SYLLABUS FOR SCI -J152

BIOLOGY

GENERAL OBJECTIVES:

At the end of the series of courses, candidates should be able to:

1. describe the fundamentals and levels of organization in living things;
2. explain functional units of biological molecules and principles of interactions among organisms;
3. apply basic statistical concepts in biological studies;
4. describe cells as living organisms and their roles in nature;
5. explain the application of Genetics in medical, industrial and biotechnological sub-sectors of economy;
6. discuss diversity, characteristics, structures, functions and taxonomy of living organisms (micro-organisms, plants and animals);
7. enumerate economic importance of living organisms;
8. describe the morphological and biochemical characteristics of micro-organisms;
9. conduct laboratory and field practical in Biology, Botany, Microbiology and Zoology;
10. highlight and explain the basic concepts of ecology;
11. explain the role of evolution in the hierarchical classification of living organisms vis a vis the theories of evolution; and
12. define basic terminologies of Genetics and state Mendelian Laws of inheritance.

FIRST SEMESTER COURSES

BIO 001: GENERAL BIOLOGY **(3 Units)**

BIO 002: MICROBIOLOGY **(3 Units)**

SECOND SEMESTER COURSES

BIO 003: BOTANY **(3 Units)**

BIO 004: ZOOLOGY **(3 Units)**

COURSE DESCRIPTION

BIO 001: GENERAL BIOLOGY

Specific Objectives

At the end of the course, the candidates should be able to:

1. explain living things in nature and biological molecules;
2. discuss cell as fundamental unit of living things and describe levels of organization of living things;
3. discuss biological methods and their applications (Biostatistics, taxonomy and nomenclature);
4. discuss principles of genetics, variation and heredity; and
5. conduct laboratory and field practical in biology.

Course Content

S/N	TOPIC	SUB TOPIC	DETAILS & NOTES
1.	Origin of Living Things	The Science of Biology	Definition of biology Branches of biology Importance of biology The nature of science - Scientific methods - Testing of hypothesis - Data collection and analysis Application of scientific methods in biological experiments Relationship between Biology & Medicine, Agriculture, etc. Brief history of organic molecules
		Origin of Organic Molecules	Brief history of organic molecules.
		Origin of the First Cells	Brief history of the evolution of the first cells
		The Earliest Cells: -Living -Fossils	Relate the living cell to the fossil
		Basic biostatistics	Definition of basic biostatistics Central tendency measurement
2	Living Things in Nature and Biological Molecules	Diversity of Living Things	Different kingdoms and characteristics.
			Practical class- Field observation of diversity of living things
		Biological Molecules	Carbohydrate, lipids, protein and nucleic acids
3	Cell Organisation, Structure and Functions	Cell Theory, Cell Structure and Functions	Demonstration of cell structure on microscopes.
		Cell Organization, Forms in which Cells Exist	Biological drawings of plant and animal cells. Comparisons of plant and animal cells
4	Cell Division, Principles of Genetics, Variations and Heredity	Cell Divisions, Mitosis in Somatic Cells, Meiosis in Germ Cells, Principles of Genetics Variation and Heredity	Definition, Cell cycle, Basic concepts in genetics : Chromosome, Gene, allele, dominant, recessive, Homozygous, Heterozygous, Hybrid, genotype, phenotype etc
		Mendel's Laws of Inheritance	The nature of genes and chromosomes Mendelian Genetics

