Biogeochemical cycles – Carbon and Phosphorous.

(ii) Pollution: Air, water and soil pollution and their control. Greenhouse effect and ozone depletion.

Environmental issues: Air pollution and its control, major sources of gaseous and particulate pollutants, control devices for air pollution such as: scrubbers and electrostatic precipitators; Water pollution, major sources and its control, eutrophication, BOD; Soil pollution – sources, effects and control Agrochemicals and their effects, biomagnification and bioconcentration; solid waste management, Radioactive waste management, e-waste.

A brief understanding of the concept Deforestation, Greenhouse effect. Impact of global warming in terms of climatic changes, rise in sea levels, melting of ice caps; impact on animals and plants due to climate changes. Ozone depletion. Any three case studies as success stories addressing environmental issues.

PAPER II

PRACTICAL WORK – 20 Marks

1. Scientific Techniques

Study parts of a dissecting microscope and compound microscope.

The students should know all parts of dissecting and compound microscope and be able to handle the microscope independently.

2. Physiology

Students will be required to carry out sequence of instructions or experiments such as:

(i) Food tests: test for starch, glucose, sucrose, proteins and fats.

Food tests: tests should be reported in tabular form. Both positive and negative tests should be reported.

(ii) To study the effect of thawing, heat and alcohol on permeability of beet root cells.

To study the effect of heat on permeability of cell membrane of beet root cells: students should record the observations at very low temperature, room temperature and higher temperature to see the degree of leaching and conclude accordingly. Experiment on effect of alcohol on the permeability with regard to leaching. Can be done separately or alongside effect of heat for comparison.

(iii) Study of pH of different soils.

Collect soil samples from two different areas and make a comparative study of their texture, moisture content and pH.

(iv) To study the effect of different temperatures and three different pH on enzyme (amylase) action on starch solution.

Self-explanatory

(v) To study the rate of respiration in germinating seeds and/or flower buds.

Self-explanatory

3. Morphology

(i) Morphology and modification of roots, stems and leaves.

Teachers can show examples of roots, stems and leaves modified for mechanical support, storage, reproduction or perennation – students should learn to identify and draw the specimens.

Leaves: phyllotaxy – alternate, opposite whorled (with an example of each), shape, venation, simple and compound.

(ii) Preparation of temporary slides of Mucor / Rhizopus.

The teacher should guide the students on the technique of culture, staining and mounting the material and then observing under the microscope. The students should also be able to make labelled diagrams and record observations.

4. Cytology

Preparation of temporary slides of -

(i) Onion peel (to study the plant cell)

(ii) Stages of Mitosis in onion root tips.

Correct method of selecting the root tip, fixing, staining and mounting should be taught. Different stages should be observed first in low power and after locating the area, the students should see it under high power. Various stages should be drawn and labelled.

After mounting and observing the tissue students should be able to draw the diagram and label all the parts.

5. Spotting: (Three minutes to be given for each spot which includes identification, drawing a labelled diagram and writing two characteristics).

(a) Identification of stained preparations of the following:

(i) Stages of mitosis.

(ii) Stages of meiosis.

(iii) Identification of mammalian blood cells.

(iv) Bacteria

(v) Oscillatoria

(vi) Spirogyra

(vii) Amoeba

(viii) Entamoeba

(ix) Plasmodium

(x) Yeast

(b) Identification of the following specimens -

(i) Liverworts

(ii) Moss

(iii) Fern

(iv) Pinus

(v) Rhizopus

(vi) Mushroom

(vii) Lichen

(viii) One monocot plant – bamboo

(ix) One dicot plant – petunia

(x) A phylloclade - cactus

(xi) Hydra

(xii) Liver Fluke

(xiii) Ascaris

(xiv) Leech

(xv) Earthworm

(xvi) Prawn/Crab

(xvii) Honey Bee

(xviii) Cockroach

(xix) Silk Worm

(xx) Rohu fish

Students should be taught how to identify, draw, label and give significantly visible characteristics, as observed, of each spot, in a given time of three minutes.

(c) Comment on experimental set up in Physiology – Aerobic and Anaerobic Respiration.

Students should identify (aim of experiment), draw physiological set up and write a brief description (observation, inference and precautions) of the experiment in three minutes.

