

BIOLOGY (863)

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

Three domains of life; taxonomy and systematics; concept of species and taxonomical hierarchy; tools for study of taxonomy-museums, zoological parks, herbaria, botanical gardens, key.

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. 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).*

Mycoplasma – three distinctive features.

Economic importance with reference to role of bacteria in sewage treatment, antibiotics, energy production and household 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 – three general characteristics, graphic outline of life cycle of Funaria with reference to alternation of generations. Economic importance of bryophytes.*

(c) *Pteridophyta*: three characteristics; Graphic outline of life cycle of a typical pteridophyte (fern). Definition of homosporous and heterosporous 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.

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

(iv) Animal Kingdom

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

Morphology of flower. 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, epiphylloous; number of lobes – monothealous, dithealous; 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: Internal structure of root, stem and leaf.

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.

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 and cork cambium, formation of secondary tissues, differences between heart wood and sap wood. Definition of bark.

(iii) Structural Organisation in Animals

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

Structure of eukaryotic cells; 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.

General structure of eukaryotic cell, ultra-structure and function of cell wall, cell membrane (description of fluid mosaic model; types of junctions (tight, adhering and gap junctions); 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; microfilaments and microtubules, flagella and cilia.

(ii) Biomolecules

Proteins, carbohydrates, lipids, 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); 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 and meiosis.

Definition of C-value, different stages of cell cycle (G_0 , G_1 , S, G_2 and M).

Different stages of meiosis with diagrams. Significance of meiosis.

4. Plant Physiology

(i) Transport in Plants

Plant-water relations, water potential, 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.

*Importance of water; active and passive absorption of water; apoplastic and symplastic movements, definition of water potential (**numerical problems based on this concept are not required**). Root pressure – definition; definition of transpiration, significance of transpiration. Stomatal mechanism – 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.*

Transport of solutes; evidence which indicate that downward movement of organic solutes takes place in phloem (tracer technique), 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 cycle, biological nitrogen fixation.

Criteria for essentiality of minerals, hydroponics, macro and micronutrients; role

and deficiency symptoms (hunger signs) of various elements. Mineral toxicity.

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: Definition; site of photosynthesis, photochemical and biosynthetic phases of photosynthesis; cyclic and non-cyclic photophosphorylation; chemiosmotic hypothesis; photorespiration; C₃ and C₄ pathways; factors affecting photosynthesis.

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

Photochemical phase - pigment systems, cyclic and non-cyclic photophosphorylation, chemiosmotic hypothesis; biosynthetic phase - C₃ and C₄ cycles – graphic representation in correct sequence (carboxylation, glycolytic reversal and regeneration of pentose); Differences between C₃ and C₄ 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

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; growth regulators - auxin, gibberellin, cytokinin, ethylene, ABA; seed dormancy; vernalisation; photoperiodism.

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

Physiological role of growth regulators in plants (such as auxins, gibberellins, cytokinins, ethylene and abscisic acid – four effects of each); 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 system in humans; mechanism of breathing and its regulation - exchange of gases, transport of gases and regulation of respiration; 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 CO₂; chloride shift, disorders of respiratory system such as - asthma, emphysema, occupational respiratory disorders.

(iii) Body fluids and circulation.

Human circulatory system - structure of human heart; cardiac cycle, cardiac output, ECG; double circulation; regulation of cardiac activity; disorders of circulatory 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. 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, role of erythropoietin; 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 and erythropoietin.

Homeostasis – definition. Disorders of the excretory system - uraemia, renal failure, renal calculi, nephritis.

Haemodialysis and artificial kidney.

(v) Locomotion and Movement

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; sliding filament theory of 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; 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. Definition of olfactory receptor and 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 heat 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.

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

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

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) Identification of mammalian blood cells.
 - (ii) Bacteria
 - (iii) *Spirogyra*
 - (iv) *Amoeba*
 - (v) 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, diagrams, photographs, statistical analysis if relevant)
- Conclusion/ Summary
- Bibliography

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. F.F. Blackman – Law of limiting factor
6. F.W. Went – Isolated Auxins
7. Farmer and Moore – Discovered meiosis
8. Garner and Allard – Photoperiodism
9. George Palade – Discovered ribosomes
10. Huxley and Niedergerke – Sliding filament theory
11. Ivanowsky – Discovered Tobacco Mosaic Virus
12. Karl Landsteiner – Blood groups
13. Katherine Esau – Anatomy of plants
14. Levitt – Active K^+ transport theory of stomatal movement
15. Munch – Proposed mass flow hypothesis
16. Peter Mitchell – Chemiosmotic coupling hypothesis
17. Priestley – Plants restore oxygen in the air

18. Renner – Coined the terms active and passive absorption of water
19. Robert Brown – Discovered nucleus
20. Singer and Nicolson – Proposed fluid mosaic model of plasma membrane
21. Sutherland – cyclic AMP as second messenger
22. T. O. Diener – Discovered viroids
23. Thomas Addison – Father of endocrinology
24. Van Neil – Oxygen released during photosynthesis comes from water
25. W. M. Stanley – Crystallised TMV
- 286 Waldeyer – Coined the term chromosome
27. Whittaker – Five kingdoms of life
28. William Harvey – Discovered circulatory system

LIST OF ABBREVIATIONS TO BE STUDIED

1. ABA – Abscisic Acid
2. ANF – Atrial Natriuretic Factor
3. CCK –Cholecystokinin
4. DPD – Diffusion Pressure Deficit
5. ECG – Electrocardiogram
6. ETS – Electron Transport System
7. FAD – Flavin Adenine Dinucleotide
8. GA – Gibberellic acid
9. GFR – Glomerular Filtration Rate
10. GIP – Gastric Inhibitory Peptide
11. IBA – Indole Butyric Acid
12. LHC – Light Harvesting Complex
13. NAA – Naphthalene Acetic Acid
14. OAA – Oxaloacetic Acid
15. PEM – Protein Energy Malnutrition
16. PGA – Phosphoglyceric Acid
17. PGRs – Plant Growth Regulators
18. PPLO – Pleuro Pneumonia Like Organism
19. PZ – Pancreozymin
20. RQ – Respiratory Quotient
21. RUBISCO – Ribulose Bisphosphate Carboxylase oxygenase
22. TMV – Tobacco Mosaic Virus