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 ... 15 marks*
Project Work … 10 marks
Practical File … 5 marks

PAPER 1- THEORY: 70 Marks

*There will be no overall choice in the paper. Candidates will be required to answer **all** questions. Internal choice will be available in two questions of 2 marks each, two questions of 3 marks each and all the three questions of 5 marks each.*

S.NO.	UNIT	TOTAL WEIGHTAGE
1.	Diversity of Living Organisms	09 Marks
2.	Structural Organisation in Animals and Plants	11 Marks
3.	Cell: Structure and Function	15 Marks
4.	Plant Physiology	17 Marks
5.	Human Physiology	18 Marks
TOTAL		70 Marks

PAPER I –THEORY – 70 Marks

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

1. Diversity of Living Organisms

(i) The Living World

What is living? Need for classification; three domains of life; taxonomy and systematics; concept of species and taxonomical hierarchy; binomial nomenclature; tools for study of taxonomy- museums, zoological parks, herbaria, botanical gardens, key.

Characteristics of living organisms. Need for classification should be discussed. Three domains of life – distinguishing features of (archaea, bacteria, eukarya). Definition and explanation of the terms taxonomy (numerical taxonomy, cytotaxonomy and chemotaxonomy) and systematics. Concept of species. Major taxonomical hierarchies (phylum, class, order, family, genus, species): definition and examples with reference to classification of man, house fly, mango and wheat. Rules of binomial nomenclature and advantages of using scientific names. Aids for study of taxonomy — a very brief idea of museum and herbaria, zoological parks and botanical gardens. Definition of taxonomical keys.

Three systems of classification – artificial, natural and phylogenetic.

(ii) Biological Classification

Five kingdom classification; salient features and classification of Monera, Protista, Fungi, Plantae and Animalia. Lichens, Viruses and Viroids.

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

(b) Kingdom Monera: Bacteria - classification of bacteria according to shape, nutrition and mode of respiration; differences between gram +ve and gram –ve bacteria; types of reproduction – definition of fission, conjugation, transduction and transformation (details not required).

A brief idea of the role of different types of archaebacteria (methanogens, halophiles and thermoacidophiles in their extreme environments).

Mycoplasma – three distinctive features.

Economic importance with reference to role of bacteria in sewage treatment, antibiotics, energy production and house hold products (curd and cheese only).

(c) 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).

(d) Kingdom Fungi: general characteristics and mode of reproduction of each (including types of spores and sexual reproduction – definition of isogamy, anisogamy, oogamy, plasmogamy, karyogamy and dikaryophase). Zygomycetes, Ascomycetes, Basidiomycetes, Deuteromycetes - characteristics with examples. Role of fungi in the field of medicine, bakery and environmental decomposition. Definition of lichens and mycorrhiza (ecto and endo).

Life cycles not required.

(e) 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. Beijerinck, W.M. Stanley) and Viroid (definition only).

(iii) Plant Kingdom

(a) Algae - characteristics (morphology, common name, major pigments, stored food, composition of cell wall, flagellar number and position of insertion, habitat, mode of sexual reproduction) and

examples of Chlorophyceae, Phaeophyceae, Rhodophyceae; Economic importance of algae – any five.

(b) Bryophyta – general characteristics, distinctive features of liverworts and mosses; graphic outline of life cycle of Funaria with reference to alternation of generations. Economic importance of bryophytes.

(c) Pteridophyta: characteristics; classification into classes: psilopsida (Psilotum), lycopsida (Selaginella, Lycopodium), sphenopsida (Equisetum) and pteropsida (Dryopteris, Pteris and Adiantum). Graphic outline of life cycle of a typical pteridophyte (fern). Definition of homospory and heterospory with relevant examples. Economic importance.

(d) Gymnosperms: general characteristics and graphic outline of life cycle of a typical gymnosperm (Pinus). Economic importance.

(e) Angiosperms – general characteristics and classification into monocots and dicots; Graphic outline of life cycle of a typical angiosperm.

(f) Comparison of life cycle patterns of different plant groups (haplontic, diplontic and haplo-diplontic).

(iv) Animal Kingdom

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 organisation in animals, acoelomate, pseudocoelomate, coelomate and haemocoelomate), segmentation.

Non-chordata - five distinguishing characters with two examples of Porifera, Cnidaria, Ctenophora, Platyhelminthes, Nematoda (Aschelminthes), Annelida, Mollusca, Arthropoda, Echinodermata, Hemichordata.

Chordata – sub-classification of Chordata with reference to notochord - sub phyla Urochordata, Cephalochordata. Vertebrata (classes – cyclostomata, chondrichthyes, osteichthyes, amphibia, reptilia, aves and mammalia) – three distinguishing characters with two examples of each).

2. Structural Organisation in Animals and Plants

(i) Morphology of Flowering Plants

(a) Morphology and modifications of root, stem, leaf.

Types of roots (tap, fibrous, adventitious), regions, modifications of roots for storage (Tuberous – e.g. Mirabilis and sweet potato; fusiform – e.g. radish; conical – e.g., carrot; napiform – e.g. turnip), respiration (pneumatophores) and support (stilt and prop).

Stems – features (nodes internodes, buds), modifications – underground (tuber, rhizome, corm) aerial (tendril, thorn, Phylloclade, cladode) and sub-aerial (runner, sucker, stolon, offset).

Leaves - parts of a simple leaf, venation, types of leaves (simple and compound – pinnate and palmate), phyllotaxy – alternate, opposite, whorled (with an example of each). Modifications for mechanical support (tendril), protection (spine), storage (bulb), reproduction (Bryophyllum); insectivorous plants (pitcher plant, Venus-fly-trap).

(b) Morphology of flower, fruit and seed. Structure of a typical flower, types of inflorescence (racemose and cymose).

Structure of a typical flower, bracteates/ebracteate, [symmetry (actinomorphic, zygomorphic), trimerous/tetramerous/pentamerous complete/ incomplete, non-essential whorls (calyx: gamosepalous, polysepalous, corolla: gamopetalous, polysepalous, perianth, aestivation: valvate, twisted, imbricate, vexillary), essential whorls (androecium: cohesion - syngenesious, synandrous, monadelphous, diadelphous, polyadelphous; adhesion – epipetalous,

epiphyllous; number of lobes – monothecous, dithecous; Gynoecium: position of ovary – epigynous, hypogynous, perigynous, cohesion – apocarpous, syncarpous, number of locules – unilocular, bilocular, multilocular], types of inflorescence (racemose and cymose – definition and differences; subtypes not required).

(ii) Anatomy of Flowering Plants

(a) Plant Tissues: types of plant tissues: Meristematic tissues: classification of meristematic tissue. Permanent Tissues: structure and function of simple tissues (parenchyma, collenchyma and sclerenchyma) and complex tissues (xylem and phloem), tissue system. Internal structure of root, stem, and leaf.

