

BIOLOGY

I OVERALL AIM

- ❖ To instill a sense of belonging in the student about the science of life.
- ❖ To enable the student to appreciate the subtleties and charm of life around oneself.
- ❖ To make the student abreast with important and recent developments in the subject.

II SPECIFIC OBJECTIVES - Pertaining to

- **Knowledge:** To familiarize the student with all important and basic concepts and principles in Biology.
- **Skills:** To inculcate in the student the correct practical approach to the study of Biology and the inquisitive outlook in his studies. To make the student learn the basic skills in practical biology with emphasis on exploratory approach.
- **Application abilities:** To make the student confident of applying his knowledge and skills to understand the world around him better.
- **Attitudes towards the subject and society:** To instill in the student the importance of scientific attitude in day-to-day life and to inspire the student to appreciate the value of biodiversity and to harness the country's strength in traditional sciences and customs, modern science and technology and trained manpower in order to emerge with an exciting strategy for equity based economic growth along with conservation and perpetuation of biodiversity.

THE BREAK-UP OF TEACHING HOURS

I PUC SYLLABUS	II PUC SYLLABUS
BIOLOGY: PART I (BOTANY)	BIOLOGY: PART I (BOTANY)
TOPICS IN GENERAL BIOLOGY	TOPICS IN GENERAL BIOLOGY
B.1 BIOSYSTEMATICS 2	B.1 MOLECULAR BIOLOGY 6
B.2 CELL BIOLOGY 10	B.2 BIOTECHNOLOGY 8
TOPICS IN BOTANY	TOPICS IN BOTANY
B.3 DIVERSITY OF LIFE ON EARTH	B.4 HISTOLOGY & ANATOMY 5
KINGDOM MONERA 6	B.5 WATER RELATIONS OF PLANTS 7
KINGDOM PROTISTA 1	B.6 BIOENERGETICS 8
KINGDOM MYCOTA 1	B.7 GROWTH & GROWTH REGULATORS 3
KINGDOM METAPHYTA 10	
B.4 PLANT TAXONOMY & ECONOMIC BOTANY 3	
B.5 ELEMENTARY PLANT PATHOLOGY 2	
BIOLOGY: PART II (ZOOLOGY)	BIOLOGY: PART II (ZOOLOGY)
TOPICS IN GENERAL BIOLOGY	TOPICS IN GENERAL BIOLOGY
Z.1 INTRODUCTION 3	Z.1 GENETICS 6
Z.2 BIOMOLECULES 4	Z.2 BIODIVERSITY 8
Z.3 ORIGIN OF LIFE & ORG. EVOLUTION 5	
TOPICS IN ZOOLOGY	TOPICS IN ZOOLOGY
Z.4 DIVERSITY OF ANIMAL LIFE 12	Z.3 MAN IN HEALTH & DISEASES 18
Z.5 ANIMAL TYPE STUDY 3	Z.4 CONTINUITY OF LIFE 6
Z.6 ANIMAL RESOURCES 8	
TOTAL 70 HOURS	TOTAL 75 HOURS

[NOTE: The above distribution of chapters with corresponding teaching load is to facilitate setting of question papers in botany and zoology sections separately. However, the actual teaching programme for every week could be on the basis of one hour each for General Biology topics, Botany topics and Zoology topics as indicated above.]

I YEAR PREUNIVERSITY SYLLABUS**BIOLOGY: PART I (BOTANY)
THEORY (35 hours)****I GENERAL BIOLOGY TOPICS****B.1 BIOSYSTEMATICS (2 HOURS)**

- 1.1 Introduction – a) Need, history and types of classification (Artificial, Natural and Phylogenetic)
b) Species concept, Binomial nomenclature with examples, Rules and advantages of binomial nomenclature.
- 1.2 Linnaean hierarchy – Kingdom to species with examples (*Cocos nucifera* and *Homo sapiens*).
- 1.3 The five-kingdom system of classification in detail – General characters of kingdoms Monera, Protista, Mycota, Metaphyta and Metazoa.

B.2 CELL BIOLOGY (10 HOURS)**2.1 CELL STRUCTURE (3 HOURS)**

- 2.1.1 Structure and functions of cell components - cell wall, plasma membrane (fluid mosaic model), endoplasmic reticulum, plastids (brief), mitochondria (brief), Golgi complex, Ribosomes, Lysosomes, Centrosome, vacuole and nucleus - nuclear envelope (nuclear pores and nuclear lamina) nucleoplasm, nucleolus and chromatin. A brief account of ergastic substances (mention about reserve food, secretory and excretory substances with examples).
- 2.1.2 Differences between plant cell and animal cell.

2.2 CHROMOSOMES (3 HOURS)

- 2.2.1 Discovery, shape, size and number of chromosomes, Autosomes and allosomes; Karyotype and idiogram.
- 2.2.2 Chemical composition and function.
- 2.2.3 General structure - Concept of centromere (primary constriction), secondary constriction, satellite, kinetochore, telomere.
- 2.2.4 Types of chromosomes based on the position of centromere.
- 2.2.5 Ultrastructural organization of the eukaryotic chromosome – nucleosome model.
- 2.2.6 Numerical aspects of chromosomes: A brief note on aneuploidy (monosomy and trisomy) and euploidy (haploidy, diploidy and polyploidy).

2.3 CELL REPRODUCTION (4 HOURS)

2.3.1 Cell division and types.

2.3.2 Concept of cell cycle.

2.3.3 Mitotic division and significance.

2.3.4 Meiotic division and its significance.

2.3.5 Cancer- meaning of cancer, benign and malignant tumours, characters of cancer cells, types of cancer (Carcinoma, Sarcoma, Lymphoma and Leukemia), causes of cancer (physical, chemical and biological carcinogens with examples).

2.3.6 Concept of cell senescence and apoptosis (programmed cell death).

II. BOTANY TOPICS**B.3 DIVERSITY OF LIFE ON EARTH****3.1 KINGDOM MONERA AND OTHER SIMPLE LIVING FORMS (6 HOURS)****3.1.1 PRIONS AND VIROIDS (0.5 HOUR)**

Concept of prions and viroids - definition, discovery, chemical nature with one example of disease each - Creutzfeldt-Jacob disease (CJD) and Potato spindle tuber disease (PSTV).