			Practical class: Determination of inheritance using colored seeds e.g. beads, grains, etc. Verifications of principles of Mendel's law and its deviation
		Human Inheritance, Human Genetic Disorders e.g. sickle cell anemia, albinism. Rhesus Factors, Polyploidy, Sex-linked Traits; Application of Genetics in Agriculture, Medicine, Criminology, etc.	Cell division experiment using onion root. Identification of stages of meiosis, Traits controlled by Multiple alleles e.g. blood group, eye colour. Determination of inheritance using coloured seeds e.g. beads, grains etc. Verifications of principles of Mendel's laws.
5	Systematics, Taxonomy and Nomenclature	Basis of Taxonomy Rules of Systematics Naming of Organisms (Nomenclature)	Criteria for classification Taxonomy hierarchy Binomial nomenclature: Genus & species *Practical class:* Classification and identification of organisms, Highlighting adaptive features and their uses
6	Ecology	Basic Concepts in Ecology	Ecosystem, food chain, food web, nutrient cycling, biogeochemical cycles
		Biological Associations and Interactions	Symbiosis, Mutualism, Parasitism, Commensalism, Ammensalism & Synergism
		Ecology Studies, Types of Habitats	Environmental studies
			Practical use of ecological equipment, Population study in a specific habitat
		Ecology and Natural Selection.	Environmental changes Biological impacts of climate change
7	Biological Methods and Application	Rules of Biological Drawings	Standard drawing rules governing: use of pencils, specimen proportions, magnification, size of specimen drawing and labelling: Diagrams must be according to length specification, Lines must not be woolly or broken. Drawings must carry appropriate titles at the correct position Labelling must be horizontal & parallel with ruled guidelines Drawing must not be artistic i.e. no shading or painting.

			Spellings must be correct and touched by labelling lines.
8	Evolution	Geological Times, and Mega Geological Events, Evolutionary Trends in Animals and Plants, Theories of Evolution- Lamarck and Darwin Theories of Evolution. Evidence of evolution from Anatomy, Embryology, Biochemistry.	Definition of evolution, Types of evolution, Application of Evolution to Plants & Animals Taxonomy.
9	Enzymes	Properties of Enzymes, Mechanism of Enzyme Reaction, Enzyme Inhibition & Enzyme Cofactors	Enzymes, Types of enzymes & Factors affecting rate of enzyme action

BIO 002: MICROBIOLOGY

Specific Objectives

At the end of this course, candidates should be able to:

1. discuss history and discovery of microorganisms;
2. discuss the different types of microorganisms and the taxonomic groupings;
3. explain microbial cellular structures, morphology and biochemical characteristics;
4. explain microbial genetics and applications in biotechnology; and
5. enumerate economic importance of microorganisms.

Course Content

S/N	TOPIC	SUB TOPIC	DETAILS & NOTES
1	History of the Discovery of Microorganisms	Spontaneous Generations Microorganisms as the Cause of some Diseases	The theory of spontaneous generation of organisms, Conflict over spontaneous generations, The golden era of microbiology (1860-1910), The germ theory of disease, The discovery of viruses, microorganisms in the 20th century
			Practical class- introduction to basic microbial laboratory equipment, principles of operation and drawings

2	Types and Taxonomic Groupings of Microorganisms	Seven Levels of Classification Prokaryotic Cells Eukaryotic Cells	Bacteria- size, shapes, motility, unusual types, general methods of bacterial classification. Fungi- yeast and mould- size, shape, general fungal classification Protozoa- specific examples, motile and non-motile types, nutrition types. Viruses- sizes, bacteriophages, viroid, prions, Algae- sizes, types, diatoms, sea weeds, lichens, sexual and asexual reproduction Archaea- general features, origin and evolution
			Practical class- aseptic techniques in microbiology
3	Structures, Morphology and Characteristics of Microorganisms	Morphology and Structures of Microbial Cells, Biochemical Characterization Reproduction, Growth Types and Phases.	Structure of bacteria cells- capsule, flagella, pilli and fimbriae, cell wall, plasma membrane, cytoplasm Cell wall of fungal cells, cytoplasm Cultural characteristics of bacterial growth-on solid and liquid media, forms of growth Cultural and cellular characteristics of mould and yeast on solid and liquid media, hyphal and mycelial types Biochemical characterization of bacteria and fungi Viruses and their structures Reproduction and microbial growth phases
			Practical class- Cultivation and identification of bacteria from soil, water and decomposing food
4	Microbial Ecology	Microbial Interactions with Animals, Plants and Microbes	Predation, Competition, Synergism, Commensalism, Infectious diseases, Immunity, Spoilage of food, Control of microbial activities
5	Microbial Nucleic Acids in Information Storage and Transfer	Genetic Materials, Mutation and Mutagenesis	Nature of DNA, Nucleosides and nucleotides, Types of RNA, Enzymes in DNA replication, Genetic code, Transcription and translation, Transfer of genetic materials in prokaryotes, Spontaneous mutation, induced mutation, expression of mutation.