PROJECT WORK AND PRACTICAL FILE – 10 Marks

Project Work – 7 Marks

Candidate is to creatively execute one project/assignment on any aspect of Biology. Following is only a suggestive list of projects. Teachers may assign or students may choose any one project of their choice.

(i) Project related to experiment on any aspect of plant life.

(ii) Project related to any aspect of environment.

(iii) Projects related to modern researches in Biology, e.g. test-tube babies.

(iv) Role of genetics in investigating crimes.

(v) Yeast fermentation and production of alcohol or any other commercial industry dependant on plants and/or animals or their products.

In addition, students may be taught how to culture:

- Earthworms.
- Protozoans.
- Moulds.
- Setting up of an aquarium.

Suggested Evaluation Criteria for Project Work:

Format of the Project:

- Content
- Introduction
- Presentation (graphs, tables, charts, newspaper cuttings, handmade diagrams, photographs, statistical analysis if relevant)
- Conclusion/ Summary
- Bibliography

Projects should be handwritten by the candidate. The written pages should not exceed 15-20 pages.

Practical File – 3 Marks

Teachers are required to assess students on the basis of the Biology Practical file maintained by them during the academic year.

Each practical done during the year, needs to be recorded by the student in the Practical file and the same must be checked, signed and dated by the teacher.

CLASS XII

There will be two papers in the subject.

***Paper I:** Theory:*	*3 hours*	*... 70 marks*
***Paper II**: Practical:*	*3 hours*	*... 20 marks*
Project Work		*… 7 marks*
Practical File		*… 3 marks*

PAPER I –THEORY – 70 Marks

There will be one paper of 3 hours duration divided into two parts.

Part I (20 marks) *will consist of compulsory short answer questions, testing knowledge, application and skills relating to elementary/fundamental aspects of the entire syllabus.*

Part II (50 marks) *will be divided into three Sections A, B and C. Candidates will be required to answer* ***two*** *out of* ***three*** *questions from Section A (each carrying 5 marks),* ***two*** *out of* ***three*** *questions from Section B (each carrying 10 marks) and* ***two*** *out of* ***three*** *questions from Section C (each carrying 10 marks). Therefore a* ***total of six*** *questions are to be answered in Part II.*

All structures (internal and external) are required to be taught along with diagrams.

SECTION A

1. Origin and Evolution of Life

(i) Origin of life: living and nonliving; chemical evolution; organic evolution - Oparin ideas, Miller-Urey experiments; interrelationship among organisms and evidences of evolution: morphological evidences - homology and analogy, vestigial organs, atavism; embryological, palaeontological (fossils) and biogeographical evidences, molecular (genetic) evidences.

Origin of life - Characteristics of living organisms, differences between living organisms and non-living objects in levels of organisation. Abiogenesis and Biogenesis. Important views on the origin of life – chemogeny, biogeny, cognogeny, modern concept of origin of life, Oparin Haldane theory, coacervates, Protobionts, Miller and Urey experiment, evidences of evolution: morphological evidences, vestigial organs, atavism, homologous and analogous organs; connecting links – definitions and differences (two examples each from plants and animals), embryological evidences – similarity in early development vertebrate embryos, temporary embryonic structures – definition and difference - theory of recapitulation and biogenetic law – ontogeny recapitulates phylogeny, palaeontological evidence – definition of fossils, missing link and example of Archaeopteryx, biogeographical evidence, molecular (genetic) evidences for example genome similarity, universal genetic code; Darwin's finches (adaptive radiation).

(ii) Theories of evolution: Lamarckism: evidences in favour of Lamarckism (giraffe's neck), criticism of Lamarckism; Darwinism: basic postulates of Darwinism, drawbacks of Darwinism, Neo-Darwinism (Modern Synthetic Theory); Hardy Weinberg's principle; variations: causes of variation, mutation, selected examples and types of natural selection (DDT resistance in mosquito, sickle-cell anaemia); artificial selection; adaptations. Human evolution: Dryopithecus, Australopithecus, *Homo erectus, Homo neanderthalensis, Cromagnon man* and *Homo sapiens*; differences between apes and man.