Characteristics of meristematic tissue; classification of meristems based on origin and location; structure, function and location of permanent tissues; simple and complex tissues; epidermal, ground and vascular tissue systems.
Cellular diagrams of T.S. of roots and stem and V.S. of monocot and dicot leaves are required.

(b) Secondary growth in dicot stem and dicot root
Basic idea of how secondary growth takes place in dicot stems and roots (with the help of outline diagrams) and formation of annual rings. Activity of the cambium and cork cambium, formation of secondary tissues, differences between heart wood and sap wood, early wood and late wood. Definition of bark.

(iii) Structural Organisation in Animals

(a) Animal tissues
Epithelial, connective, muscular and nervous tissues to be taught with the help of diagrams.
Location, structure and functions of epithelial tissues (simple, stratified, pseudostratified, specialised – transitional, neurosensory and pigmented) with examples, types of junctions (tight, adhering and gap junctions) location and general structure of areolar tissue - functions of different types of cells (fibroblasts, macrophages, Mast cells, plasma cells, adipocytes); fibrous connective tissue (ligaments and tendon); difference between bone and cartilage; types of cartilage (hyaline, white fibrous, yellow elastic and calcified); T.S. of hyaline cartilage, T.S and L.S. of mammalian bone(to be taught with the help of diagrams); different types of muscles and their functions; structure of a neuron (types – unipolar, bipolar, multipolar, myelinated, non-myelinated). Neuroglial cells.

(b) Cockroach
Morphology, anatomy and functions of different systems (digestive, circulatory, respiratory, nervous and reproductive) of an insect (cockroach) - a brief account only.

3. Cell: Structure and Function

(i) Cell - the Unit of Life
Cell theory and cell as the basic unit of life: Structure of prokaryotic and eukaryotic cells; Plant cell and animal cell; cell envelope; cell membrane, cell wall (including definition of plasmodesmata); cell organelles – ultrastructure and function; endomembrane system (endoplasmic reticulum, Golgi bodies, lysosomes, vacuoles), mitochondria, ribosomes, plastids, microbodies; cytoskeleton, cilia, flagella, centrioles;

nucleus, nuclear membrane, chromatin, nucleolus.

Historical aspects, cell theory, size and shape of cells; *general structure of prokaryotic cell.*
General structure of eukaryotic cell, ultra-structure and function of cell wall, cell membrane (description of fluid mosaic model; functions of the plasma membrane: active and passive transport, brief explanation of facilitated diffusion (uniport, symport and antiport) with one example. Mitochondria, nucleus (structure and types of chromosomes on the basis of the position of centromere, satellite), types of plastids, endomembrane system (endoplasmic reticulum, Golgi complex, lysosomes and vacuoles), ribosomes, microbodies, cytoskeleton, cilia, flagella and centrioles; difference between prokaryotic cell and eukaryotic cell, plant and animal cell, microfilaments and microtubules, flagella and cilia.

(ii) Biomolecules

P roteins, carbohydrates, lipids, nucleic acids, enzymes.

Carbohydrates: general classification and functions of: monosaccharides (glucose, ribose and deoxyribose), disaccharides (maltose, lactose and sucrose), polysaccharides (glycogen, starch, cellulose, inulin, and chitin).

Proteins: amino acids – (structure: glycine, alanine, serine); amino acids as zwitter-ion; examples of acidic, basic, neutral, sulphur containing amino acids; essential and nonessential amino acids; levels of protein structure (primary, secondary, tertiary and quaternary); functions of proteins.

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

Enzymes: general properties, nomenclature and classification of enzymes according to type of reactions, co-factors (prosthetic groups, coenzymes and metal ions. Factors affecting enzyme activity - temperature, pH, substrate concentration. Competitive inhibitors.

(iii) Cell Cycle and Cell Division

Cell cycle, mitosis, meiosis and their significance.

Definition of C-value, different stages of cell cycle (G_o, G_1, S and G_2 and M).

Different stages of mitosis and prophase – I of meiosis with diagrams. Significance of mitosis and meiosis. Differences between mitosis and meiosis.

4. Plant Physiology

(i) Transport in Plants

Movement of water, gases and nutrients; cell to cell transport, diffusion, facilitated diffusion, active transport; plant-water relations, imbibition, water potential, osmosis, plasmolysis; long distance transport of water - absorption, apoplast, symplast, transpiration pull, root pressure and guttation; transpiration, opening and closing of stomata; uptake and translocation of mineral nutrients - transport of food - phloem transport, mass flow hypothesis; diffusion of gases.

Definition 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; definition of turgidity, plasmolysis, deplasmolysis, 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, significance of transpiration. Stomatal mechanism – starch ↔ sugar interconversion and K^+-ion mechanism. Mechanism of ascent of sap by cohesion – tension and transpiration pull theory. Guttation – definition, differences between transpiration and guttation. Function of stomata, lenticel and hydathode. Mineral uptake by active and passive transport.*

Transport of solutes; evidences which indicate that downward movement of organic solutes takes place in phloem (girdling and tracer techniques), mechanism of translocation - mass flow hypothesis.

(ii) Mineral Nutrition

Essential minerals, macro- and micronutrients and their role; deficiency symptoms; mineral toxicity; elementary idea of hydroponics nitrogen metabolism, nitrogen cycle, biological nitrogen fixation.

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

Root nodule formation, biological nitrogen fixation, non-symbiotic nitrogen fixation and symbiotic nitrogen fixation. Role of Rhizobium, Azospirillum, Azolla, Anabaena and Nostoc; importance of nitrogenase complex and leghaemoglobin pigment. Nitrogen cycle (graphic outline).

(iii) Photosynthesis in higher plants

Photosynthesis as a mean of autotrophic nutrition; site of photosynthesis, pigments involved in photosynthesis (elementary idea); photochemical and biosynthetic phases of photosynthesis; cyclic and non-cyclic photophosphorylation; chemiosmotic hypothesis; photorespiration; C_3 and C_4 pathways; factors affecting photosynthesis.

Contributions of Priestley, Sachs, Engelmann, van Neil; differences between absorption and action spectra.

Brief idea of photosynthetic pigments (difference between chlorophyll 'a'&'b', carotenoids and xanthophyll), 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, Photorespiration pathway in brief - explanation of how RuBP carboxylase acts as RuBP oxygenase. Kranz anatomy. Blackman's Law of limiting factors, factors affecting photosynthesis.

(iv) Respiration in Plants

Exchange of gases; cellular respiration - glycolysis, fermentation (anaerobic), TCA cycle and electron transport system (aerobic); energy relations - number of ATP molecules generated; amphibolic pathways; respiratory quotient.