6	Microorganisms and their Application in Biotechnology	Biotechnological Application of Microorganism in Various Fields	Biotechnological use of microorganisms in Food industry, Environment, Pharmaceuticals, Medical and Agricultural fields.

BIO 003: BOTANY

Specific Objectives

At the end of this course, candidates should be able to:

1. discuss general characteristics of plants;
2. explain the taxonomy of lower and higher plants;
3. discuss biodiversity and conservation of plants;
4. explain plant structures, functions and physiological processes in plants; and
5. enumerate economic and ecological importance of plants.

Course Content

S/N	TOPIC	SUB TOPIC	DETAILS & NOTES
1	General Characteristics and Diversity of Plants	Characteristics of Lower and Higher Plants groups	Classification of major plant groups(Lower and Higher plants) Divisions up to generic level Lower plants- algae, fungi, Bryophytes, Pteridophytes
		Morphology and Life Cycle of Lower and Higher Plants	Morphological and life cycle of named example in each major group considering the simplest and the complex in each group of the lower plants. Economic and ecological importance of plant groups

S/N	TOPIC	SUB TOPIC	DETAILS & NOTES
			Practical class- classification and morphological drawings of lower plants : Algae (*Chlorella, Euglena/Chlamydomonas, Volvox, Spirogyra)* Fungi e.g. yeast, *Rhizopus*, *Mucor*, *Aspergylus*, *Penicillium*, mushroom, *Phytophthora*, Bryophytes e.g. *Riccia, Marchantia*, *Funaria* Pteridophytese.g. *Lycopodium, Seleginella*, Nephrolepis Higher plant (Non-vascular and vascular plants) Spermatophytes e.g. *Cycas, Pinus, Gnetum, Hibiscus rosa-sinensis*
		Morphology of *Eleusine indica* and Morphology of *Talinum triangulare*	*Eleusine indica* and *Talinum triangulae* treated comparatively
2	Taxonomy of Lower and Higher Plants	Plant Taxonomy and Systematics Taxonomy of Lower and Higher Plants	Definition, Plant nomenclature, Plant classification & the difference between Taxonomy and Systematics.
3	Plant Conservation	Importance of Plant Conservation Measures in Plant Conservation Climate change	Definition, concepts in plant conservation, *In-situ* and *ex-situ* conservation. Advantages and disadvantages of each: Biological control, Pest management, Impact of climate change on plants
4	Plant Tissues and Functions	Plant Tissues Anatomy & Functions	Emphasis on composition, distribution, forms and functions of each tissues: Parenchyma, Collenchyma, Schlerenchyma, Epidermal, Peridermal, Vascular (cambium, phloem, xylem)
5	Plant Morphology/ Anatomy	Morphology of Plant Parts	Morphology of roots, stems, leaf types and their modification due to functions
		Anatomy of Plant Parts.	Anatomy of monocot and dicot roots, stems and leaves with emphasis on tissue arrangement in relation to functions and environment

S/N	TOPIC	SUB TOPIC	DETAILS & NOTES
		Types of Root	Practical class- Roots- - Adventitious and tap root systems, modification and adaptations - Anatomical observation and drawing of permanent/ temporary mount of monocot and dicot roots (T.S and L.S) - Locate, draw and label different plant tissues (parenchyma, collenchyma etc)
		Types of Stem	Stem: - Aerial and underground stem, modifications/ adaptations related to functions - Anatomical observation and drawing of permanent/ temporary mount of monocot and dicot stems (T.S and L.S) - Locate, draw and label different plant tissues (parenchyma, collenchyma etc)
		Types of Leaves	Leaves - Simple and compound leaves, arrangements, modifications to suit habitats - T.S of leaves of both monocot and dicot plants Locate, draw and label different plant tissues (parenchyma, collenchyma etc)
		Types of Flowers	Flowers - L.S of dicot flowers e.g. regular and irregular flowers, floral diagrams and formula
		Types of Fruits	Fruits - L.S and T.S of various types of fruits (dry dehiscent, indehiscent and fleshy fruits should be observed and drawn).

