

## BIOLOGY (863)

### Aims:

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

### CLASS XI

*There will be two papers in the subject.*

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

**Paper II: Practical:** 3 hours ... 20 marks

Project Work ... 7 marks

Practical File ... 3 marks

#### PAPER I –THEORY – 70 Marks

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

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

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

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

#### SECTION – A

##### 1. Diversity of Life

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

*Need for classification should be discussed. Definition and explanation of the terms taxonomy and phylogeny should be given for*

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

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

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

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

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

- (b) *General characteristics of Kingdom Protista – Only two general characteristics and two examples of subgroups: (i) Chrysophytes (ii) Dinoflagellates, (iii) Euglenoids, (iv) Slime moulds, (v) Protozoans (to be studied under rhizopods, flagellates, ciliates and sporozoans with two characteristics including modes of locomotion and two examples of each).*
- (c) *Kingdom Fungi: general characteristics of each (including types of spores). Zygomycetes, Ascomycetes, Basidiomycetes, Deuteromycetes - two characteristics with two examples of each. Role of fungi in the field of medicine, bakery and environmental decomposition. Definition of lichens and mycorrhiza (ecto and endo).*

**Life cycles not required.**

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

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

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

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

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

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

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

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

## SECTION B

### 2. Plant Physiology

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

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

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

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

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

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

(iii) Photomorphogenesis in plants.

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

### **3. Multicellularity: Structure and Functions of Plants and Animals**

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

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

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

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

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

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

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

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

*Organs involved in respiration; diagram of the respiratory tract and the associated organs. Mechanism of pulmonary gas exchange; breathing process should be explained showing the action of diaphragm and intercostal muscles; Transport of oxygen in the blood as dissolved oxygen and as oxyhaemoglobin; transport of CO<sub>2</sub> as carbonic acid, as bicarbonates and carbamino haemoglobin; Chloride shift, pulmonary air volumes and lung capacity must be taught. Disorders of respiratory system such as emphysema, asthma, occupational respiratory disorders.*

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

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

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

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

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

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

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

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

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

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

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

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

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

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

*Disorders of muscular and skeletal system*

- (i) Muscular dystrophy, (ii) Arthritis, (iii) Gout, (iv) Osteoporosis, (v) Tetany, (vi) Myasthenia gravis.

## SECTION C

### 4. Units of Life

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

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

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

*Lipids - classification, structure and functions of fats and oils.*

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

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

*General properties, nomenclature and classification of enzymes according to type of reactions, co-enzymes and co-factors; Lock and key hypothesis should be explained with diagram to give a clear concept of enzyme action. Factors affecting enzyme activity*

*should be taught - temperature, pH, substrate concentration, competitive and non-competitive inhibitors.*

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

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

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

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

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

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

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

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

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

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

## 5. Organisms and Environment

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

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

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

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

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

### PAPER II

#### PRACTICAL WORK - 20 Marks

##### 1. Scientific Techniques

Study parts of a dissecting microscope and compound microscope.

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

## 2. Physiology

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

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

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

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

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

- (iii) Study of pH of different soils.

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

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

*Self-explanatory*

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

*Self-explanatory*

## 3. Morphology

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

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

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

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

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

#### 4. Cytology

Preparation of temporary slides of -

- (i) Onion peel (to study the plant cell)  
(ii) Stages of Mitosis in onion root tips.

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

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

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

- (a) Identification of stained preparations of the following:
- (i) Stages of mitosis.
  - (ii) Stages of meiosis.
  - (iii) Identification of mammalian blood cells.
  - (iv) Bacteria
  - (v) Oscillatoria
  - (vi) Spirogyra
  - (vii) Amoeba
  - (viii) Entamoeba
  - (ix) Plasmodium
  - (x) Yeast

- (b) Identification of the following specimens -

- (i) Liverworts
- (ii) Moss
- (iii) Fern
- (iv) Pinus
- (v) Rhizopus
- (vi) Mushroom
- (vii) Lichen
- (viii) One monocot plant – bamboo
- (ix) One dicot plant – petunia
- (x) A phylloclade - cactus
- (xi) Hydra
- (xii) Liver Fluke
- (xiii) Ascaris
- (xiv) Leech
- (xv) Earthworm
- (xvi) Prawn/Crab
- (xvii) Honey Bee
- (xviii) Cockroach
- (xix) Silk Worm
- (xx) Rohu fish

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

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

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

**PROJECT WORK AND PRACTICAL FILE –  
10 Marks**

**Project Work – 7 Marks**

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

- (i) Project related to experiment on any aspect of plant life.
- (ii) Project related to any aspect of environment.
- (iii) Projects related to modern researches in Biology, e.g. test-tube babies.
- (iv) Role of genetics in investigating crimes.
- (v) Yeast fermentation and production of alcohol or any other commercial industry dependant on plants and/or animals or their products.

In addition, students may be taught how to culture:

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

**Suggested Evaluation Criteria for Project Work:**

Format of the Project:

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

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

**Practical File – 3 Marks**

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

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