

LATEST EDITION

BIOLOGY

JUPEB SYLLABUS



SYLLABUS FOR SCI-J152 BIOLOGY

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FIRST SEMESTER COURSES

BIO 001: GENERAL BIOLOGY

BIO 002: MICROBIOLOGY

SECOND SEMESTER COURSES

BIO 003: BASIC BOTANY

BIO 004: FUNDAMENTALS OF ZOOLOGY

COURSE DESCRIPTION

BIOLOGY 001: General Biology

Specific Objectives

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

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 Cell Biology 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 003: MICROBIOLOGY	(3 UNITS)

SECOND SEMESTER COURSES

BIO 002: BASIC BOTANY	(3 UNITS)
BIO 004: FUNDAMENTALS OF ZOOLOGY	(3 UNITS)

COURSE DESCRIPTION

BIOLOGY 001: General Biology (3 Units)

Specific Objectives

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

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

Course Content

S/N	TOPIC	SUB TOPIC	DETAILS
1.	Origin of Living Things	<ul style="list-style-type: none"> • The Science of Biology • Origin of Organic Molecules • Origin of the First Cells • The Earliest Cells: <ul style="list-style-type: none"> -Living -fossils 	<ul style="list-style-type: none"> • Definition of biology • Importance of biology • The nature of science <ul style="list-style-type: none"> - Scientific methods - Testing of hypothesis - Data collection and analysis • Application of scientific methods in biological experiments • Relationship between Biology & Medicine, Agriculture, etc. • Practical class- field observation of diversity of living things.
2	Living Things in Nature and Biological Molecules	<ul style="list-style-type: none"> • Diversity of Living Things • Biological Molecules 	<ul style="list-style-type: none"> • Different kingdoms and characteristics. • Carbohydrate, lipids, protein and nucleic acids.
3	Cell Organisation, Structure and Functions	<ul style="list-style-type: none"> • Cell Theory • Cell Structure and Functions • Cell Organization • Forms in which Cells Exist 	<ul style="list-style-type: none"> • Demonstration of cell structure on microscopes. • Biological drawings of plant and animal cells. • Comparisons of plant and animal cells.
4	Cell Division, Principles of Genetics, Variations and Heredity	<ul style="list-style-type: none"> • Cell Divisions • Mitosis in Somatic Cells • Meiosis in Germ Cells • Principles of Genetics • Variation and Heredity • Mendel's Laws of Inheritance 	<ul style="list-style-type: none"> • Basic concepts in genetics : Chromosome, Gene, allele, dominant, recessive, Homozygous, Heterozygous, Hybrid, genotype, phenotype etc • The nature of genes and chromosomes. • Practical class: <ul style="list-style-type: none"> -Determination of inheritance using colored seeds e.g. beads, grains, etc -Verifications of principles of Mendel's law and its deviation

		<ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • Cell division experiment using onion root. • Identification of the 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 the principles of Mendel's laws.
5	Systematics: Taxonomy and Nomenclature	<ul style="list-style-type: none"> • Basis of Taxonomy • Rules of Systematics • Naming of Organisms (Nomenclature) 	<ul style="list-style-type: none"> • Practical class: -Classification and identification of organisms -Highlighting adaptive features and their uses
6	Ecology	<ul style="list-style-type: none"> • Basic Concepts in Ecology • Biological Associations and Interactions • Ecological Studies • Types of Habitats • Ecology and Natural Selection. 	<ul style="list-style-type: none"> • Symbiosis • Mutualism • Parasitism • Environmental studies • Practical use of ecological equipment • Population study in a specific habitat • Environmental changes • Biological impacts of climate change
7	Biological Methods and Application	<ul style="list-style-type: none"> • Rules of Biological Drawings 	<p>Standard drawing rules governing: use of pencils, specimen proportions, magnification, size of specimen drawing and labelling.</p> <ul style="list-style-type: none"> • Diagrams must be according to length specification • Lines must not be wooly or broken • Drawings must carry appropriate titles at the correct position • Labeling 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	<ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • Definition of evolution • Types of evolution • Application of Evolution to Plants & Animals Taxonomy.
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RECOMMENDED TEXTS

1. *Functional approach* by MBV Roberts, 1982. Third edition.
2. *Advanced Biology* by Simkins & Williams, 1989. Third edition.
3. *Collins College Biology (Fully revised and updated)* by Marshall Sunder, Ph.D., 2007.
4. *Heath Biology* by James McLaren & Lissa Rotundo, 1985. D.C Heath and Company.
5. "*Biology*" by P.T Raven and B. Johnson, 4th Edition. 1996, WCB McGraw- Hill Companies, Inc. USA.