S/N	TOPIC	SUB TOPIC	DETAILS & NOTES
6	Nutrition in Plants	Nature and Types of Nutrition	Autotrophic (photosynthetic and chemosynthetic), Dark and light reaction in photosynthesis, Heterotrophic & Holozoic nutrition, Mineral requirements of plants, their sources, roles and deficiency symptoms. Composition of chemical fertilizers
			Practical class: Demonstration of etiolation. Measurement of photosynthesis in leaf Growth experiments to show deficiency symptoms Field study of deficiency symptoms in plants
7	Transport System in Plants	Need for Transport System Water Relation	Mineral requirements of plants Transport in xylem Transport in phloem Transport media in plant and materials to be transported
			Practical class -Transpiration, osmosis, and food transport in plants
8	Respiration	Mechanism of Gaseous Exchange	Stomata apparatus, Lenticels, Aerobic and anaerobic respiration
9	Plant reproduction	Asexual and Sexual Reproduction	Definition, Asexual reproduction, Types of asexual reproduction, Vegetative propagation. Sexual reproduction in flowering plants, Angiosperm flower and differences between monocots and dicot flowers
10	Growth in Higher Plants and growth Regulators	Plant growth, Roles and Interactions of Growth Regulators	Growth in the roots and shoots Auxins, Gibberellins, Cytokinins, Ascorbic acids, Ethylene
11	Crop improvement	Importance of GMC	Genetically Modified Crops (GMC) Challenges of resistant plant species, Ethical implications of genetic modifications
12	Economic and Ecological Importance of Plants	Plants of Economic & Medical Importance	Economically important food plants, Economically valuable medicinal plants& Ornamental plants

BIO 004: Zoology (3 Units)

Specific Objectives

At the end of this course, candidates should be able to:

1. discuss the general characteristics of kingdom Animalia;
2. explain the taxonomy of invertebrates and vertebrates;
3. discuss diversity of animal species;
4. explain physiological processes in animals; and
5. enumerate the economic and ecological importance of animals.

Course Content

S/N	TOPIC	SUB TOPIC	DETAILS & NOTES
1	Diversity and General Characteristics of Animals	What is Zoology? What are Animals? Scope and Areas in Zoology Importance of Zoology	Definition, General characteristics of animals, Diversity of lifestyles, habitats, Categories of animals
2	Systematics (Taxonomy) of Animals	Classification of Animals, Basis of Animal Classification, Levels of Animal Organization - Phyla of Animals - Tissues and Organs in Animals	Unicellular levels of organization- protozoa, Cellular levels of organization- eumetazoa Multicellular levels of organization- metazoan, Classification of invertebrates - Animals without tissues - Animals with tissues - Animals exhibiting bilateral symmetry (bilateria) - Animals with body cavity (coelomates). - Segmented animals - Animals with jointed appendages - Animals with backbone (vertebrates) Major and minor phyla Types of tissues and organ systems
			Practical class- - Identification and classification of animal specimens in the different phyla - Dissection of selected animals- cockroaches, fish, frog, rat, etc.