Brief idea of Lamarck's theory to be given for better understanding of evolution – examples in favour of Lamarkism such as evolution of long neck giraffe to be discussed. Three examples favouring criticism of Lamarkism; salient features of Darwinism – criticism of Darwinism and Neo Darwinism (Modern Synthetic Theory) is to be taught; causes of variation, De Vries theory of mutation – definition and its role in evolution, examples of natural selection - resistance of mosquitoes to DDT, sickle cell anaemia, differences between natural and artificial selection, types of natural selection (directional, disruptive and stabilising), definition of gene pool, gene flow, genetic drift and Hardy Weinberg's principle – convergent and divergent evolution with

examples; evolution of man - three features of each of the ancestors Dryopithecus, Australopithecus, Homo erectus, Homo neanderthalensis, Cromagnon man and Homo sapiens leading to man of today; comparison and homology in chromosomes of apes and man, characters that have developed during human evolution.

SECTION B

2. Multicellularity

A. Plants

T. S of young dicot and monocot stem, T. S of young dicot and monocot root and V. S. of dicot and monocot leaf. Secondary growth in stem: brief idea of formation of secondary xylem and secondary phloem by cambium ring formation, annual rings.

Anatomical differences between dicot and monocot root, stem and leaf must be taught for better understanding. Students should be able to draw the T.S. of roots and stem and V.S. of monocot and dicot leaves showing cellular details.

Basic idea of how secondary growth takes place in dicot stems (with the help of outline diagrams) and formation of annual rings. Activity of the cambium, formation of secondary tissues, differences between Heart wood and Sap wood.

(ii) Absorption and movement of water in plants: diffusion, imbibition, osmosis, osmotic pressure, turgor pressure, wall pressure, water potential, diffusion pressure deficit. Mechanism of water absorption (active and passive absorption), root pressure, transpiration, transpiration pull theory for ascent of sap, mechanism of opening and closing of stomata (active potassium theory), guttation.

Characteristics of imbibition; factors affecting imbibition; importance of imbibition, characteristics and significance of diffusion; osmosis - endosmosis and exosmosis; significance of osmosis and turgidity - osmotic pressure, turgor pressure, wall pressure and diffusion pressure deficit should be explained. Students should know the significance of turgidity, plasmolysis and its practical utility, importance of water; active and passive absorption of water; apoplastic and symplastic movements, definition of water potential and its components viz. solute, matrix and pressure potential (Numerical problems based on this concept are not required). Root pressure – definition and experiment to demonstrate it. Explanation and definition of transpiration to give students a clear idea; significance of transpiration. Stomatal mechanism - K^+ transport mechanism. Mechanism of ascent of sap by cohesion – tension and transpiration pull theory. Guttation – definition, differences between transpiration and guttation. Function of stomata and hydathode.

(iii) Photosynthesis: ultra structure of chloroplast, photochemical and biosynthetic phases, absorption and action spectra, factors affecting photosynthesis, photophosphorylation; photorespiration, transport of solutes.

Photosynthesis and photorespiration.

Definitions and differences between absorption and action spectra.

Brief idea of photosynthetic pigments (chlorophyll 'a'&'b', carotenoids and xanthophyll), ultra structure of chloroplast including role of quantasomes. photochemical phase - pigment systems, cyclic and non-cyclic photophosphorylation (chemiosmotic hypothesis); biosynthetic phase - C_3 and C_4 cycles – graphic representation in correct sequence (carboxylation, glycolytic reversal and regeneration of pentose); Differences between C_3 and C_4 plants, C_3 and C_4 cycles, Photosystems I and II, cyclic and non-cyclic photophosphorylation. Photorespiration pathway in brief - explanation of how RuBP carboxylase acts as RuBP oxygenase. Kranz anatomy. Blackman's Law of limiting factors, factors affecting Photosynthesis. Translocation.

Transport of solutes and water; Evidences which indicate that downward movement of organic solutes takes place in phloem; mechanism of translocation; mass flow hypothesis with diagram.

(iv) Reproduction and development in angiosperms: vegetative reproduction, structure of a typical flower, types of inflorescence (racemose and cymose), sexual reproduction: development of male and female gametophytes, placentation, pollination, fertilisation (Amphimixis) and formation of endosperm, embryo, seed and fruits (broadly classified). Apomixes, Polyembryony, Parthenocarpy. Significance of seed and fruit formation.