3.1.2 VIRUSES (2 HOURS)

3.1.2.1 Introduction - living and non-living properties of viruses.

3.1.2.2 Types of viruses - Plant viruses, Animal viruses, Bacterial viruses, DNA viruses and RNA viruses (Only definitions with examples to include the following: Viral diseases in plants - Tobacco Mosaic, Cauliflower Mosaic, Potato Mottle, Leaf mosaic of tomato and Banana Bunchy Top; viral diseases in animals-Rabies, Dog distemper; Viral diseases in man- Japanese Encephalitis, Poliomyelitis, Hepatitis-B, Herpes, AIDS and Conjunctivitis).

3.1.2.3 Structure of T₄ Bacteriophage, multiplication of T₄ phage (Lytic cycle only).

3.1.3 BACTERIA (2.5 HOURS)

3.1.3.1 Introduction

3.1.3.2 Classification of bacteria based on mode of nutrition (Heterotrophic bacteria -parasitic, saprophytic and symbiotic - and Autotrophic bacteria -photosynthetic and chemosynthetic; definition and one example for each group).

3.1.3.3 Ultrastructure of the bacterial cell

3.1.3.4 Reproduction in bacteria- asexual reproduction by binary fission, endospore formation and sexual mechanism (genetic recombination in bacteria – transduction, transformation and conjugation with details of HFR conjugation only).

3.1.3.5 Importance of bacteria.

- a) Beneficial aspects – Scavenging, Fermentation, Retting, Antibiotics, Ecological importance, Importance in Genetic engineering and Importance in mineral extraction.
- b) Harmful aspects
Food spoilage and food poisoning.
Bacterial diseases – Brief and introductory information on the following diseases: Citrus canker, Anthrax, Cholera, Gastric ulcer, Tuberculosis and Syphilis (details of treatment are not required).
- c) A brief introduction on Archaea and their importance.

3.1.4 CYANOBACTERIA (1 HOUR)

3.1.4.1 Introduction.

3.1.4.2 Structure and reproduction of *Nostoc*.

3.1.4.3 Differences between bacteria and Cyanobacteria.

3.1.4.4 Importance of Cyanobacteria.

3.2 KINGDOM PROTISTA (1 HOUR)

3.2.1 General characters.

3.2.2 Mentioning the following divisions with suitable examples.

Chrysophyta (Diatoms), Euglenophyta (*Euglena*) and Protozoa (to be studied in Zoology).

3.2.3 Taxonomic position of Algae with reference to the five-kingdom classification choosing the following examples: Desmids (typical members of Protista) and *Spirogyra* (A member of metaphyta) are both included in division Chlorophyta (Green Algae).

3.2.4 Importance of Algae (in brief).

3.3 KINGDOM MYCOTA - The Fungi: (1 HOUR)

3.3.1 General characters of Fungi.

3.3.2 Mentioning divisions with suitable examples. Zygomycota - *Rhizopus*; Ascomycota - *Saccharomyces*; Basidiomycota - *Agaricus*; Duteromycota - *Cercospora*.

3.3.3 Importance of Fungi; A brief account of mushroom culturing (paddy straw mushroom culturing).

3.4 KINGDOM METAPHYTA (10 HOURS)

3.4.1 BRYOPHYTA (1 HOUR)

3.4.1.1 General characters of Bryophytes.

3.4.1.2 Mentioning classes with suitable examples- Hepaticopsida - *Riccia*; Anthocerotopsida - *Anthoceros*; Bryopsida - *Funaria*.

3.4.2 PTERIDOPHYTA (1 HOUR)

3.4.2.1 General characters of Pteridophytes.

3.4.2.2 Mentioning classes with suitable examples: Psilotopsida - *Psilotum*; Lycopsidea - *Selaginella*; Sphenopsida - *Equisetum*; Pteropsida - *Nephrolepis*.

3.4.3 GYMNOSPERMS (1 HOUR)

3.4.3.1 General characters of Gymnosperms.

3.4.3.2 Mentioning classes with suitable examples - Cycadopsida - *Cycas*; Coniferopsida - *Pinus*; Gnetopsida - *Gnetum*.

3.4.4 ANGIOSPERMS: (7 HOURS)

3.4.4.1 General characters of Angiosperms - Typical dicotyledonous and monocotyledonous plants (*Brassica* and grass) and differences between dicotyledons and monocotyledons.

3.4.4.2 Study of the Angiosperm flower.

Technical terms used in description of flower- Actinomorphic, Zygomorphic, Unisexual, Bisexual, Pedicellate, Sessile, Bracteate, Ebracteate, Bracteolate, Ebracteolate, Homochlamydeous, Heterochlamydeous. Complete flower, Incomplete flower, Epigynous, Hypogynous and Perigynous flowers.

The parts of the flower:

a) Accessory whorls:

- i. Concept of perianth.
- ii. Calyx - polysepalous and gamosepalous conditions with one example each.
- iii. Corolla - Polypetalous and Gamopetalous conditions.
- iv. aestivation-definition and types - Valvate, Imbricate and Twisted types with one example each.

b) Essential whorls:

- i. Androecium - parts of a stamen, adelphy, syngony, synandry and epipetaly. Anther lobes - monothealous and dithealous conditions with one example each.

- ii. Gynoecium - parts of gynoecium, concept of carpel, Types of gynoecium - apocarpous and syncarpous gynoecium. Types of gynoecium based on number of carpels - monocarpellary, bicarpellary, tricarpellary and multicarpellary conditions. Nature of ovary of gynoecium with reference to locule - unilocular, bilocular, trilocular and multilocular conditions. Placentation - definition, types - marginal, axile, basal and parietal.
- 3.4.4.3 Internal structure of essential parts
- a) T.S of mature anther and structure of the pollen grain (Microsporogenesis not needed)
 - b) Structure of a mature anatropous ovule (Megasporeogenesis not needed)
- 3.4.4.4 Pollination in Angiosperms
Definition, self and cross pollination, types, (Autogamy, Allogamy, Geitonogamy, Xenogamy, Cleistogamy, Homogamy)
Agents (Anemophily, Zoophily - Entomophily, Ornithophily and Hydrophily) with examples. (Pollination mechanisms not needed)
- 3.4.4.5 Fertilization in Angiosperms -
Definition, a brief account of double fertilization and its significance (Embryogeny not required)
- 3.4.4.6 The Angiosperm fruit-
Definition, types of fruits - Simple fruits - fleshy fruits (drupe and berry), Dry fruits (capsule, cypsela and cremocarp) and Pome (apple). Aggregate fruits - etaerio of follicles. Multiple fruits - Sorosis.
- 3.4.4.7 The Angiosperm seed -
Concept of seed.
A typical dicotyledonous seed (Example: Bean seed)
A typical monocotyledonous seed (Example: Maize grain)

B.4 TAXONOMY AND ECONOMIC BOTANY (3 HOURS)

4.1 TAXONOMY (1.5 hours)

4.1.1 An outline of classification system of Engler and Prantl.

4.1.2 Distinguishing characters and plants of economic interest of the following families of angiosperms:

Malvaceae - (Hibiscus, Cotton, Lady's finger).