Types of respiration; mechanism of respiration: glycolysis, 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.

(v) Plant Growth and Development

Seed germination; phases of plant growth; differentiation, dedifferentiation and redifferentiation; sequence of developmental processes in a plant cell; growth regulators - auxin, gibberellin, cytokinin, ethylene, ABA; seed dormancy; vernalisation; photoperiodism.

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.

Discovery and physiological role of growth regulators in plants (such as auxins, gibberellins, cytokinins, ethylene and abscisic acid – four effects of each); application of growth regulators, Definition of dormancy and quiescence; causes and methods of breaking seed dormancy.

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.

5. Human Physiology

(i) Digestion and Absorption.

Alimentary canal and digestive glands, role of digestive enzymes; peristalsis, digestion, absorption and assimilation of proteins, carbohydrates and fats; calorific values of proteins, carbohydrates and fats; egestion; nutritional and digestive disorders.

Calorific value of carbohydrates, proteins and fats per gram; Structure and functions of the digestive organs and their associated glands, types of dentition (thecodont, heterodont, diphyodont) and dental formula of human; 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; physiology of digestion and absorption of food; definition of bolus, peristalsis, deglutition, emulsification; assimilation of digested food; disorders of the digestive system – Protein Energy Malnutrition (PEM), indigestion, constipation, vomiting, jaundice, diarrhoea.

(ii) Breathing and exchange of gases.

Respiratory organs in animals (recall only); Respiratory system in humans; mechanism of breathing and its regulation - exchange of gases, transport of gases and regulation of respiration, respiratory volumes; disorders related to respiration.

Organs involved in respiration; mechanism of pulmonary gas exchange; breathing process should be explained showing the action of diaphragm and intercostal muscles, regulation of respiration; transport of oxygen in the blood, oxyhaemoglobin dissociation curve; transport of CO_2; chloride shift, pulmonary air volumes and lung capacities; disorders of respiratory system such as - asthma, emphysema, occupational respiratory disorders.

(iii) Body fluids and circulation.

Composition of blood, blood groups, coagulation of blood; composition of lymph and its function; human circulatory system - structure of human heart and blood vessels; cardiac cycle, cardiac output, ECG; double circulation; regulation of cardiac activity; disorders of circulatory system.

Composition of blood plasma, functions of plasma proteins, blood corpuscles. Difference between closed and open vascular system; external and internal structure of heart; 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; definition of stroke volume and cardiac output, regulation of heart beat, ECG; arterial blood pressure (systolic and diastolic), double circulation. The internal structure of artery, vein and capillary. Importance of ABO groups in blood transfusion, Rh factor and its importance in transfusion and pregnancy; clotting of blood to be taught briefly; lymphatic system – a brief idea of lymph (composition and function), lymphatic capillaries and lymph nodes; disorders of the circulatory system such as hypertension, coronary artery disease, angina pectoris and heart failure.

(iv) Excretory products and their elimination.

Modes of excretion - ammonotelism, ureotelism, uricotelism; human excretory system - structure and function; urine formation, osmoregulation; regulation of kidney function, renin - angiotensin, atrial natriuretic factor, ADH and diabetes insipidus; role of erythropoietin; role of other organs in excretion; disorders of the excretory system - uraemia, renal failure, renal calculi, nephritis; dialysis and artificial kidney.

Define, differentiate and explain the terms ammonotelism, ureotelism and uricotelism; external and internal structure of the kidney (L.S.); structure of nephron; physiology of urine formation - ultra filtration, selective reabsorption and active (tubular) secretion. Counter current system, regulation of urine formation, definition of micturition, renin-angiotensin system, role of atrial natriuretic factor, ADH and erythropoietin.

Role of skin, liver and lungs in excretion. Homeostasis – definition. Disorders of the excretory system - uraemia, renal failure, renal calculi, nephritis.

Haemodialysis and artificial kidney.

(v) Locomotion and Movement

Types of movement - ciliary, flagellar, muscular; skeletal muscles - contractile proteins and muscle contraction; skeletal system and its functions; joints; disorders of muscular and skeletal system.

Locomotion: Basic aspects of human skeleton (number and names of the bones of axial and appendicular skeleton).

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

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

(vi) Neural Control and Coordination

Neuron and nerves; nervous system in humans - central nervous system; peripheral nervous system and visceral nervous system; generation and conduction of nerve impulse; reflex action; sensory perception; sense organs; elementary structure and functions of eye and ear.

Structure and functions of various parts of the brain and spinal cord; conduction of nerve impulses through nerve fibre (non-myelinated and myelinated) and through synapse; physiology of reflex action, natural reflex and conditioned reflex - definition, examples and differences; reflex arc to be taught with diagram showing the pathway by means of arrows; eye and ear: structure and working to be done along with the help of – diagrams. Elementary idea of nose (olfactory receptor) and tongue (gustato receptor).

(vii) Chemical Co-ordination and Integration

Endocrine glands and hormones; human endocrine system - hypothalamus, pituitary, pineal, thyroid, parathyroid, adrenal, pancreas, gonads; mechanism of hormone action (elementary idea); role of hormones as messengers and regulators, hypo - and hyperactivity and related disorders; dwarfism, acromegaly, cretinism, goitre, exophthalmic goitre, diabetes mellitus and diabetes insipidus, Grave's disease, Addison's disease.

Brief idea of location of endocrine glands; role of hypothalamus; hormones secreted by different lobes of pituitary and their functions; feedback control of tropic hormones to be discussed giving examples; hormones of pineal, thymus, thyroid, parathyroid, pancreas, adrenal glands, GI tract (gastrin, secretin, GIP, CCK-PZ) 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.

Note: Diseases related to all the human physiological systems to be taught in brief.

PAPER II

PRACTICAL WORK – 15 Marks

1. Scientific Techniques

To 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

(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.

(iii) Separation of plant pigments from leaves by chromatography.

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

(v) Demonstration of plasmolysis (using *Rhoeo* leaf / onion bulb).

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

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.

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

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

After staining and mounting the tissue students should be able to draw the diagram and label all the parts as seen under the low power of microscope.

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

(a) Identification of stained preparations of the following:

(i) Stages of meiosis.

(ii) Identification of mammalian blood cells.

(iii) Bacteria

(iv) *Spirogyra*

(v) *Amoeba*

(vi) Yeast

(b) Identification of the following specimens -

(i) Liverworts

(ii) Moss

(iii) Fern

(iv) *Pinus*

(v) Mushroom

(vi) One monocot plant – bamboo

(vii) One dicot plant – *Petunia*

(viii) Sponge

(ix) *Hydra*

(x) Tape worm

(xi) Leech

(xii) Silk Worm

(xiii) Rohu fish

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

(c) 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 the physiological set-up and write observation and inference of the experiment within the allotted time i.e., 3 minutes.

