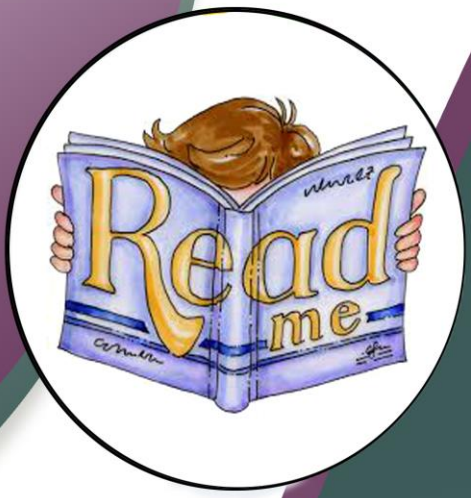
Syllabus



Preface

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.

There will be two papers in the subject.

Paper I Theory: 3 hours (70 marks)
Paper II Practical: 3 hours (20 marks, 10 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 2 parts.

Part 1 (20 marks) will consist of compulsory short answer questions, testing knowledge, application and skills relating to elementary/fundamental aspects of the entire syllabus.

Part 2(50 marks) will be divided into two Sections A and B. Candidates are required to answer **three** out of five questions from Section A and **two** out of **four** questions from Section B. Each question in this part shall carry 10 marks.

SECTION A

1. Origin and Evolution of Life

Origin of life
Living and nonliving; chemical evolution; organic evolution – Oparia ideas, Miller – Urey experiments; interrelationship among organisms and evidences of evolution: morphological evidences – homology and analogy, vestigial organs, atavism; embryological, palaentological (fossils) and biogeographical evidences, molecular (genetic) evidences.
Origin of life - Characteristics of living organisms, differences between living organisms and non-living objects in levels of organisation. Abiogenesis and Biogenesis. Important views on the origin of life – chemogeny, biogeny, cognogeny, modern concept of origin of life, Oparin Haldane

theory, coacervates, Protobionts, Miller and Urey experiment, evidences of evolution: morphological evidences, vestigial organs, atavism, homologous and analogous organs; connecting links – definitions and differences (two examples each from plants and animals), embryological evidences –similarity in early development vertebrate embryos, temporary embryonic structures – definition and difference - theory of recapitulation and biogenetic law – ontogeny recapitulates phylogeny,palaeontological evidence – definition of fossils, missing link and example of Archaeopteryx, biogeographical evidence, molecular (genetic) evidences for example genome similarity, universal genetic code; Darwin's finches (adaptive radiation).

Theories of evolution

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

Brief idea of Lamarck's theory to be given for better understanding of evolution – examples in favour of Lamarkism such as evolution of long neck giraffe to be discussed. Three examples favouring criticism of Lamarkism; salient features of Darwinism – criticism of Darwinism and Neo Darwinism (Modern Synthetic Theory) is to be taught; causes of variation, De Vries theory of mutation –definition and its role in evolution, examples of natural selection - resistance of mosquitoes to DDT, sickle cell anaemia, differences between natural and artificial selection, types of natural selection(directional, disruptive and stabilising), definition of gene pool, gene flow, genetic drift and Hardy Weinberg's principle – convergent and divergent evolution with examples; evolution of man - three features of each of the ancestors Dryopithecus, Australopithecus, Homo erectus, Homo neanderthalensis, Cromagnon man and Homo sapiens leading to man of today; comparison and homology in chromosomes of apes and man, characters that have developed during human evolution.

SECTION B

2. Multicellularity

A. Plants

Tissues types of plant tissues

T. S of young dicot and monocot stem, T. S of young dicot and monocot root and V. S. of dicot and monocot leaf. Secondary growth in stem: brief idea of formation of secondary xylem and secondary phloem by cambium ring formation, annual rings. Anatomical differences between dicot and monocot root, stem and leaf must be taught for better understanding. Students should be able to draw the T.S. of roots and stem and V.S. of monocot and dicot leaves showing cellular details. Basic idea of how secondary growth takes place in dicot stems (with the help of outline diagrams) and formation of annual rings. Activity of the cambium, formation of secondary tissues, differences between Heartwood and Sap wood.