Apocynaceae - (*Catheranthus roseus*, *Rauwolfia serpentina*, *Plumeria alba* and *Nerium indicum*)

Musaceae - (*Musa paradisiaca* and *Ravenala madagascariensis*)

- 4.2 ECONOMIC BOTANY (1.5 hours)
- 4.2.1 Introduction.
- 4.2.2 Oil yielding plants - Groundnut and Sunflower.
- 4.2.3 Cereals and millets - Rice and Jowar.
- 4.2.4 Pulses - Pigeon pea and Bengal gram.
- 4.2.5 Medicinal plants - *Adathoda vasica*, *Ephedra gerardiana*, *Dryopteris*, *Santalum album*, *Gymnema sylvestre*, *Ocimum sanctum*, *Phyllanthus emblica*
- 4.2.6 Spices - Pepper, cloves and cardamom.
- 4.2.7 Beverages - Coffee, cocoa and tea.
(Mentioning scientific names, family, parts used and uses only).
- B.5 ELEMENTS OF PLANT PATHOLOGY (2 HOURS)**
Symptoms, etiology, type and nature of pathogens, and methods of control with reference to the following diseases:
- Banana bunchy top
 - Tikka disease of groundnut
 - Crown gall (of any common dicot plant).

BIOLOGY: PART II (ZOOLOGY)
THEORY (35hours)

III GENERAL BIOLOGY TOPICS

Z.1 INTRODUCTION TO BIOLOGY (3 HOURS)

- 1.1 Definition of Biology and its main branches - Botany and Zoology.
- 1.2 Scope of Biology.
- 1.3 Branches of Biology (definitions only)
- 1.3.1 Classical branches - morphology, cytology, histology, anatomy, physiology, developmental biology, biosystematics, genetics, ecology, organic evolution and palaeontology.
- 1.3.2 Interdisciplinary branches - biophysics, biochemistry and biostatistics.
- 1.3.3 Applied branches and career prospects - agriculture, entomology, sylviculture, pathology, apiculture, microbiology and bioinformatics.
- 1.4 Role of biology in dispelling myths and disbeliefs.

Z.2 BIOMOLECULES (4 HOURS)*

2.1 CARBOHYDRATES

Definition

Classification - monosaccharides (ribose, deoxyribose, glucose, fructose and galactose), oligosaccharides (maltose, sucrose and lactose) and polysaccharides (starch, glycogen, cellulose, pectin, chitin and agar agar).
Biological significance

2.2 PROTEINS

Definition

Classification – simple proteins (albumins, globulins, histones, actin, myosin and keratin), conjugate proteins – Chromoproteins (haemoglobin), glycoproteins (mucin of saliva), phosphoproteins (casein of milk) and lipoproteins (lipovitelline of egg yolk).

Biological significance of amino acids and proteins.

2.3 LIPIDS

Definition

Classification: Simple lipids - oils (vegetable oils and oils of animal origin), fats (butter) and waxes (beeswax), Compound lipids - phospholipids (lecithin and cephalin) and sphingolipids (cerebrosides), Related compounds - steroids (estrogen, progesterone and testosterone), sterols (cholesterol) and prostaglandins.

Biological significance.

2.4 ENZYMES

Definition, properties, classification based on functions.

Mode of action – induced fit theory of Koshland.

2.5 NUCLEIC ACIDS – Occurrence, basic chemical composition (nucleoside and nucleotide), mention of types (DNA and RNA) and functions (structural details are not required).

[*Note: Details of chemical structure of biomolecules are not required]

Z.3 ORIGIN OF LIFE AND ORGANIC EVOLUTION (5 HOURS)

3.1 ORIGIN OF LIFE (2 HOURS)

3.1.1 Introduction.

3.1.2 Concept of abiogenesis and biogenesis (experimental evidences not required).

3.1.3 A.I. Oparin's Theory of chemical evolution of life (Views of Haldane and Sidney Fox to be mentioned).

3.1.4 Stanley Miller's experiment in support of chemical evolution.

3.2 ORGANIC EVOLUTION (3 HOURS)

3.2.1 Introduction

3.2.2 Darwin's theory (DDT resistance in mosquitoes and industrial melanism in Peppered moth, to illustrate natural selection to be quoted as examples).

3.2.3 Brief account of Mutation theory.

- 3.2.4 NeoDarwinism – Introduction, Darwinian concept vs NeoDarwinian concept (gene pool and gene frequency), Hardy-Weinberg law and sources of variations evolutionary force – sexual reproduction, genetic drift, gene flow mutation and isolation (reproductive and geographic).

IV ZOOLOGY TOPICS

Z.4 DIVERSITY OF ANIMAL LIFE (12 HOURS)

- 4.1 Introduction.
- 4.2 Outline classification of kingdom Animalia (only the major phyla to be considered).
- 4.3 Major animal phyla[®]:
- 4.3.1 Non-chordata (animals without backbone) – General characters and classification up to classes* with suitable examples of the following phyla: Protozoa, Porifera, Coelenterata, Platyhelminthes, Nematoda, Annelida, Arthropoda, Mollusca and Echinodermata.
- 4.3.2 a) Chordata (Animals with backbone) – Fundamental characters and classification of chordata up to subphyla – Hemichordata, Urochordata, Cephalochordata and Vertebrata with suitable examples.
 b) Subphylum Vertebrata – Salient features with examples of
 i) Superclass Pisces: Class Chondrichthyes and Class Osteichthyes
 ii) Superclass Tetrapoda: Amphibia, Reptilia, Aves and Mammalia.
 c) Differences between non-chordates and chordates.