PROJECT WORK AND PRACTICAL FILE –

15 Marks

Project Work – 10 Marks

Candidate is to creatively execute one project/assignment on any aspect of Biology. Preference is to be given to investigatory projects. 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/animal life.

(ii) Project related to any aspect of environment.

(iii) Diabetes.

(iv) Endocrine disorders.

(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 – 5 Marks

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.

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

SCIENTISTS AND THEIR CONTRIBUTIONS

1. Beijerinck – *Contagium vivum fluidum*
2. Carl Woese – Three domains of life
3. Curtis – Transpiration is a necessary evil
4. Engelmann – Action spectrum of photosynthesis
5. Ernst Mayr – Biological species concept
6. F.F. Blackman – Law of limiting factor
7. F W Went – Isolated Auxins
8. Farmer and Moore – Discovered meiosis
9. G.N. Ramachandran – Analysis of Protein structure
10. Garner and Allard – Photoperiodism
11. George Palade – Discovered ribosomes
12. Huxley and Niedergerke – Sliding filament theory
13. Ivanowsky – Discovered Tobacco Mosaic Virus
14. Karl Landsteiner – Blood groups
15. Katherine Esau – Anatomy of plants
16. Levitt – Active K^+ transport theory of stomatal movement
17. Munch – Proposed mass flow hypothesis
18. Peter Mitchell – Chemiosmotic coupling hypothesis
19. Priestley – Plants restore oxygen in the air
20. Renner – Coined the terms active and passive absorption of water
21. Robert Brown – Discovered nucleus
22. Singer and Nicolson – Proposed fluid mosaic model of plasma membrane
23. Sutherland – cyclic AMP as second messenger
24. T. O. Diener – Discovered viroids
25. Thomas Addison – Father of endocrinology
26. Van Neil – Oxygen released during photosynthesis comes from water
27. W. M. Stanley – Crystallised TMV
28. Waldeyer – Coined the term chromosome
29. Whittaker – Five kingdoms of life
30. William Harvey – Discovered circulatory system

LIST OF ABBREVIATIONS TO BE STUDIED

1. 2,4-D – 2, 4-Dichlorophenoxy acetic acid
2. ABA – Abscisic Acid
3. ANF – Atrial Natriuretic Factor
4. CCK –Cholecystokinin
5. DPD – Diffusion Pressure Deficit
6. ECG – Electrocardiogram
7. ERV – Expiratory Reserve Volume
8. ETS – Electron Transport System
9. FAD – Flavin Adenine Dinucleotide
10. FRC – Functional Residual Capacity
11. GA – Gibberellic acid
12. GFR – Glomerular Filtration Rate
13. GIP – Gastric Inhibitory Peptide
14. IBA – Indole Butyric Acid
15. IRV – Inspiratory Reserve Volume
16. LHC – Light Harvesting Complex
17. NAA – Naphthalene Acetic Acid
18. NADPH – Nicotinamide Adenine Dinucleotide Phosphate (reduced)
19. OAA – Oxaloacetic Acid
20. PEM – Protein Energy Malnutrition
21. PGA – Phosphoglyceric Acid
22. PGRs – Plant Growth Regulators
23. PPLO – Pleuro Pneumonia Like Organism
24. PZ – Pancreozymin
25. RQ – Respiratory Quotient
26. RUBISCO – Ribulose Bisphosphate Carboxylase oxygenase
27. RuBP – Ribulose Bisphosphate
28. TMV – Tobacco Mosaic Virus

CLASS XII

There will be two papers in the subject:

Paper I: *Theory: 3 hours ... 70 marks*

Paper II*: Practical: 3 hours ... 15 marks*

Project Work … 10 marks

Practical File … 5 marks

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PAPER I- THEORY: 70 Marks

*There will be no overall choice in the paper. Candidates will be required to answer **all** questions. Internal choice will be available in two questions of 2 marks each, two questions of 3 marks each and all the three questions of 5 marks each.*

S. No.	UNIT	TOTAL WEIGHTAGE
1.	Reproduction	16 Marks
2.	Genetics and Evolution	15 Marks
3.	Biology and Human Welfare	14 Marks
4.	Biotechnology and its Applications	10 marks
5.	Ecology and Environment	15 Marks
TOTAL		70 Marks

PAPER I –THEORY – 70 Marks

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

1. Reproduction

(i) Reproduction in Organisms

Reproduction, a characteristic feature of all organisms for continuation of species; modes of reproduction - asexual and sexual reproduction; asexual reproduction - binary fission, sporulation, budding, gemmule formation, fragmentation; vegetative propagation in plants.

Definition of life span; life span of a few organisms (banana, rice, rose, banyan, butterfly, fruit fly, tortoise, crocodile, parrot, crow, elephant, dog, horse, and cow).

Asexual reproduction – definition, types (binary fission in Amoeba and Paramoecium, budding in yeast and Hydra, conidia in Penicillium, zoospores in Chlamydomonas, gemmules in sponges), definition of clone.

Vegetative propagation – definition, vegetative propagules (tuber of potato, rhizome of ginger, bulbil of Agave, leaf buds of Bryophyllum, offset of water hyacinth, runner of grass, sucker of pineapple, bulb of onion).

Sexual reproduction: Plants – definition, phases of life cycle (juvenile/vegetative, reproductive and senescence), unusual flowering phenomenon (bamboo and Strobilanthes kunthiana). Animals – continuous and seasonal breeders (definition, differences and examples).

Events in sexual reproduction – pre-fertilisation (gametogenesis and gamete transfer in plants and animals), chromosome number in the cells of house fly, fruit fly, butterfly, human beings, rat, dog, maize, apple, onion, cat, rice, Ophioglossum; fertilization (definition, types - external and internal), post-fertilisation (embryogenesis), definition and example of parthenogenesis, differences between asexual and sexual reproduction.

(ii) Sexual reproduction in flowering plants

Flower structure; development of male and female gametophytes; pollination - types, agencies and examples; outbreeding devices; pollen-pistil interaction; double fertilization; post fertilization events - development of endosperm and embryo, development of seed and formation of fruit; special modes - apomixis, parthenocarpy, polyembryony; Significance of seed dispersal and fruit formation.

Pre-fertilisation structures and events.

Structure of microsporangium, T.S. of anther microsporogenesis, structure and development of pollen grain, viability of pollen grain, economic importance of pollen grain. Pistil – structure of megasporangium (L.S. of anatropous ovule), megasporogenesis, structure and development of female gametophyte.