Absorption and movement of water in plants

Diffusion, imbibition, osmosis, osmotic pressure, turgor pressure, wall pressure, water potential, pressure potential, diffusion pressure deficit. Types of soil water, mechanism of water absorption (active and passive absorption), root pressure, guttation, transpiration pull theory for ascent of sap, transpiration, mechanism of opening and closing of stomata (active potassium theory), guttation.

Characteristics of imbition, factors affecting imbition; importance of imbition, characteristics and significance of diffusion; osmosis – endosmosis and exosmosis; significance of osmosis, plasmolysis, importance of water, soil water (gravitational, capillary, hygroscopic and combined water – only definitions); active and passive absorption of water. Definition of water potential.

Explanation and definition of transpiration to give students a clear idea; differences between transpiration and guttation; significance of transpiration, stomatal mechanism – K+ transport mechanism. Mechanism of ascent of sap by cohesion – tension and transpiration pull theory. Guttation – definition, differences between transpiration and guttation. Function of stomata and hydathode.

Photosynthesis

Ultra-structure of chloroplast, photochemical and biosynthetic phases, absorption and action spectra, factors influencing photosynthesis, photophosphorylation; photorespiration, transport of solutes.

Photosynthesis and photorespiration.

Definitions and differences between absorption and action spectra.

Brief idea of photosynthetic pigments (chlorophyll 'a'&'b', carotenoids and xanthophyll), ultra structure of chloroplast including role of quantasomes. photochemical phase - pigment systems,cyclic and non-cyclic photophosphorylation (chemiosmotic hypothesis); biosyntheticphase - C3 and C4 cycles – graphic representation in correct sequence (carboxylation, glycolytic reversal and regeneration of pentose); Differences between C3 and C4 plants, C3 and C4 cycles, Photosystems I and II, cyclic and non-cyclic photophosphorylation. Photorespirationpathway in brief - explanation of how RuBP carboxylase acts as RuBPoxygenase. Kranz anatomy. Blackman's Law of limiting factors, factors affecting Photosynthesis. Translocation.

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

Reproduction and development in angiosperms

Vegetative reproduction, sexual reproduction: development of male and female gametophytes, placentation, pollination, fertilization(Amphimixis) and formation of endosperm, embryo, seed and fruits (broadly classified). Apomixes, Polyembryony, Parthenocarpy. Significance of seed and fruit formation.

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

Differentiation and organ formation

Embryo formation (monocot and dicot); endosperm formation; changes in the ovule and ovary for seed and fruit formation.

B. Animals

Reproduction(human)

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

Organs of male and female reproductive system and their functions; internal structure of testis and ovary, gametogenesis, spermatogenesis an oogenesis; menstrual cycle – different phases and hormone action, capacitation, fertilization, physio-chemical events during fertilization, implantation, embryonic development up to three germ layers, foetal membranes, placenta and

its functions. Parturition; brief knowledge about medical termination of pregnancy and causes of infertility. Amniocentesis – role in detecting genetic defects. Assisted reproductive technologies – IVF, ZIFT, GIFT (Definition and application only).

SECTION C

3. Genetics

Fundamentals of Genetics

Concept of alleles; dominant and recessive; phenotype and genotype, homozygous and heterozygous, mono and dihybrid crosses.

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

Mendel's experiments with peas

Mendel's principles of inheritance, incomplete dominance, co-dominance and multiple alleles.

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

Genes

Packaging of hereditary material in chromosomes. Linkage and crossing over; linkage maps, sex determination and sex linkage, search for DNA as genetic material, central dogma; genetic code, protein synthesis. Human genome project. DNA finger printing.

Chromosomal theory of inheritance; chromosomes in eukaryotic organisms, autosomes and sex chromosomes (sex determination in humans, birds and honey bees), sex-linked inheritance, complete and incomplete linkage – definition and example of fruit fly, crossing over - definition, mechanism and significance; mutation: definition and types – spontaneous and induced, point mutation; search for DNA as genetic material - Griffith's experiment, Hershey and Chase's experiment; replication

of genetic material (role of enzymes, namely DNA polymerase and ligase), Messelson and Stahl's experiment, properties of genes such as ability to replicate, chemical stability, mutability and inheritability, gene expression in prokaryotes; Lac Operon in E-coli; central dogma – concept only; reverse transcription (basic idea only), genetic code – essential features, definition of codon. Protein synthesis - transcription and translation in prokaryotes. Intron, exon, cistron, recon and muton (definitions only).