Natural vegetative propagation, advantages and disadvantages of vegetative reproduction. Structure of a typical flower, types of inflorescence (racemose and cymose – subtypes not required). Types of pollination and adaptations in flowers pollinated by wind, water and insects. Advantages of self and cross-pollination. Contrivances for prevention of self pollination. Development of male and female gametophytes to be taught with the help of diagrams. Structure of anatropous ovule (L.S.), types of placentation with diagrams. Events leading to fertilization should be discussed. Various ways of entry of pollen tube into the ovule, definition of triple fusion, double fertilization and significance of double fertilization, changes after fertilization. Fruits to be classified into simple (dry and fleshy), aggregate and multiple. Apomixes, Polyembryony, Parthenocarpy to be explained briefly. Significance of seed and fruit formation.

(v) Differentiation and organ formation.

Embryo formation (monocot and dicot); types of endosperm (cellular, nuclear and helobial); changes in the ovule and ovary for seed and fruit formation.

B. Animals

Reproduction (human): internal structure of human testis and ovary, menstrual cycle, gametogenesis, embryonic development in mammals (up to three germ layers). Medical termination of pregnancy, infertility. Amniocentesis. Assisted reproductive technologies.

Organs of male and female reproductive system and their functions; internal structure of testis and ovary to be taught with the help of diagrams; gametogenesis- spermatogenesis and oogenesis; menstrual cycle - different phases and hormone action, Menarche and Menopause, capacitation, fertilisation, physio-chemical events during fertilisation, implantation, embryonic development up to blastocyst formation, foetal membranes, placenta and its functions. Parturition; lactation – hormonal control and importance. Definition of medical termination of pregnancy (MTP) and reasons for it; causes of infertility. Amniocentesis – role in detecting genetic defects. Assisted reproductive technologies: IVF, ZIFT, GIFT - Definition and application only.

SECTION C

3. Genetics

(i) Fundamentals of Genetics: concept of alleles: dominant and recessive; phenotype and genotype, homozygous and heterozygous, mono and dihybrid crosses.

Homologous chromosomes, autosomes and sex chromosomes; alleles – dominant and recessive; phenotype; genotype; homozygous; heterozygous, monohybrid and dihybrid crosses; back cross and test cross, definitions to be taught with simple examples using Punnett square.

(ii) Mendel's experiments with peas; Mendel's Principles of inheritance, incomplete dominance, co-dominance and multiple alleles, Polygenic inheritance, Pleiotropy.

Explanation of the terms heredity and variation; Mendel's Principles of inheritance; reasons for Mendel's success; incomplete dominance with examples from plants (snapdragon - Antirrhinum) and co-dominance in human blood group, multiple alleles – e.g. blood groups, polygenic inheritance with one example of inheritance of skin colour in humans (Students should be taught examples from human genetics through pedigree charts). Biological importance of Mendelism. Pleiotropy with reference to the example of Phenylketonuria (PKU).

(iii) Genes: packaging of hereditary material in chromosomes. Linkage and crossing over; mutation, sex determination and sex linkage, search for DNA as genetic material, central dogma; genetic code, protein synthesis. Human genome project. DNA finger printing.

Chromosomal theory of inheritance; chromosomes in eukaryotic organisms, autosomes and sex chromosomes (sex determination in humans, birds and honey bees), sex-linked inheritance, complete and incomplete linkage – definition and example of fruit fly, crossing over - definition, mechanism and significance; mutation: definition and types – spontaneous and induced, point mutation; search for DNA as genetic material - Griffith's experiment, Hershey and Chase's experiment; replication of genetic material (role of enzymes, namely DNA polymerase and ligase), Messelson and Stahl's experiment, properties of genes such as ability to replicate, chemical stability, mutability and inheritability, gene expression in prokaryotes; Lac Operon in E-coli; central dogma – concept only; reverse transcription (basic idea only), genetic code – essential features, definition of codon. Protein synthesis - transcription and translation in prokaryotes. Intron, exon, cistron, recon and muton (definitions only).