Types of pollination (autogamy, chasmogamy, cleistogamy, geitonogamy, xenogamy), adaptations in flowers pollinated by wind, water and insects. Advantages of self and cross-pollination. Contrivances for prevention of self-pollination. Pollen-pistil interaction in terms of incompatibility/compatibility, events leading to fertilisation, definition of triple fusion and double fertilization, changes in the ovary and ovule for seed and fruit formation. Significance of double fertilization. Apomixis, polyembryony, parthenocarpy to be explained briefly. Fruits to be classified into true and false, structure (L.S) of a typical fruit (mango and coconut); Internal structure of dicot (bean) and monocot (maize) seeds; definition, differences and examples of albuminous and non-albuminous seeds. Significance of seed and fruit formation. Significance of dispersal of seeds.

Post-fertilisation events - embryo formation (monocot and dicot); types of endosperm (cellular, nuclear and helobial); definition of perisperm.

(iii) Human Reproduction

Male and female reproductive systems; microscopic anatomy of testis and ovary; gametogenesis - spermatogenesis and oogenesis; menstrual cycle; fertilisation, embryo development upto blastocyst formation, implantation; pregnancy and placenta formation (elementary idea); parturition (elementary idea); lactation (elementary idea).

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 (including spermiogenesis and spermiation) oogenesis; hormonal control of gametogenesis, structure of sperm and mature ovum, menstrual cycle - different phases and hormone action, differences between oestrous and menstrual cycle, menarche and menopause, physico-chemical events during fertilisation, implantation, embryonic development up to blastocyst formation, important features of human embryonic development (formation of heart, limbs, digits, appearance of hair on head, eyelashes, separation of eye lids, external genital organs and first movement of foetus with reference to time period) placenta and its functions. Parturition; lactation – hormonal control and importance.

(iv) Reproductive Health

Need for reproductive health and prevention of Sexually Transmitted Diseases (STDs); birth control - need and methods, contraception and medical termination of pregnancy (MTP); amniocentesis; infertility and assisted reproductive technologies - IVF, ZIFT, GIFT (elementary idea for general awareness).

Definition of reproductive health, programs of reproductive health (family planning, RCH), population explosion - role of government in controlling the population, contraceptives methods and their methods of action (natural-periodic abstinence, withdrawal or coitus interruptus, lactational amenorrhea; artificial – barriers, IUDs, oral pills, implants and surgical methods, definition of medical termination of pregnancy (MTP) and reasons for it; causes of infertility. Amniocentesis and its role in detecting genetic defects. Assisted reproductive technologies: IVF, IUT, ZIFT, ICSI, GIFT, AI, IUI. - definition and application only. Causes, symptoms and methods of prevention of sexually transmitted diseases (gonorrhoea, syphilis, genital herpes, chlamydiasis, genital warts, trichomoniasis, hepatitis- B, AIDS).

2. Genetics and Evolution

(i) Principles of inheritance and variation

Heredity and variation: Mendelian inheritance; deviations from Mendelism - incomplete dominance, co-dominance, multiple alleles and inheritance of blood groups, pleiotropy; elementary idea of polygenic inheritance; chromosomal theory of inheritance; chromosomes and genes; sex determination - in humans, fruit fly, birds and honey bee; linkage and crossing over; mutation; sex linked inheritance - haemophilia, colour blindness; Mendelian disorders in humans; chromosomal disorders in humans.

Explanation of the terms heredity and variation; Mendel's Principles of inheritance; reasons for Mendel's success; definition of 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. 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. They should be able to interpret the patterns of inheritance by analysis of pedigree chart). Biological importance of Mendelism. Pleiotropy with reference to the example of Phenylketonuria (PKU) in human beings and starch synthesis in pea seeds. Chromosomal theory of inheritance; autosomes and sex chromosomes (sex determination in humans, fruit fly, birds, honey bees and grasshopper), sex-linked inheritance - with reference to Drosophila (colour of body-yellow and brown; and colour of eyes-red and white), and man (haemophilia and colour blindness), definition and significance of linkage and crossing over. Mutation: spontaneous, induced, gene (point – transition, transversion and frame-shift); chromosomal aberration: euploidy and aneuploidy; human genetic disorders: phenylketonuria, thalassaemia, colour blindness, sickle cell anaemia; chromosomal disorders: Down's syndrome, Klinefelter's syndrome, Turner's syndrome.

(ii) Molecular basis of Inheritance

Search for genetic material and DNA as genetic material; structure of DNA and RNA; DNA packaging; DNA replication; central dogma; transcription, genetic code, translation; gene expression and regulation - lac operon; human and rice genome projects; DNA fingerprinting.

Structure of eukaryotic chromosomes with reference to nucleosome; properties of genes such as ability to replicate, chemical stability, mutability and inheritability. Search for DNA as genetic material - Griffith's experiment, Hershey and Chase's experiment, Avery, McLeod and McCarty's experiment; double helical model of DNA (contributions of Meischer, Watson and Crick, Wilkins, Franklin and Chargaff); Differences between DNA and RNA; types of RNA (tRNA, mRNA and rRNA, snRNA, hnRNA); central dogma – concept only; reverse transcription (basic idea only), Meselson and Stahl's experiment, replication of DNA (role of enzymes, namely DNA polymerase and ligase), transcription, post-transcriptional processing in eukaryotes (splicing, capping and tailing). Intron, exon, cistron, (definitions only). Discovery and essential features of genetic code. Definition of codon. Protein synthesis - translation in prokaryotes. Gene expression in prokaryotes; lac operon in E. coli.

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. Rice Genome Project (salient features and applications).

(iii) Evolution

Origin of life; biological evolution and evidences for biological evolution (palaeontology, comparative anatomy, embryology and molecular evidences); Darwin's contribution, modern synthetic theory of evolution; mechanism of evolution - variation (mutation and recombination) and natural selection with examples, types of natural selection; gene flow and genetic drift; Hardy - Weinberg's principle; adaptive radiation; human evolution.

Origin of life - abiogenesis and biogenesis, effect of oxygen on evolution to show that reducing atmosphere is essential for abiotic synthesis. Important views on the origin of life, modern concept of origin of life, Oparin Haldane theory, definition of protobionts, coacervates), vestigial organs; Miller and Urey experiment. Evidences of evolution: morphological evidences, definition and differences between homologous and analogous organs (two examples each from plants and animals). Embryological

evidences – theory of recapitulation, definition and differences between ontogeny and phylogeny. Palaeontological evidence – definition of fossils. Geological time scale (with reference to dominant flora and fauna) Biogeographical evidence – definition of biogeography, molecular (genetic) evidences -for example genome similarity, universal genetic code; Darwin's finches (adaptive radiation).