[Note: 1)[®] Outline classification as treated in 'A Manual of Zoology' Vol. I and Vol. II (1971) by Ekambarantha Ayyar.

2)* Salient features of classes of Invertebrate phyla not to be given]

Z.5 TYPE STUDY: COCKROACH- *Periplaneta* sp. (3 HOURS)

- 5.1 Morphology (Structure of head capsule and compound eye not required) Digestive and nervous systems.

Z.6 ANIMAL RESOURCES (8 HOURS)

- 6.1 SERICULTURE
- 6.1.1 Definition
- 6.1.2 Main aspects – moriculture, rearing of silkworms and reeling.
- 6.1.3 Brief account of moriculture: definition, methods (row and pit systems) and its importance.
- 6.1.4 Types of silk – mulberry and non-mulberry (Tasar, Eri and Muga)
- 6.1.5 Diseases of mulberry silkworm – Pebrine, Muscardine or Calcino, Flacherie and Grasserie [Listing of diseases and causative organisms only].

- 6.2 **AQUACULTURE**
- 6.2.1 Definition.
 - 6.2.2 Areas – fin fisheries and shell fisheries.
 - 6.2.3 Pisciculture: definition, capture fisheries and culture fisheries.
 - 6.2.4 Inland fisheries – procedure.
 - 6.2.5 Monoculture, monosex culture and polyculture (composite fish farming) – meaning with examples.
- 6.3 **DAIRY**
- 6.3.1 Definition
 - 6.3.2 Types of indigenous cattle with examples based on utility - draught, milching and dual purpose (Cow breeds- Sindhi, Sahiwal, Amrithmahal, Hallikar, Ongole and Haryana; Buffalo breeds – Murrah, Surti, Mehsana and Nagpuri).
 - 6.3.3 Examples of high yielding exotic breeds (Holstein, Red Dane, Jersey and Brown Swiss).
 - 6.3.4 Nutritive value of milk.
 - 6.3.5 Utility of cattle – biogas, leather, gelatin and organic manure.
- 6.4 **POULTRY**
- 6.4.1 Definition
 - 6.4.2 Types of indigenous fowls with examples based on utility – layers, broilers and dual purpose (Aseel, Chittagong, Ghagus, Basra and Kadaknath).
 - 6.4.3 Examples of exotic breeds (White Leghorn, Cornish, Rhode Island Red Plymouth Rock and Newhampshire).
 - 6.4.4 Giriraj – origin and salient features.
 - 6.4.5 Nutritive value of egg.
 - 6.4.6 Diseases (Respiratory mycoplasmosis, Fowl pox candidiasis, Raniketh and Fowl cholera) – Mentioning of diseases and causative organisms only.
- 6.5 **VERMICULTURE**
- Definition and procedure.
 - Vermicompost – degradation of organic wastes and role of Earthworm in soil fertility.

I PREUNIVERSITY BIOLOGY PRACTICALS

BIOLOGY: Part I (BOTANY)

BP - I INTRODUCTION AND STUDY OF MONERA.

- a) Study of microscopes – simple and compound and their use.
- b) Observation and identification of examples belonging to following groups:
 - i. Viruses - Eg: Any virus-infected plant such as mosaic infected bean plant.
 - ii. Bacteria - Gram stained Lactobacilli; an example bacterial disease of plants such as Citrus canker
 - iii. Cyanobacteria - Permanent slide of *Nostoc*.

BP - II STUDY OF GENERAL CHARACTERS AND IMPORTANT EXAMPLES OF THE FOLLOWING GROUPS:

- a) Algae- Chlorophyta- Eg: *Spirogyra*.
- b) Fungi- Basidiomycetes- Eg: *Agaricus*.
- c) Bryophyta- Eg: *Riccia*- thallus.
- d) Pteridophyta – Eg: *Nephrolepis*- plant body.
- e) Gymnosperms- Eg: *Cycas*- plant body, sporophylls and seeds (external study only).

BP - III ANGIOSPERMS

- a) A typical plant body of a dicot (*Brassica* or any other common available plant) and a monocot (grass plant). –General description of the vegetative plant body.
- b) Leaf and its modifications in the following examples:
 - i. Simple leaf (*Hibiscus*)
 - ii. Pinnately compound leaf (*Cassia*)
 - iii. Palmately compound leaf (*Oxalis*)
 - iv. Phyllotaxy - Alternate leaves (*Hibiscus*), Opposite leaves (*Vinca*) and Whorled leaves (*Nerium*)
 - v. Insectivorous leaf (*Drosera* or *Nepenthes*) – either specimen or photograph.
 - vi. Propagation through leaves (*Bryophyllum*)

BP - IV ANGIOSPERMS – THE FLOWER (Eg: *Hibiscus*)

Study of an angiosperm flower to learn the following skills:

- a) To make a technical description of a flower.
- b) To prepare and mount a T. S. of the ovary and to mount a single stamen.

- c) To derive the floral diagram and floral formula of a flower.

BP - V ANGIOSPERMS - THE INFLORESCENCE

Study of the following types of inflorescence:

- a) Racemose types - Simple raceme (*Crotalaria*), Spike (*Achyranthes*), Compound spadix (*Cocos nucifera*) and Capitulum (*Tridax*).
- b) Cymose types - Solitary cyme (*Hibiscus*), Helicoid cyme (*Hamelia*), Dichasial cyme (*Jasminum* or *Clerodendrum*) and Polychasial cyme (*Calotropis*).
- c) Special types - Cyathium (*Euphorbia*) and Hypanthodium (*Ficus*).

BP - VI ANGIOSPERMS - THE FRUIT AND THE SEED

- a) Types of fruit: Cypsela (sunflower), Legume (Bean), Capsule (lady's finger), Berry (Tomato), Drupe (mango or coconut), Aggregate of follicles (*Michelia*), Sorosis (Jack), Syconus (*Ficus*) and Pome (Apple).
- b) Types of seed: Dicotyledonous and exalbuminous seed (Bean) and monocotyledonous and albuminous seed (Maize).

BP - VII ANGIOSPERMS - TAXONOMY

Study of any one member of each of the following families with reference to distinguishing features, floral diagram and floral formula.

- a. Malvaceae (Example suggested: *Hibiscus rosa-sinensis*.)
- b. Apocynaceae (Example suggested: *Vinca rosea*.)
- c. Musaceae (Example suggested: *Musa* sp.)