Human genome project: goal; methodologies [Expressed Sequence Tags (EST), Sequence Annotation], salient features and applications. DNA finger printing – technique, application and ethical issues to be discussed briefly.

(iv) Recombinant DNA technology and its applications.

Tools for Recombinant DNA technology. Restriction enzymes, DNA insertion by vectors and other methods, regeneration of recombinants, RNA interference.

Applications of recombinant DNA technology: In human health – production of insulin, vaccines and growth hormones, gene therapy. In industry – production of expensive enzymes, strain improvement to scale up bioprocesses, bioreactors. In agriculture – GM crops by transfer of genes for nitrogen fixation, herbicide-resistance and pest-resistance including Bt crops. Transgenic animals – significance (study of disease, biological products, chemical safety testing, vaccine safety), Ethical issues. GMO with special reference to Bt crops. Biosafety issues: biopiracy and patents – definition and two examples of each.

4. Applications of Biology

(i) Crop improvement: methods of crop improvement: selection, hybridisation, plant breeding, plant introduction, tissue culture; single cell protein; biofortification; biopesticides.

A brief reference to green revolution. Plant breeding, introduction, definition of selection (types not required) and techniques of hybridisation. Definition of heterosis, protoplast culture and protoplasmic fusion. applications of tissue culture to be discussed; *single cell protein – source and significance*; *biofortification: meaning and its role in improving food production. Definition and brief idea of Integrated Pest Management (IPM); Biopesticides: definition, importance and two examples (Bioinsecticides e.g. Bacillus thuringiensis, Bioherbicides e.g. Cochineal insect).*

(ii) Biotic community: intraspecific and interspecific relationship, commensalism, predation, scavenging, parasitism, symbiosis, biotic stability, biotic succession and ecological adaptations.

Trophic organisation, stratification, dominance, variety of species; interactions – Intraspecific such as mating behaviour, parental care, communication, animal societies, altruism; Interspecific – positive e.g. commensalism, scavenging, symbiosis, procooperation and negative e.g. predation, parasitism with examples of each. Biotic stability: should be taught with examples to show that the larger the number of diverse forms, more stable is the community. Succession: definition to explain the meaning, kinds of succession and significance of ecological succession. Definition of ecological adaptations, classification into hydrophytes, mesophytes, xerophytes, osmoregulators, osmoconformers with an example of each.

(iii) Biodiversity today: importance of biodiversity, types of biodiversity, genetic conservation, gene banks and

cryopreservation. Loss of biodiversity - threatened, endangered and extinct species. Strategies for conservation of biodiversity – in-situ and ex-situ.

Importance of biodiversity, Few examples of each type of biodiversity - species, ecosystem and genetic.

Causes and implications of loss of biodiversity. Categorizing species in different groups like - threatened, endangered and extinct - definition and examples of plants and animals.

Looking at various in-situ and ex-situ strategies for their efficacy and viability: In-situ - protected areas :biosphere reserves, national parks, wildlife sanctuaries; Hotspots and red data book. Ex-situ - captive breeding, zoo, botanical gardens. Definitions and examples of each of the above.

Only a brief understating of the following is required:

A general idea that species share a common gene pool and represent the lowest taxonomic group. Definition of genetic conservation, gene bank, cryopreservation and genetic erosion; factors affecting genetic erosion.

(iv) Biofertilisers: green manure, nitrogen fixation – symbiotic and non-symbiotic organisms, nitrogen cycle.

Green manures – definition and types; reasons for preference of biofertilisers over chemical fertilisers should be discussed. Brief idea of nodule formation, biological nitrogen fixation, non-symbiotic nitrogen fixation and symbiotic nitrogen fixation (such as Rhizobium and Azospirillum). Role of cyanobacteria such as Azolla, Anebena, Nostoc; importance of leghaemoglobin pigment. Role of bacteria and cyanobacteria in improving soil fertility. Nitrogen cycle.