Lamarckism: brief idea of Lamarck's theory, evidences in favour of Lamarckism such as evolution of long neck of giraffe to be discussed. Darwinism: salient features of Darwinism, contribution of Malthus, criticism of Darwinism. Examples of natural selection – Long neck of giraffe, industrial melanism, resistance of mosquitoes to DDT and resistance of bacteria to antibiotics, Lederberg's replica plating experiment, Neo-Darwinism (Modern Synthetic Theory); Variation - causes of variation, Hugo de Vries theory of mutation - role of mutation in evolution; Hardy Weinberg's principle, factors affecting Hardy Weinberg equilibrium: gene migration or gene flow, genetic drift (Founder's effect, bottle-neck effect), mutation, genetic recombination and natural selection, types of natural selection (directional, disruptive and stabilizing). Evolution of man - three features of each of the ancestors Dryopithecus, Ramapithecus, Australopithecus, Homo habilis, Homo erectus, Homo neanderthalensis, Cro-magnon man and Homo sapiens leading to man of today.

3. Biology and Human Welfare

(i) Human Health and Diseases

Pathogens; parasites causing human diseases (common cold, dengue, chikungunya, typhoid, pneumonia, amoebiasis, malaria, filariasis, ascariasis, ring worm) and their control; Basic concepts of immunology - vaccines; cancer, HIV and AIDS; Adolescence - drug and alcohol abuse.

Communicable and non-communicable diseases; modes of transmission, causative agents, symptoms and prevention; viral diseases (common cold, chikungunya and dengue), bacterial diseases (typhoid, pneumonia, diphtheria and plague), protozoal diseases (amoebiasis, and malaria, graphic outline of life cycle of Plasmodium), helmintic diseases (ascariasis, and filariasis); fungal (ringworm); cancer - types of tumour (benign, malignant), causes, diagnosis and treatment, characteristics of cancer cells (loss of contact inhibition and metastasis).

Immunity (definition and types – innate and acquired, active and passive, humoral and cell-mediated), Interferons – definition, source and function; structure of a typical antibody molecule, types of antibodies - IgG, IgA, IgM, IgD and IgE (function and occurrence, e,g. in serum, saliva, colostrum); vaccination and immunisation, allergies and allergens – definition and general symptoms of allergies; autoimmunity, primary and secondary lymphoid organs and tissues, brief idea of AIDS – causative agent (HIV), modes of transmission, diagnosis (ELISA), symptoms, replication of retrovirus in the infected human cell (including diagram) and prevention.

Alcoholism and smoking - effects on health.

Drugs: effects and sources of opioids, cannabinoids, cocaine and barbiturates.

Reasons for addiction; prevention and control of alcohol and drug abuse.

(ii) Strategies for enhancement in food production

Improvement in food production: green revolution, plant breeding, tissue culture, single cell protein, biofortification, apiculture and animal husbandry.

Measures for proper maintenance of dairy farms and poultry farms; apiculture and

pisciculture – definition, brief idea and advantages of each.

Animal breeding - brief idea of inbreeding, out-breeding, cross-breeding and artificial insemination, Multiple Ovulation Embryo Transfer Technology (MOET). Advantages of artificial insemination.

Plant breeding – a brief reference to green revolution. Steps in plant breeding (germplasm collection, evaluation, selection, cross hybridisation or artificial hybridisation (concept of emasculation and bagging), selection and testing of superior recombinants, testing, release and commercialisation of new cultivars), advantages of mutation breeding, examples of some Indian hybrid crops like wheat, rice, maize, sugarcane, millet. Definition of heterosis and inbreeding depression.

Application of plant breeding for (i) disease resistantance [examples of some disease-resistant varieties of crops for example wheat (Himgiri), Brassica (Pusa swarnim), cauliflower (Pusa shubhra, Pusa snowball K – 1), Cow pea (Pusa komal), chilli (Pusa sadabahar)],(ii) insect resistance [examples of some insect resistant varieties of crops – Brassica (Pusa Gaurav), flat bean (Pusa sem 2, Pusa sem 3), okra (Pusa sawani, Pusa A–4)], (iii) improved food quality (biofortification, e.g., wheat – Atlas 66, maize hybrids, iron fortified rice). Tissue culture (technique and application – micropropagation, somaclones, disease free plants and somatic hybridisation), single cell protein – source and significance.

(iii) Microbes in Human Welfare

In household food processing, industrial production, sewage treatment, energy generation and microbes as biocontrol agents and biofertilisers. Antibiotics.

Use of microbes in: (i) Household products: Lactobacillus (curd), Saccharomyces (bread), Propionibacterium (Swiss cheese); (ii) Industrial products: beverages (with and without distillation), antibiotics (Penicillin – discovery and use); sources (microbes) and uses of organic acids, alcohols and enzymes (lipase, pectinase, protease, streptokinase) in industry, source (microbes) and applications of Cyclosporin-A, Statins. (iii) Sewage treatment – primary and secondary treatment; (iv) Production of biogas (methanogens, biogas plant, composition of biogas and process of production); (v) Microbes as biocontrol agents (ladybird, dragonfly, Bacillus thuringiensis Trichoderma, Nucleopolyhedrovirus (Baculovirus), and (vi) Microbes as biofertilisers (Rhizobium, Azospirillum, Azotobacter, Mycorrhiza, Cyanobacteria), IPM, harmful effects of chemical pesticides.

4. Biotechnology and its Applications

(i) Biotechnology - Principles and processes

Genetic Engineering (recombinant DNA technology).

Definition and principles of biotechnology; isolation of genomic (chromosomal) DNA (from bacteria/plant cell/animal cell, by cell lysis), isolation of gene of interest (by electrophoresis), steps of formation of recombinant DNA, discovery, nomenclature, features and role of restriction enzymes (EcoRI, HindII) and role of ligase; cloning vectors (features of a good cloning vector, examples of cloning vectors like pBR322, Agrobacterium, retroviruses, bacterial artificial chromosome (BAC), yeast artificial chromosome (YAC)), methods of transfer of rDNA into a competent host, e.g. by direct-method (temperature shock), microinjection, gene gun, methods of selection of recombinants (antibiotic resistance, insertional inactivation/blue-white selection), cloning of recombinants, i.e., gene amplification (by in vivo or in vitro method - using PCR technique), bioreactor (basic

features and uses of stirred tank and sparged tank bioreactors), downstream processing.

(ii) Biotechnology and its applications

Applications of biotechnology in health and agriculture: human insulin and vaccine production, stem cell technology, gene therapy; genetically modified organisms - Bt crops; transgenic animals; biosafety issues, biopiracy and biopatents.

In agriculture: for production of crops tolerant to abiotic stresses (cold, drought, salt, heat); pest-resistant crops (Bt-crops, RNAi with reference to Meloidogyne incognita); crops with enhanced nutritional value (golden rice).

In medicine: insulin, gene therapy - with reference to treatment of SCID, molecular diagnosis by PCR, ELISA and use of DNA/RNA probe.