BP - VIII CYTOLOGY

- a) Study of plant cells in a peeling of onion or tomato pulp.
- b) Observation of slides of onion root tip squash (either fresh preparation or permanent slide) to study the following stages of mitosis:
 - i. Prophase; ii. Metaphase; iii. Anaphase; iv. Telophase.

SUGGESTED ACTIVITY:

A comparative study of appearance of bacteria through light microscope, transmission electron microscope and scanning electron microscope using photographs of some common microbe such as *Escherichia coli*.

BIOLOGY: PART II (ZOOLOGY)**ZP - I MICROSCOPIC OBSERVATION**

Observation of culture particularly for *Paramecium* (permanent slide also to be observed) and identification of other microorganisms with the aid of books and making their drawings.

ZP - II ANIMAL TAXONOMY

- a) Protozoa – *Amoeba* and *Euglena*.
- b) Porifera – *Sycon*.
- c) Coelenterata – *Hydra*, *Aurelia* and *Astraea* (stony coral).

ZP - III ANIMAL TAXONOMY

- a) Platyhelminthes – *Planaria* and Tapeworm.
- b) Nematoda – *Ascaris* (male and female)
- c) Annelida – Earthworm and Leech.

ZP - IV ANIMAL TAXONOMY

- a) Arthropoda – Prawn (*Palaemon* or *Penaeus*), Scorpion and Millipede.
- b) Mollusca – *Unio* and Octopus.
- c) Echinodermata – Starfish.

ZP - V ANIMAL TAXONOMY

- 1) Chordata – Pisces – Shark and Carp.
- 2) Chordata – Amphibia – *Bufo* (Toad)

ZP - VI ANIMAL TAXONOMY

- a) Chordata – Reptilia – Chamaeleon.
- b) Chordata – Aves – Pigeon.
- c) Chordata – Mammalia – Bat.

ZP - VII LIFE CYCLE OF SILKMOTH (*Bombyx mori*).

Adult moth (male and female), silkworm, cocoon and pupa.

ZP - VIII DISSECTION OF COCKROACH

- a) Digestive system.
- b) Nerve cord.

SCHEME OF QUESTION PAPER FOR I PU BIOLOGY PRACTICAL EXAMINATION

Time: 2 hours

Max. Marks: 20

Question I (BOTANY)

1. Assign the given plant A to the respective family with a minimum of 6 reasons.

OR

Derive the floral diagram and floral formula for the given plant A.

OR

Prepare and mount a T. S. of ovary of specimen A and also write a labeled diagram of the same.

2. Identify and classify specimen/slide B with any two valid reasons. 4

3. Identify and classify the type of specimen C with two reasons. 2

Question II (ZOOLOGY)***4. Taxonomy:**

a) Identify and classify D. Draw its neat labelled diagram. 2

b) Identify and classify E. Write atleast two reasons for identification. 2

5. Life cycle of Silk moth:

Identify and comment on F giving at least three reasons. 2

***6. Cockroach:**

Identify and comment on the flag-labeled part of G. 2

CLASS RECORDS (Botany and Zoology)

(2+2) 4

[Note 1: *One representative each from non-Chordata and Chordata

2: *A Cockroach may be dissected for internal parts (digestive system or nerve cord) a day before start of the examination and maintained in formalin.]

**II YEAR PREUNIVERSITY SYLLABUS
BIOLOGY: PART I (BOTANY)
THEORY (37 hours)**

I GENERAL BIOLOGY TOPICS

B.1 MOLECULAR BIOLOGY (6 HOURS)

1.1 NUCLEIC ACIDS

1.1.1 DNA - Occurrence, DNA as the genetic material (with the experiment of Avery as evidence), chemical composition, structure (Watson-Crick model), Semiconservative method of replication.

1.1.2 RNA - Occurrence, chemical composition, brief account of structure and functions of genetic RNA, rRNA, mRNA and tRNA (clover-leaf model).

1.2. THE GENE, THE GENETIC CODE AND GENETIC CONTROL OF PROTEIN SYNTHESIS - Concept of gene (prokaryotic and eukaryotic), genetic code and its characteristics, genetic control of protein synthesis (transcription and translation) and Lac operon concept.

B.2 BIOTECHNOLOGY (8 HOURS)

2.1 INTRODUCTION (1 HOUR) Scope of biotechnology.

2.2 GENETIC ENGINEERING (1 HOUR)

Introduction; Tools used in genetic engineering - Vectors (plasmid - pUC18), Enzymes (REN and Ligase), Host cell (*E.coli*) and Bioreactors.

2.3 RECOMBINANT DNA TECHNOLOGY AND ITS APPLICATIONS (1 HOUR)

Insulin synthesis to be used as an example.

2.4 A BRIEF ACCOUNT OF: (1.5 HOURS)

- | | |
|-------------------------|--------------------------|
| a) DNA fingerprinting | b) Gene therapy |
| c) Human genome project | d) Monoclonal antibodies |

2.5 IMPROVEMENT OF CROP PLANTS (1.5 HOURS)

Breeding techniques; Tissue culture technique – organ culture e.g.: stem; transgenic plants e.g.: Golden rice.

2.6 IMPROVEMENT OF ANIMALS (1.5 HOURS)

Breeding techniques and stem cell culture, transgenic animals e.g.: Cattle.

2.7 HAZARDS AND SAFEGUARDS OF GENETIC ENGINEERING (0.5 HOUR)

II BOTANY TOPICS**B.3 PLANT HISTOLOGY & ANATOMY (5 HOURS)**

- 3.1 INTRODUCTION: Definition and general classification of plant tissues.
- 3.2 MERISTEMS (1 HOUR)
Definition, structure and classification based on position, origin and function (theories on apical organization not required).
- 3.3 PERMANENT TISSUES (3 HOURS) – Distribution, structure and functions of :
- 3.3.1 Simple tissues: Parenchyma (Chlorenchyma and Aerenchyma), Collenchyma (angular, lacunar & lamellar) and Sclerenchyma - Fibres (Intraxylary and Extraxylary), Sclereids (Macrosclereids, Brachysclereids, Astrosclereids and Osteosclereids)
- 3.3.2 Complex tissues: Xylem and Phloem
- 3.4 Definition of the terms: Primary and secondary vascular tissues, exarch xylem, endarch xylem, collateral conjoint open and collateral conjoint closed vascular bundles, radial arrangement of vascular tissues.
- 3.5 SECONDARY GROWTH IN DICOT STEM (1 HOUR)
(This part shall be taught only after studying primary structure) - intrastelar and extrastelar secondary growth.