(v) Human Diseases: Body's defence mechanisms: (specific and non-specific); immune disorders (SCID and AIDS); allergies, interferons. Communicable diseases: causative agent, symptoms and prevention of the following: bacterial diseases (typhoid and pneumonia), viral diseases (common cold, swine flu and dengue), protozoa (malaria, and amoebiasis), helminthes (ascariasis, ringworm, and filariasis); sexually transmitted diseases (STD). Non-communicable diseases: cancer (types, causes, diagnosis and treatment); human genetic disorders: (haemophilia, thalassaemia, Down's syndrome, Klinefelter's syndrome, Turner syndrome). Rh factor incompatibility – during transfusion and pregnancy. Genetic counselling; a brief idea of stem cells, organ transplants and immunosuppression.

Skin, blood vessels, WBC, antibodies to be discussed as non-specific defence mechanisms; Humoral and cell-mediated immune system; antibody and antigen; cells of the immune system and difference between them; mechanism of action of T cells to antigens; Interferons, brief idea of SCID and AIDS – causative agent (HIV), modes of transmission symptoms, replication of retrovirus in the infected human cell (including diagram) and prevention; diseases should be discussed on basis of causative agent, symptoms and prevention. Allergies and allergens – definitions and general symptoms of allergies.

Communicable and Non-communicable diseases; modes of transmission, sexually transmitted diseases (STD) – gonorrhoea and syphilis – causative agents and prevention; - bacterial diseases (typhoid and pneumonia), viral diseases (common cold, swine flu and dengue), protozoa (malaria, and amoebiasis), helminthes (ascariasis, ringworm, and filariasis); Cancer (types, causes, diagnosis and treatment);

Human genetic disorders: (haemophilia, thalassaemia, Down's syndrome, Klinefelter's syndrome, Turner syndrome). Rh factor incompatibility – role of Rh factor in blood transfusion and pregnancy; brief idea of genetic counselling, role of genetic counsellor.

Organ transplants and role of immunosuppressants. A brief idea of the role of stem cells in medical treatment.

(v) Adolescent issues: alcoholism and drugs.

Adolescent issues:

Alcoholism – reasons for addiction and its effects on health).

Drugs: Types of drugs such as opioids, cannabinoids and barbiturates – reasons for addiction, examples and effect of each on human health.

Prevention and control of Alcohol and drug abuse.

(vi) Biomedical Engineering: (only applications) Instruments – ECG, EEG, CT scan, ultrasound, MRI, pacemakers, implants, dialysis, external prosthesis.

Students should know one application of each of the instruments mentioned above. Details are not required.

(vii) Human population: population growth curves, causes of increase in population.

Definition of the following terms: biotic potential, environmental resistance and carrying capacity; population: demography, birth rate, death rate, age distribution – pyramids for human population.

Types of growth curves; S and J shaped along with equations for the same, causes and consequences of population growth and measures to control population (natural and artificial).

(viii) Animal Husbandry: Dairy farm management, poultry farm management, apiculture, pisiculture.

Brief idea of inbreeding, outbreeding, crossbreeding and artificial insemination, Multiple Ovulation Embryo Transfer Technology (MOET). Advantages of artificial insemination; measures for proper maintenance of dairy farms and poultry farms.

Apiculture and Pisiculture – definition, brief idea and advantages of each.

PAPER II

PRACTICAL WORK – 20 Marks

1) **Taxonomy**: Study floral characteristics through dissection of flowers, drawing floral formula and diagrams of following families:

(i) Malvaceae: type – China rose / Hollyhock.

(ii) Compositae: type – Sunflower/ Cosmos/ Marigold (with single whorled ray florets)/ Dahlia/ Zinnia.

(iii) Leguminosae: subfamily – Papilionaceae – type – Sweet pea/ Pea/ Bean/ *Sesbania*/ *Clitoria* (single flower).

(iv) Solanaceae: type – *Petunia* / *Datura* / Brinjal Flower / *Solanum nigrum*.

(v) Liliaceae: type – Onion or Amarallydaceae –type – Lily/Spider lily/ Tiger lily/ Tube rose/ *Gladiolus*.

Floral characteristics should be explained by dissection of flowers. Students should be taught how to cut vertical section of the flower and draw accurately labelled diagrams. The technique of drawing floral diagrams with the mother axis in the right position should be taught. Floral formula should be correctly written. Identification of the correct family giving reasons, technique of cutting T.S. and L.S of ovary should be explained and accordingly correct labelled-diagram should be drawn.