Transgenic animals for bioactive products like alpha-1-antitrypsin for emphysema, alpha-lactalbumin; vaccine safety testing, chemical safety testing; study of diseases.

Role of GEAC, definition and two examples of biopiracy, biopatent; ethical issues.

5. Ecology and Environment

(i) Organisms and Populations

Organisms and environment: habitat and niche, population and ecological adaptations; population interactions - mutualism, competition, predation, parasitism; population attributes - growth, birth rate and death rate, age distribution.

Definition of ecology; major biomes of India – Tropical rain forests, deciduous forests, deserts and sea coasts (their annual temperatures and precipitation). Definition of habitat and niche.

Definition of population; population attributes: sex ratio, types of age distribution pyramids for human population; definition of population density, natality, mortality, emigration, immigration, carrying capacity. Ways to measure population density. Calculation of natality and mortality.

Population growth: factors affecting population growth and population growth equation; growth models: exponential growth and logistic growth along with equations, graph and examples of the same; life history variations: definition of reproductive fitness and examples.

Population interactions – definition of mutualism, competition (interspecific, interference, competitive release and Gause's Principle of Competitive Exclusion), predation (adaptations in organisms to avoid predation), parasitism (ecto-, endo-, and brood parasites), commensalism, amensalism.

(ii) Ecosystem

Ecosystems: patterns, components; productivity and decomposition; energy flow; pyramids of number, biomass, energy; nutrient cycles (carbon and phosphorous); ecological succession; ecological services - carbon fixation, pollination, seed dispersal, oxygen release (in brief).

Definition and types of ecosystems; structure of ecosystem (brief idea about biotic and abiotic components).

Effects of abiotic factors (temperature, water, light, soil) on living organisms, definition of stenothermal, eurythermal, stenohaline and euryhaline), responses to abiotic factors (regulate, conform, migrate, suspend); ecological adaptations: morphological, physiological and behavioural in response to loss of water and extremes of temperature in plants and animals including humans. Allen's rule.

Structure and function of pond ecosystem; ecosystem functions: (i) Productivity – gross primary productivity (GPP), net primary productivity (NPP) and secondary productivity (ii) Decomposition (fragmentation, leaching, catabolism,

humification and mineralization), factors affecting rate of decomposition (iii) Energy flow. Various types of food chains – grazing and detritus, food webs, trophic levels, ecological pyramids – energy, number and biomass (iv) Nutrient cycle – definition of biogeochemical cycles – gaseous cycle (Carbon) and sedimentary cycle (Phosphorous).

Definition of PAR, 10% Law, standing crop and standing state.

Succession: definition to explain the meaning, kinds of succession (hydrarch, xerarch; primary and secondary succession with examples), definition of pioneer community, climax community and sere; significance of ecological succession.

Ecological services and their cost.

(iii) Biodiversity and its Conservation

Concept of biodiversity; patterns of biodiversity; importance of biodiversity; loss of biodiversity; biodiversity conservation; hotspots, endangered organisms, extinction, Red Data Book, biosphere reserves, national parks, sanctuaries and Ramsar sites

Definition of biodiversity, few examples of each type of biodiversity - species, ecosystem and genetic. Global biodiversity and proportionate number of species of major taxa of plants, invertebrates and vertebrates; patterns of biodiversity (latitudinal gradients, species-area relationship – graph and equation), "rivet popper hypothesis", importance of species diversity to the ecosystem (narrowly utilitarian, broadly utilitarian, ethical terms).

Examples of some recently extinct organisms, causes of loss of biodiversity (habitat loss and fragmentation, over-exploitation, alien species invasion, co-extinction).

Biodiversity conservation: In-situ methods - protected areas: biosphere reserves, national parks, wildlife sanctuaries, sacred groves; ex-situ methods - captive breeding, zoo, botanical gardens, cryopreservation, wild life safari, seed banks, tissue culture. Definitions and examples of each of the above. Hotspots, Ramsar sites and Red Data Book.

The place, year and main agenda of historic conventions on biological diversity (the Earth Summit and the World Summit).

(iv) Environmental Issues

Air pollution and its control; water pollution and its control; agrochemicals and their effects; solid waste management; radioactive waste management; greenhouse effect and climate change; ozone layer depletion; deforestation; any one case study as success story addressing environmental issue(s).

Definition of pollution and pollutant; 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, catalytic converter, CNG, Bharat stages, noise pollution: harmful effects and control; Water pollution, major sources and its control, composition of waste water, thermal pollution, eutrophication - cultural or accelerated, BOD, effect of sewage discharge on BOD and dissolved oxygen content in river; case studies of waste water treatment (FOAM and EcoSan); Soil pollution – sources, effects and control, agrochemicals and their harmful effects, integrated organic farming, contribution of Ramesh Chandra Dagar, biomagnification and bioconcentration; solid waste management, Radioactive waste management, e-waste.

A brief understanding of the concept of deforestation (slash and burn agriculture or jhum cultivation's contribution), greenhouse effect. Impact of global warming in terms of climatic changes, rise in sea levels, melting of ice caps, El Nino effect; impact on animals and plants due to climate changes. Ozone depletion – causes, ozone hole, Dobson unit, effects on plants and animals, methods to control ozone depletion, Montreal protocol. The following case studies as success stories addressing environmental issues: Chipko Movement, Joint Forest Management, contribution of Ahmed Khan of Bangalore.

Main provisions of Environmental Acts — Environmental Protection Act, Water (prevention and control of pollution), Air (prevention and control of pollution act).

PAPER II

PRACTICAL WORK – 15 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) Leguminosae: subfamily – Papilionaceae – type – Sweet pea/ Pea/ Bean/ *Sesbania*/ *Clitoria* (single flower).

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

(iv) Liliaceae: type – Onion or Amaryllidaceae – 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 is necessary.*** *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 know 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.

NOTE: In the examination, candidates will be tested on <u>any one</u> of the above families.

2) Simple biochemical and physiological experiments

(i) Study of arrangement/distribution of stomata in dicot and monocot leaves.

(ii) Study of soils from ***two different sites***.

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

Guidelines for collection of soil samples:

- *Texture - loamy, sandy and clayey soil.*
- *Moisture content – Soil samples are to be collected from a dry place and a wet place. Alternatively, samples of soil can be dried to different degrees in oven/by keeping in sun.*
- *Humus Content – Collect one sample from roadside/barren land and one sample from garden/cultivated field.*
- *Water holding capacity – Pour given amount of water in known weight of soil sample and record the volume of water retained by the soil sample.*
- *pH – Add water to the soil sample and test with pH paper.*

Students should be taught to set up and demonstrate the experiments with correct diagram of the setup, 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.

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

Effect of enzyme (amylase/ diastase) action at three different temperatures (low- below 10^oC, optimum - 37^oC and high – above 70^oC) and pH (acidic, neutral and basic) on starch solution.