PLANT PHYSIOLOGY**B.4 WATER RELATIONS OF PLANTS (7 HOURS)**

- 4.1 FUNDAMENTAL CONCEPTS (2 HOURS)
- 4.1.1 Importance of water to plants.
- 4.1.2 Significance and definitions of the following: Imbibition, Diffusion, Osmosis, Endosmosis, Exosmosis, Plasmolysis, Deplasmolysis, Turgor pressure, Wall pressure, Osmotic pressure (Concept of DPD not to be introduced)
- 4.1.3 Water potential and its components.
- 4.2 ABSORPTION OF WATER (1 HOUR)
- 4.2.1 Structure of root hair.
- 4.2.2 Sources of water for plants (available water and nonavailable water).
- 4.2.3 Region of absorption of water in plants.
- 4.2.4 Entry of water from soil into xylem of root.
- 4.2.5 Active and passive absorption of water (active absorption to show osmotic and non osmotic processes)

4.3 ASCENT OF SAP (1 HOUR)

- 4.3.1 Definition and evidences to show the involvement of xylem (the Balsam plant experiment).
- 4.3.2 Composition of xylem sap.
- 4.3.3 Transpiration pull theory - merits and demerits.

4.4 LOSS OF WATER IN PLANTS (2 HOURS)**4.4.1 TRANSPIRATION**

- 4.4.1.1 Definition and types.
- 4.4.1.2 Structure of a typical stomatal apparatus (dicot example only).
- 4.4.1.3 Mechanism of stomatal movement – Steward's Starch hydrolysis theory and K^+ pump theory.
- 4.4.1.4 Factors influencing the rate of transpiration (external).
- 4.4.1.5 Significance of transpiration.
- 4.4.1.6 A brief note on antitranspirants.

4.4.2 GUTTATION

A brief account of guttation – occurrence, causes and structure of hydathode.

4.5 TRANSLOCATION OF SOLUTES (1 HOUR)

- 4.5.1 Definition and evidences in support of involvement of phloem in the process (Girdling experiment and Tracer method)
- 4.5.2 Composition of phloem sap.
- 4.5.3 Münch's mass flow hypothesis with merits and demerits.
- 4.5.4 Vein loading.

B.5 BIOENERGETICS (8 HOURS)**5.1 INTRODUCTION (1 HOUR)**

Light as the source of energy and ATP as energy currency.

5.2 PHOTOSYNTHESIS (3.5 HOURS)

- 5.2.1 Definition.
- 5.2.2 Ultrastructure of the chloroplast.
- 5.2.3 Photosynthetic pigments and their role; composition of photosystems I & II. (Molecular structures and formulae not required)
- 5.2.4 Mechanism – light reaction – cyclic and noncyclic photophosphorylations
Dark reaction (C_3 pathway- Calvin cycle) – (details of regeneration step not required); C_4 pathway and CAM (definition and examples only)

5.2.5 Influence of external factors on photosynthesis; Blackman's law of limiting factors.

5.2.6 Significance of photosynthesis.

5.3 RESPIRATION (3.5 HOURS)

5.3.1 Definition and types (aerobic and anaerobic).

5.3.2 Ultra structure of mitochondrion.

5.3.3 Mechanism of aerobic respiration – Glycolysis, Krebs cycle & Terminal oxidation.

5.3.4 Anaerobic respiration – Mechanism of fermentation in the presence of yeast and lactic acid bacteria.

5.3.5 Role of external factors, respiratory quotient (RQ) and its significance and Pasteur effect.

B.6 GROWTH AND GROWTH REGULATORS IN PLANTS (3 HOURS)

6.1 GROWTH (1 HOUR)

Definition, regions of growth, phases of growth and growth curve.

6.2 GROWTH REGULATORS (2 HOURS)

6.2.1 Definition.

6.2.2 Role of the following plant hormones (Details of experiments on discovery of hormones not required):

i. Auxins.

ii. Gibberellins.

iii. Cytokinins.

iv. Abscissic acid.

v. Ethylene.

6.2.3 Synthetic growth regulators and their applications (with reference to IAA, IBA, NAA, 2,4-D, BAP and Ethephon).

**BIOLOGY: PART II (ZOOLOGY)
THEORY (38 HOURS)**

III GENERAL BIOLOGY TOPICS

Z.1 GENETICS (6 HOURS)

1.1 MENDELIAN GENETICS (2 HOURS)

1.1.1 Mendel and his work.

1.1.2 Definitions of the following terms: Allele, Phenotype, Genotype, Homozygous and Heterozygous.

1.1.3 Principles of inheritance: unit characters, dominance, law of segregation (purity of gametes) and law of independent assortment.

1.1.4 Monohybrid cross, Dihybrid cross and Test cross.

1.2 DEVIATIONS FROM MENDELIAN LAWS (3 HOURS)

1.2.1 Incomplete dominance: E.g.: Flower colour in *Mirabilis jalapa*.

1.2.2 Multiple allelism: E.g.: ABO blood groups and their inheritance in man: Blood typing; Rh factor with a note on erythroblastosis foetalis.

1.2.3 Sex linked inheritance in man: E.g.: Inheritance of colourblindness and hypertrichosis in man.

1.3 GENETIC DISORDERS IN MAN (1 HOUR)

1.3.1 Chromosomal disorders – Down's syndrome, Klinefelter's syndrome, Turner's syndrome and Cri-du-Chat syndrome.

1.3.2 Gene disorders – Sickle cell anemia; haemophilia.

Z.2 BIODIVERSITY (8 HOURS)

2.1 DEFINITION AND TYPES (1 HOUR)

Ecosystem or habitat diversity, Species diversity and Genetic diversity.

**2.2 BIODIVERSITY PROFILES OF INDIA AND KARNATAKA
(1.5 HOURS)**

Species diversity, Endemic species, Threatened species and Endangered species.

2.3 BENEFITS OF BIODIVERSITY (1 HOUR)

2.3.1 Economic: Traditional crop varieties and lesser known plants and animals of food value, medicinal plantsharvested from wild habitat.

2.3.2 Ecological / Social - For controlling soil - water regimes and hydrology, for efficient organic residue management and soil fertility management.