Students should be taught the examples of plants (belonging to each family) which are of economic importance. The examples of common names of plants must be supported with correct scientific names as well.

2) **Simple biochemical and physiological experiments**-

(i) Study of imbibition in raisins/seeds.

(ii) Demonstration of plasmolysis (using *Rhoeo* leaf and onion bulb).

(iii) Demonstration of osmosis in living plant cells (potato osmoscope).

(iv) Demonstration of unequal transpiration in leaves.

(v) Study of arrangement/distribution of stomata on isobilateral and dorsiventral leaves.

(vi) To demonstrate the effect of different intensities of light on photosynthesis.

(vii) Separation of plant pigments by chromatography.

(viii) To demonstrate that oxygen is evolved during photosynthesis.

(ix) Effect of different carbon dioxide concentrations on the rate of photosynthesis.

Students should be taught to set up and demonstrate the experiments with correct diagram of the set up, record their observations methodically and give conclusions. This will give a clear idea of the physiological processes. Questions can be asked based on the above physiological processes studied.

3) **Slide preparation-**

(i) T.S. of dicot root.

(ii) T.S. of monocot root.

(iii) T.S. of dicot stem.

(iv) T.S. of monocot stem.

(v) Germination of pollen grain.

The technique of staining and mounting neatly should be explained. Identification of the mount under the microscope should be taught. Students must know the use of low power and high power microscope. They should also know how to make labelled diagram showing cellular details. Identifying features of the above should also be mentioned.

4) **Spotting: (Three minutes to be given for each spot which includes identification, drawing a labelled diagram and writing two identifying characteristics).**

NOTE: <u>Spotting must be done on a separate answer sheet during examination, which should be handed over to the Examiner immediately after spotting</u>.

(i) Identify and comment on permanent slides of:

(a) T.S of monocot and dicot stem.

(b) T.S. of monocot and dicot root.

(c) T.S. of monocot and dicot leaf.

(d) T.S. of ovary of mammal.

(e) T.S. of testis of mammal.

(f) Germinating pollen grain.

(g) T.S. of blastula / blastocyst of a mammal.

(h) *Plasmodium* (whole mount).

(i) *Entamoeba histolytica* (whole mount).

Students should be taught how to identify, draw, label and give significantly visible characteristics as observed, of each spot, in a given time of three minutes. 'T.S.', 'L.S.', 'model', 'whole mount', 'chart' of the specific specimen should be mentioned as a part of identification.

(ii) Students should identify, draw and comment on:

(a) Different types of inflorescence: fresh specimen, model or a chart (labels covered) – basic racemose example gladiolus, basic cymose example jasmine / *Calotropis/ Dianthus* and capitulum example marigold.

Students should be able to identify the type of inflorescence, draw its diagram and write two identifying characteristics of the specimen.

(b) Flowers adapted to pollination by different agencies – insect and wind.

Students should be able to identify the type of pollination of the given flower, draw the diagram of the flower and give two reasons for the type of pollination. Example: Hibiscus and grass.

(iii) Comment on experimental set up studied in physiology.

(a) Osmosis

(b) Transpiration

(c) Photosynthesis

(d) Transpiration pull.

Students should identify (aim of the experiment), draw a labelled diagram of physiological set-up and write observation and inference of the experiment within the allotted time i.e., 3 minutes.

PROJECT WORK AND PRACTICAL FILE – 10 Marks

Project Work – 7 Marks

The project work is to be assessed by a Visiting Examiner appointed locally and approved by the Council.

The candidate is to creatively execute **one** project/assignment on an aspect of biology. Teachers may assign or students may choose any **one** project of their choice. Students can choose any other project besides the ones indicated in the list. Following is **only a suggestive** list of topics:

(i) Diabetes.
(ii) Cancer.
(iii) AIDS/Hepatitis.
(iv) Drug addiction and community.
(v) Endocrine glands.
(vi) Role of micro-organisms in industry.
(vii) Human population.
(viii) Mendelian Inheritance
(ix) Environmental resistance.
(x) Traditional and modern methods: Study of a few traditional methods of pest deterrence vis-a-vis modern methods of pest control - viability of traditional methods in today's scenario and limitations and dangers of modern methods.
(xi) Role of agrochemicals in increasing food production.