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

Recombinant DNA technology and its applications

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

4. Applications of biology

Crop improvement

Methods of crop improvement: selection, hybridisation, plant breeding, plant introduction, tissue culture; single cell protein; biofortification; biopesticides.

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

Biotic community

Intraspecific and interspecific relationship, commensalism, predation, scavenging, parasitism, symbiosis, biotic stability, biotic succession and ecological adaptations.

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

Biodiversity today

Importance of biodiversity, types of biodiversity, genetic conservation, gene banks and cryopreservation. Loss of biodiversity – threatened, endangered and extinct species. Strategies for conservation of biodiversity – in-situ and ex-situ.

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

Causes and implications of loss of biodiversity. Categorizing species in differentgroups like - threatened, endangered and extinct - definition and examples of plants andanimals.

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

Only a brief understating of the following is required:

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

Biofertilsers

Green manure, nitrogen fixation – symbiotic and non-symbiotic organisms, nitrogen cycle.

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

Human Diseases

Body's defence mechanisms: (specific and non-spefic); immune disorders (SCID and AIDS); allergies, interferons, communicable diseases; causative agent, symptoms and prevention of the following: bacterial diseases (typhoid and pneumonia), viral diseases (common cold, swine flu and dengue), protozoa (malaria and amoebiasis), helminthes (ascariasis, ringworm, and fukaruasus); sexually transmitted diseases (STD); non-communicable diseases; cancer (types, causes, diagnosis and treatment); human genetic disorders: (haemophilia, thalassaemia,

albinism, Down's syndrome, Klinefelter's syndrome, Turner syndrome). Rh factor incompatibility – during transfusion and pregnancy. Genetic counselling; a brief idea of stem cells, organ transplatns and immunosuppression.
Skin, blood vessels, WBC, antibodies to be discussed as non-specific defence mechanisms; Humoral and cell-mediated immune system; antibody and antigen; cells of the immune system and difference between them; mechanism of action of T cells to antigens; Interferons, brief idea of SCID and
AIDS – causative agent (HIV), modes of transmission symptoms, replication ofretrovirus in the infected human cell(including diagram) and prevention; diseasesshould be discussed on basis of causativeagent, symptoms and prevention. Allergiesand allergens – definitions and generalsymptoms of allergies.
Communicable and Non-communicablediseases; modes of transmission, sexuallytransmitted diseases (STD) – gonorrhoea andsyphilis – causative agents and prevention; -bacterial diseases (typhoid and pneumonia),viral diseases (common cold, swine flu anddengue), protozoa (malaria, andamoebiasis), helminthes (ascariasis,ringworm, and filariasis); Cancer (types,causes, diagnosis and treatment);
Human genetic disorders: (haemophilia,thalassaemia, Down's syndrome,Klinefelter's syndrome, Turner syndrome).Rh factor incompatibility – role of Rh factorin blood transfusion and pregnancy; briefidea of genetic counselling, role of geneticcounsellor.
Organ transplants and role ofimmunosuppressants. A brief idea of the roleof stem cells in medical treatment.

Adolescent issues: alcoholism and drugs
Adolescent issues (Alcoholism reasons for addiction and its effects on health).
Drugs: Types of drugs such as opioids, cannabinoids and barbiturates – reasons for addiction, examples and effect of each on human health. Prevention and control of Alcohol and drug abuse.

Biomedical Engineering
(only applications) Instruments – ECG, EEG, CT scan, ultrasound, MRI, pacemakers, implants, disposables, external prosthesis.
Students should know one application of each of the instruments mentioned above, details are not required.

Human population
Population growth curves, causes of increase in population.
Definition of the following terms: biotic potential, environmental resistance and carrying capacity; population: demography, birth rate, death rate, age distribution – pyramids for human population.
Types of growth curves; S and J shaped along with equations for the same, causes and consequences of population growth and measures to control population (natural andartificial).

Animal Husbandry
Dairy farm management, poultry farm management, apiculture, pisiculture.
Brief idea of inbreeding, outbreeding, crossbreeding and artificial insemination, Multiple Ovulation Embryo Transfer Technology (MOET). Advantages of artificial insemination; measures for proper maintenance of dairy farms and poultry farms.
Apiculture and Pisiculture – definition, briefidea and advantages of each.