- 2.3.3 Ethical – Cultural, Spiritual and Religious belief systems centred around the concept of sacred species, sacred groves and sacred landscapes.
- 2.4 **BIODIVERSITY DEPLETION (1 HOUR)**
Anthropocentric causes- urbanization, expansion of agriculture, deforestation, pollution, acidification of soil and water, mining activities, desertification and loss of soil fertility.
- 2.5 **INTELLECTUAL PROPERTY RIGHTS (0.5 HOUR)**
Patenting life forms.
- 2.6 **CONCEPT OF ECOSYSTEM SUSTAINABILITY (2 HOURS)**
Conservation of natural resources based on traditional ecological knowledge (TEK):
- 2.6.1 Conservation of water - rainwater harvesting and watershed management.
- 2.6.2 Conservation of soil - Prevention of soil erosion and maintenance of soil fertility: methods of soil conservation.
- 2.6.3 Conservation of forests - Afforestation and maintenance of biosphere reserves.
- 2.6.4 Conservation of wild life – i. Setting up of national parks, sanctuaries, bioserves and zoos ii. Habitat improvement.
- 2.7 **GLOBAL ISSUES (1 HOUR)**
Concept, causes, effects and control measures of the following:
- 2.7.1 Global warming and greenhouse effect.
- 2.7.2 Ozone layer depletion.
- 2.7.3 Acid rain.
- 2.7.4 Nuclear winter.

IV ZOOLOGY TOPICS

Z.3 MAN IN HEALTH AND DISEASES (18 HOURS)

- 3.1 **CONCEPT OF HOMEOSTASIS – THE CENTRAL DOGMA IN PHYSIOLOGY (1 HOUR)**
- 3.1.1 Definition.
- 3.1.2 Meaning of internal environment
- 3.1.3 Factors to be kept constant to achieve homeostasis
- 3.1.4 An example to illustrate homeostasis – regulation of blood glucose level by liver and pancreas through negative feed back
- 3.1.5 A note on diabetes mellitus.
- 3.2 **BODY DEFENCE AND IMMUNITY (2HOURS)**
- 3.2.1 Introduction.

- 3.2.2 Nonspecific body defences: a) Surface barriers b) Cellular and biochemical defences: phagocytosis, natural killer cells, interferons and inflammatory response.
- 3.2.3 Specific body defences (immunity): Antigen and antibody, role of B and T lymphocytes.
- 3.2.4 Types of immunity: Active (infection and vaccination) and Passive (from mother and immune serum γ -globulins).

3.3 DIGESTION (3 HOURS)

- 3.3.1 Gross anatomy of human digestive system (structure of tooth not required).
- 3.3.2 Components of food (concept of balanced diet).
- 3.3.3 Physiology of digestion of carbohydrates, proteins and fats.
- 3.3.4 Disorders: Causes, symptoms and prevention of hyperacidity and ulcer, jaundice and its types and hepatitis.

3.4 CIRCULATION (3 HOURS)

- 3.4.1 Introduction.
- 3.4.2 Gross anatomy of the human heart.
- 3.4.3 Mechanism of working of heart – cardiac cycle, stroke volume, cardiac out-put, complete double circulation.
- 3.4.4 Origin and conduction of heart beat.
- 3.4.5 Mechanism of blood clotting (Best and Taylor theory).
- 3.4.6 Blood pressure – hypotension and hypertension.
- 3.4.7 Disorders – causes and symptoms of myocardial infarction and cyanosis.

3.5 RESPIRATION (3 HOURS)

- 3.5.1 Gross anatomy of human respiratory system.
- 3.5.2 Mechanism of respiration:
 - i. Breathing (inspiration and expiration)
 - ii. External respiration (exchange of oxygen and carbon dioxide between alveoli and blood).
 - iii. Internal respiration (exchange of oxygen and carbon dioxide between blood and body cells).
 - iv. Cellular respiration (to be taught under the topic B.5 'bioenergetics')
- 3.5.3 Disorders: Rhinitis, Asthma and bronchogenic carcinoma.
- 3.5.4 Artificial breathing.

3.6 EXCRETION (2 HOURS)

- 3.6.1 Introduction.
- 3.6.2 Gross structure of nephron.
- 3.6.3 Physiology of urine formation.

- 3.6.4 Chemical composition of urine.
- 3.6.5 Disorders: a. Renal failure – acute and chronic.
b. Renal calculi.
- 3.6.6 Kidney replacement therapy: a brief note on dialysis (haemodialysis and continuous ambulatory peritoneal dialysis) and kidney transplantation.
- 3.7 **NERVOUS SYSTEM (4 HOURS)**
 - 3.7.1 Components – CNS, PNS & ANS.
 - 3.7.2 Human brain - structure (sagittal section only) and functions (functional areas of cerebrum not required).
 - 3.7.3 Human spinal cord – structure and functions.
 - 3.7.4 Meaning of reflex arc and reflex action.
 - 3.7.5 A brief study of the endocrine functions of the pituitary.
 - 3.7.6 Disorders: Meaning, causes and symptoms of epilepsy, Parkinson's disease, Alzheimer's disease and Huntington's chorea.
 - 3.7.7 Alcoholism and its effects.
 - 3.7.8 Narcotic drugs – meaning, listing of types (stimulants, depressants, analgesics and hallucinogens) and their effects. Drug abuse and addiction, Efforts to counter alcoholism and drug menace.

Z.4 CONTINUITY OF LIFE (6 HOURS)

Part A Developmental biology (Basics of sexual reproduction)

4.1 GAMETOGENESIS

- 4.1.1 Spermatogenesis – formation of spermatids and spermiogenesis (details of spermiogenesis are not required).
- 4.1.2 Ultrastructure of human sperm.
- 4.1.3 Oogenesis
- 4.1.4 Generalized structure of ovum.

4.2 FERTILIZATION

- 4.2.1 Definition.
- 4.2.2 Types – external and internal.
- 4.2.3 Mechanism.
- 4.2.4 Significance.

4.3 EARLY DEVELOPMENT OF FROG

- 4.3.1 Structure of egg.
- 4.3.2 Cleavage.
- 4.3.3 Blastulation.
- 4.3.4 Gastrulation.
- 4.3.5 Derivatives of primary germ layers.