3	Evolution of Animals	History and Origin of Animals, Major Evolutionary Adaptation of Animals	Adaptation of animals in water, Adaptation of animals on land, Adaptation of animals in air
4	Invertebrates	Phylum Protozoa Phylum Porifera Phylum Cnidaria (Coelenterata) Phylum Platyhelminthes Phylum Nematoda Phylum Annelida Phylum Arthropoda Phylum Mollusca Phylum Echinodermata	Taxonomy, characteristics, diversity, lifestyles, morphology and life cycle providing named representative examples in each order Free living flat worms Parasitic flat worms (trematodes and cestodes) of medical and veterinary importance Emphasize on the body plan Why arthropods are successful.
5	Introduction to Chordates	Adaptation of Chordates to Water, Land and Air. Protochordates - Class Chondrichthyes - Class Osteichthyes - ClassAmphibia - ClassReptilia - Class Aves - Class Mammalia	Challenges and adaptations to living in the different habitats, History and important adaptations, Diversity, classification, morphology and life cycle, providing, representative examples from the different orders, History and important adaptations, Rise and fall of dominant reptiles, Clearly state the taxonomic features that warrant the grouping into classes.
6	Ecologic and Economic Importance of Animals	Diverse Economic Importance of Animals - Invertebrates - Vertebrates Ecological Importance of Animals	Benefits of animals to man, Economic importance of arthropods
7	Physiological Processes	Nutrition in Animals	Types of nutrition in animals, Nutrition in human, Types of dentition in animals, Alimentary system in man, Digestion (diverse enzymes) and absorption
			Practical class- food test
		Respiration in Mammals	Characteristics of respiratory surfaces, Lung as a respiratory organ, Breathing mechanism, Human respiratory structure and function Role of circulatory system in respiration.

		Skeletal System and Muscles	Axial and appendicular skeleton, Types of muscular movement, Control of muscle contraction, Joints (types of joints) & Functions of skeleton.
		Reproduction	Mammalian reproductive organs -Spermatogenesis/oogenesis -Courtship/mating and viviparity -Hormonal regulation in male and female systems -Gonadal steroids and there control -The menstrual cycle -Hormone of human pregnancy and birth Structure and function of human female and male reproductive system.
		Excretion	Morphology of the excretory system, Osmoregulation, Structure and function of the nephron – ultrafiltration, selective reabsorption and excretion. Also he effects of weather on excretion.
		Circulatory System	Human circulatory/transport system, Blood as agent of transport, - Components of blood - The functions of blood and types of circulation
		Growth and Development	Principles of development- stages in embryology.
8	Transport of Substances across Membranes	Diffusion Osmosis Plasmolysis Flaccidity Haemolysis Crenation & Turgidity	Osmotic balance, Selective transport of substances across membranes, Osmotic pressure, Turgor pressure & Active transport
			Practical class- Experiment demonstrating diffusion, osmosis and plasmolysis
9	Nervous System	Coordination and control	Nerve cells (Neuron and reflex) Structure of neuron Reflex arc Central nervous system Peripheral nervous system Sympathetic and parasympathetic nervous system

10	Sense Organ	Structures and functions of sense organs Chemoreception, Mechanoreception and Photoreception	Structures and functions of Human ears, eyes, nose, skin and tongues
11	Endocrine System	Mechanism of Hormonal Action	Types of hormones, Control of Hormonal actions, Secreting glands, Functions of hormones

RECOMMENDED TEXTS

1. Dutta, A. C., & Dutta, T. C. (2010). *Botany for Degree Students*. New York: Oxford Press
2. Hickman, C., Keen, S., Larson, A., Eisenhour, D., Anson, H., & Roberts, L. (2020). *Integrated Principles of Zoology*. New York: McGraw-Hill.
3. Klug, W., Cummings, M., Nickla, H., Palladino, M. A, Spencer, C. A., Gaudette, M., & Killian, D. (2019). *Essentials of Genetics*. New York: Pearson.
4. Madigan, M. T., Martinko, J. M., Dunlap, P. V., & Clark, D. P. (2009). *Brock Biology of Microorganisms*. Pearson.
5. Raven, P. J., Mason, K. A., Losos, J. B., & Duncan, T. (2019). *Biology*. New York: McGraw-Hill.
6. Solomon, E. P., Martin, D. W., Martin, C. E., & Berg, L. R. (2019). *Biology*. New York: Cengage Learning.
7. Taylor, D. J., Green, N. P. O., Stout, G. W., & Soper, R. (2010). *Biological Science1 & 2* Delhi, Cambridge University Press
8. Urry, L., Cain, M., Wasserman, S., Minorsky, P., & Reece, J. (2016). *Campell Biology*. Hobekan, Pearson