Suggested Evaluation Criteria for Project Work:

Format of the Project:

- Content
- Introduction
- Presentation (graphs, tables, charts, newspaper cuttings, handmade diagrams, photographs, statistical analysis if relevant)
- Conclusion/ Summary
- Bibliography

Projects should be handwritten by the candidate. Written pages should not exceed 15-20 pages.

Practical File – 3 Marks

The Visiting Examiner is required to assess students on the basis of the Biology Practical file maintained by them during the academic year.

Each practical done during the year, needs to be recorded by the student in the Practical file and the same must be checked, signed and dated by the teacher.

(The Visiting Examiner will assess the Practical File on the basis of the above).

SCIENTISTS AND THEIR CONTRIBUTIONS:

1. Lederberg – Chemogeny, Biogeny, & Cognogeny
2. Oparin – Coacervates, Conditions on primitive earth were favourable for chemical evolution
3. Stanley Miller & Harold Urey – Recreated probable conditions on primitive earth
4. Sydney Fox – Microspheres
5. Andreas Wagner – Obtained the fossil of Archaeopteryx lithographica
6. Von Baer – Biogenetic law
7. Ernst Haeckel – Proposed the recapitulation theory
8. Charles Darwin – Natural Selection
9. Lamarck – Inheritance of acquired characters
10. Hugo de Vries – Mutation
11. Raymond Dart – Discovered the fossil of Australopithecus
12. Mac Gregor – Discovered the fossil of Cromagnon man
13. Meyer – Coined the term “Diffusion Pressure Deficit”
14. Kramer – Active & Passive absorption of water by roots
15. Dixon & Jolly – Cohesion – Tension & Transpirational pull
16. Levitt – Active K^+ ion Transport mechanism of opening & closing of stomata
17. Munch – Mass Flow Hypothesis
18. Robert Hill – Photolysis of water
19. Ruben & Kamen – Oxygen comes from water in photosynthesis
20. M. D. Hatch & C. R. Slack – Proposed C_4 cycle
21. Blackman – Principle of Limiting Factors
22. Calvin – C_3 cycle
23. Decker – Photorespiration
24. Rudolph Camerarius – First to describe sexual reproduction in plants

25. Leeuwenhock – Reported Polyembryony
26. Gustafon – First to induce parthencarpy
27. P. K. Sethi – Prosthesis
28. Spallanzani – Artificial Insemination / disproved abiogenesis
29. John Otto – Reported Haemophilia
30. Ronald Ross – Malarial parasite life cycle in mosquito
31. Karl Landsteiner – Rh factor / blood groups (ABO system)
32. T. R. Malthus – Theory of Human Population Growth
33. Alec Jeffrey – DNA finger printing
34. William Roentgen – Discovery of X- rays
35. Godfrey Hounsfield – First invented C T Scan
36. G. Nawaschin – Double Fertilization
37. John Ray – Introduced the term 'species'

LIST OF ABBREVIATIONS TO BE STUDIED:

1. LSD – Lysergic Acid Diethylamide
2. DPD – Diffusion Pressure Deficit
3. HIV – Human Immunodeficiency Virus
4. RuBP – Ribulose Biphosphate (or Bisphosphate)
5. PGA – Phosphoglyceric Acid
6. RUBISCO – Ribulose Biphosphate (or Bisphosphate) Carboxylase Oxygenase
7. IPM – Integrated Pest Management
8. EEG – Electroencephalogram
9. DDT – Dichloro diphenyl tri chloro ethane
10. ECG – Electrocardiogram
11. C. T. Scan – Computed Tomographic Scanning
12. IUCD – Intra uterine contraceptive device
13. G6PD – Glucose-6-Phosphate dehydrogenase
14. SCID – Severe Combined Immuno Deficiency
15. NADP – Nicotinamide Adenine dinucleotide phosphate
16. STD – Sexually Transmitted Disease
17. MRI – Magnetic Resonance Imaging
18. MTP – Medical Termination of Pregnancy
19. IVF – In vitro fertilization
20. ZIFT – Zygote Intrafallopian Transfer
21. GIFT – Gamete Intrafallopian Transfer
22. PEP – Phosphoenol pyruvate