Part B Human Reproduction**4.4 A BRIEF ACCOUNT OF:**

4.4.1 Fertilization.

4.4.2 Implantation.

4.4.3 Placenta.

4.4.3 Role of gonadotropins and sex hormones in males and females (meaning of menstrual cycle to be highlighted).

4.5 FERTILITY CONTROL

4.5.1 Need for fertility control

4.5.2 Survey of family planning methods: Spacing methods (Barriers, IUDs, Hormonal and Physiological) and Terminal methods (Tubectomy and Vasectomy).

4.6 INFERTILITY CONTROL

4.6.1 Meaning and causes of infertility in males and females.

4.6.2 Remedial methods (Assisted conception methods) – IVF, ET, GIFT and ZIFT. (details of GIFT and ZIFT not required).

4.7 SEXUALLY TRANSMITTED DISEASES

Meaning, causative organisms, mode of infection, symptoms and preventive measures of gonorrhoea, syphilis and AIDS.

II PREUNIVERSITY BIOLOGY PRACTICALS

BIOLOGY: Part I (BOTANY)

BP - I PLANT HISTOLOGY

The following tissues could be studied in a T. S. of the stem of any commonly available plant such as *Cucurbita*.

- a) Meristematic tissue (cambium)
- b) Parenchyma
- c) Collenchyma
- d) Sclerenchyma

(For meristems, root tip of onion in L.S. could also be studied).

BP - II PLANT HISTOLOGY

The following tissues could be studied in a T. S. of the stem of any commonly available plant such as *Cucurbita*.

- a) Study of complex tissues (xylem and phloem) and their organization in a T. S. of stem of any commonly available plant such as *Cucurbita*.
- b) Mounting and observation of macerated material of *Cucurbita* stem to identify the following cells: - Parenchyma, Sclerenchyma, Tracheary elements (as many as possible) and Sieve tube elements.

BP - III PLANT ANATOMY

Sectioning, staining and mounting (in glycerine) to study the T. S. of the following organs. [To be performed by every student.]

- a) Young dicot stem (Eg: *Tridax* or *Eupatorium* whichever is available)
- b) Monocot stem (Eg: Any grass plant)

BP - IV PLANT ANATOMY

Study of the anatomy of the following organs through freshly prepared or permanent slides of T. S.

- a) Young dicot root (Eg: *Cicer* or bean)
- b) Monocot root (Eg: Maize)

BP - V PLANT ANATOMY

Study of the anatomy in freshly prepared or permanent slides of T. S. of *Helianthus* or *Eupatorium* leaf and maize leaf.

BP - VI PLANT PHYSIOLOGY

- a) Study of osmosis with a potato osmoscope.
- b) Peeling and mounting of coloured epidermis of onion bulb or *Rhoeo* leaf to show plasmolysis. [To be performed by every student.]

BP - VII PLANT PHYSIOLOGY

- a) Preparing, staining and mounting of the lower epidermal peel of a leaf (suggested examples: *Mirabilis*, *Vinca*, Betel or *Commelina*) to show stomatal apparatus. [To be performed by every student.].
- b) Demonstration of unequal transpiration using cobalt chloride paper.
- c) Demonstration of transpiration pull in plants (simple potometer).

BP - VIII PLANT PHYSIOLOGY

- a) Demonstration of separation of leaf pigments by paper chromatography.
- b) Demonstration of fermentation by yeasts using Kuhne's fermentation apparatus.
- c) Demonstration of aerobic respiration using Ganong's respiroscope and germinating seeds or flower buds.

BP - IX INVESTIGATIVE EXPERIMENTS

The students of the entire practical batch would conduct a collective experiment with the assistance of the teacher in charge and prepare a report in detail in the practical record. [The practical record shall be deemed to be INCOMPLETE without the report of these experiments.]

- a) Performing the experiment involving evolution of oxygen in aquatic plants like *Elodea* or *Hydrilla* under varying conditions such as presence of sunlight (normal illumination in bright sunlight), absence of sunlight (covering the apparatus with an opaque box), presence of carbon dioxide (adding NaHCO_3 to the water in the trough) and absence of carbon dioxide (adding lime water to the water in the trough). The difference could be determined on the quantity of oxygen liberated using a graduated test tube to collect the gas.
- b) Experiment on growth: Comparison of bean seedlings of different ages fixed on to a graph sheet. Region of meristematic activity, region of elongation and region of root hair could be identified.

BIOLOGY: Part II (ZOOLOGY)

ZP - I Microscopic study of permanent slides of epithelium types – squamous, columnar and ciliated (pointer eyepiece should be used to show columnar and ciliated epithelium)

ZP - II Microscopic study of permanent slides of connective tissue types- areolar connective tissue and hyaline cartilage.

ZP - III Microscopic study of permanent slides of connective tissue types- Mammalian bone and human blood smear (for RBC and types of WBC).

ZP-IV Microscopic study of permanent slides of muscular tissue types- unstriated, striated and cardiac (Pointer eyepiece should be used to show unstriated muscle).

A permanent slide of Myelinated neuron.

ZP - V Histology of mammalian organs: Small intestine and liver.

ZP - VI Microscopic study of

- 1) Graafian follicle in the section of mammalian ovary
- 2) T. S. of mammalian testis.

ZP - VII Embryology of Frog : Egg (W.M.), Blastula (V.S.) and Gastrula with yolk plug (V.S.).

ZP - VIII Physiology experiments:

- 1) Determination of salivary amylase activity. *
- 2) Detection of abnormal constituents of urine[®] - Glucose (Benedict's test) and Albumin (Biuret test).

ZP - IX Study of human organs such as heart, brain and kidney using respective specimens or models.

Activities recommended :

1. Vermiculture practice in the college campus.
2. Rain water harvesting in the college campus.
3. Visit to a nearby poultry farm/dairy/sericulture center/fishery station.
4. conducting a survey of the following hereditary traits (students of the practical batch be used as a sample) -
 - i. To distinguish tasters and non-tasters using phenylthiocarbamide(PTC).
 - ii. Tongue rolling .
 - iii. Blood groups - pooling and tabulation of data only (test not required)
 - iv. Arranging a guest lecture from a medical doctor to gather first hand information about various disorders, family planning methods and sexually transmitted diseases.

[Note: For experiment ZP - VIII (1)*, source of amylase is saliva; and for experiment ZP - VIII (2)[®], artificial samples could be prepared].