(iv) To isolate DNA from available plant material.

Isolation of DNA from spinach leaves, green pea seeds, pulp of banana and papaya.

Take half a ripe and peeled banana into a beaker and add 50 ml of extraction fluid (1.5gm table salt +10 ml liquid detergent +90 ml distilled water). Place the beaker in a water bath set at 60 °C for 15 minutes. Stir gently with a glass rod. Filter 5ml of cooled content into a clean test tube and add 5ml of cold 90% ethanol. DNA molecules separate out and appear as white fibres.

3) Slide preparation

(i) Germination of pollen grain in a nutrient medium.

(ii) T.S. of ovary of any locally available flower, to show marginal / axile placentation.

(iii) T.S. of a hydrophyte stem.

(iv) T.S. of a xerophytic leaf (*Nerium).*

(v) L.S. of monocot and dicot seed (soaked seeds of maize/wheat, pea/ bean.)

The technique of staining and mounting neatly should be explained. Students should also know how to make labelled outline diagrams. They should also be taught to identify the mount under low/ high power of microscope. ***Two*** *identifying features of the above need to be mentioned.*

4) Spotting: (three minutes to be given for each spot which includes identification, drawing a labelled diagram and writing at least 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 the following:

(a) T.S. of ovary of mammal (Permanent slide).

(b) T.S. of testis of mammal (Permanent slide).

(c) Germinating pollen grain (slide/chart).

(d) T.S. of ovary to show the type of placentation (marginal, axile, basal (LS), parietal).

(e) T.S. of blastula / blastocyst of a mammal (chart/ slide).

(f) Whole mount of *Plasmodium* sporozoite (slide /chart).

(g) Whole mount of *Entamoeba histolytica* trophozoite (slide/chart).

(h) Preserved specimen/ chart/ model of *Ascaris.*

(ii) Comment upon ecological adaptations of plants and animals.

Models/ virtual images/ charts of one plant and one animal found in xeric and aquatic habitats. Examples: Hydrilla, cactus, fish and camel.

. (iii) 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.*

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.', 'model', 'whole mount', 'chart', 'image' of the specimen should be mentioned as a part of identification.

PROJECT WORK AND PRACTICAL FILE – 15 Marks

Project Work – 10 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. Preference is to be given to investigatory projects. 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) Genetic disorders
(ii) Gene therapy
(iii) Human Genome Project
(iv) DNA fingerprinting
(v) Bio-piracy
(vi) Cancer.
(vii) AIDS/Hepatitis.
(viii) Drug addiction and community.
(ix) Role of micro-organisms in industry.
(x) Human population.
(xi) Mendelian Inheritance
(xii) Environmental resistance.
(xiii) 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.

(xiv) 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 – 5 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.

SCIENTISTS AND THEIR CONTRIBUTIONS:

1. Oparin: Coacervates, Conditions on primitive earth were favourable for chemical evolution
2. Stanley Miller & Harold Urey: Recreated probable conditions on primitive earth
3. Ernst Haeckel: Proposed the recapitulation theory
4. Charles Darwin: Natural Selection
5. Lamarck: Inheritance of acquired characters
6. Hugo de Vries: Mutation
7. T. R. Malthus: Theory of Human Population Growth/ Essays on population
8. Alec Jeffrey: DNA finger printing
9. Temin and Baltimore: Reverse transcription.
10. Jacob, Monad and Lwoff: proposed Lac operon.
11. Watson and Crick: Structure of DNA
12. Nirenberg and Khorana: Genetic code
13. Benzer: Cistron, recon, muton
14. Gregor Mendel: Father of genetics
15. Sutton and Boveri: Chromosomal theory of inheritance
16. Hugo de Vries, Correns and Tschermack: Rediscovered Mendelism
17. T H Morgan: Linkage
18. P Maheshwari: Plant tissue culture
19. Henking: Discovered X-chromosome
20. F. Meischer: Isolated nucleic acid from pus cells, called Nuclein
21. Chargaff: Rule of equivalence in DNA structure
22. F. Griffith: Transformation in bacteria
23. Avery, MacLeod and McCarty: DNA is the genetic material
24. Hershey and Chase: DNA is the genetic material
25. Meselson and Stahl: Semi-conservative replication of DNA
26. G. Gamow: Triplet nature of codons
27. S Ochoa: discovered polynucleotide phosphorylase
28. Wallace: divided the Earth into biogeographical regions
29. M S Swaminathan: Green revolution in India
30. H Boyer: discovered Restriction Enzyme
31. S Cohen: method to transfer plasmid DNA in host cells
32. R. Mishra: Father of Indian Ecology
33. E. Wilson: coined the term Biodiversity
34. P Ehrlich: Rivet Popper Hypothesis
35. Sanger: DNA/Protein sequencing

LIST OF ABBREVIATIONS TO BE STUDIED

1. ADA- Adenosine Deaminase
2. CMI- Cell Mediated Immunity
3. CNG- Compressed Natural Gas
4. CPCB- Central Pollution Control Board
5. DDT – Dichloro diphenyl trichloro ethane
6. DFC- Detritus Food Chain
7. EFB- European Federation of Biotechnology

8. EST- Expressed Sequence Tags
9. ET- Embryo Transfer
10. GFC- Grazing Food Chain
11. GMO- Genetically Modified Organism
12. GPP- Gross Primary Productivity
13. hnRNA - Heterogeneous Nuclear Ribo Nucleic Acid
14. IARI- Indian Agricultural Research Institute
15. IMR- Infant Mortality Rate
16. IRRI- International Rice Research Institute
17. ICSI - Intra Cytoplasmic Sperm Injection
18. IUCD/IUD – Intra uterine contraceptive device
19. IUCN- International Union for Conservation of Nature and Natural Resources
20. IUI- Intra Uterine Insemination
21. IUT- Intra Uterine Transfer
22. JFM- Joint Forest Management
23. LAB- Lactic Acid Bacteria
24. MALT- Mucosal Associated Lymphoid Tissue
25. MMR- Maternal Mortality Rate
26. MOET- Multiple Ovulation Embryo Transfer Technology
27. NACO- National AIDS Control Organisation
28. NPP- Net Primary Productivity
29. PID- Pelvic Inflammatory Diseases
30. PKU- Phenyl ketonuria
31. RCH- Reproductive and Child Health Care Programmes
32. SCID – Severe Combined Immuno Deficiency
33. SNPs - Single Nucleotide Polymorphisms
34. snRNA- Small Nuclear Ribo Nucleic Acid
35. sRNA - Soluble Ribo Nucleic Acid
36. SSBP – Single Strand Binding Protein
37. UTR - Untranslated Region
38. VNTRs - Variable Number of Tandem Repeats