Specific Objectives

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

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

Course Content

S/N	TOPIC	SUB TOPIC	DETAILS
1	General Characteristics and Diversity of Plants	<ul style="list-style-type: none"> • Plant Diversity and Classifications (Lower and Higher plants) • Characteristics of Lower and Higher Plants groups • Morphology and Life Cycle of Lower and Higher Plants 	<ul style="list-style-type: none"> • Classification of major plant groups (Lower and Higher plants) • Divisions up to generic level • Lower plants- algae, fungi, Bryophytes, Pteridophytes • 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 • Practical class- classification and morphological drawings of lower plants : • Algae (<i>Chlorella</i>, <i>Euglena/Chlamydomonas</i>, <i>Volvox</i>, <i>Spirogyra</i>) • Fungi e.g. yeast, <i>Rhizopus</i>, <i>Mucor</i>, <i>Aspergylus</i>, <i>Penicillium</i>, mushroom, <i>Phytophthora</i>, • Bryophytes eg <i>Riccia</i>, <i>Marchantia</i>, <i>Funaria</i> • Pteridophytes eg <i>Lycopodium</i>, <i>Seleginella</i>, <i>Nephrolepis</i> • Higher plant (Non-vascular and vascular plants) • Spermatophytes eg <i>Cycas</i>, <i>Pinus</i>, <i>Gnetum</i>, <i>Hibiscus rosa-sinensis</i>

		<ul style="list-style-type: none"> Morphology of <i>Eleusine indica</i> and Morphology of <i>Talinum triangulare</i> 	<ul style="list-style-type: none"> <i>Eleusine indica</i> and <i>Talinum triangulare</i> treated comparatively
2	Taxonomy of Lower and Higher Plants	<ul style="list-style-type: none"> Plant Taxonomy and Systematics Taxonomy of Lower and Higher Plants 	<ul style="list-style-type: none"> Plant nomenclature Plant classification The difference between taxonomy and systematics.
3	Plant Conservation	<ul style="list-style-type: none"> Importance of Plant Conservation Measures in Plant Conservation Climate change 	<ul style="list-style-type: none"> <i>In-situ</i> and <i>ex-situ</i> conservation Advantages and disadvantages of each Biological control Pest management Impact of climate change on plants
4	Plant Tissues and Functions	<ul style="list-style-type: none"> Plant Tissues Anatomy Functions 	<p>Emphasis on composition, distribution, forms and functions of each tissues:</p> <ul style="list-style-type: none"> Parenchyma Collenchyma Sclerenchyma Epidermal Peridermal Vascular (cambium, phloem, xylem) Practical class in osmosis and transpiration in plants.
5	Plant Morphology/ Anatomy	<ul style="list-style-type: none"> Morphology of Plant Parts Anatomy of Plant Parts Types of Root 	<ul style="list-style-type: none"> Morphology of roots, stems, leaf types and their modification due to functions Anatomy of monocot and dicot roots, stems and leaves with emphasis on tissue arrangement in relation to functions and environment Practical class- Roots- <ul style="list-style-type: none"> 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

		<ul style="list-style-type: none"> • Types of Stem • Types of Leaves • Types of Flowers • Types of Fruits 	<p>(parenchyma, collenchyma etc)</p> <ul style="list-style-type: none"> • Stem <ul style="list-style-type: none"> - 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) • Leaves- <ul style="list-style-type: none"> - 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) • Flowers – <ul style="list-style-type: none"> - L.S of dicot flowers e.g regular and irregular flowers, floral diagrams and formula • Fruits – <ul style="list-style-type: none"> - L.S and T.S of various types of fruits (dry dehiscent, indehiscent and fleshy fruits should be observed and drawn).
<p>6</p>	<p>Nutrition in Plants</p>	<ul style="list-style-type: none"> • Nature and Types of Nutrition 	<ul style="list-style-type: none"> • 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- <ul style="list-style-type: none"> - Demonstration of etiolation. - Measurement of photosynthesis in leaf - Growth experiments to show

			deficiency symptom Field study of deficiency symptoms in plants
7	Transport System in Plants	<ul style="list-style-type: none"> • Need for Transport System • Water Relation 	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Mechanism of Gaseous Exchange 	<ul style="list-style-type: none"> • Stomata apparatus • Lenticels • Aerobic and anaerobic respiration
9	Plant reproduction	<ul style="list-style-type: none"> • Asexual and Sexual Reproduction 	<ul style="list-style-type: none"> • Angiosperm flower and differences between monocots and dicot flowers
10	Growth Regulators	<ul style="list-style-type: none"> • Roles and Interactions of Growth Regulators 	<ul style="list-style-type: none"> • Auxins • Gibberellins • Cytokinins • Ascorbic acids • Ethylene
11	Crop improvement	<ul style="list-style-type: none"> • Importance of GMC 	<ul style="list-style-type: none"> • Genetically Modified Crops (GMC) • Challenges of resistant plant species • Ethical implications of genetic modifications
12	Economic and Ecological Importance of Plants	<ul style="list-style-type: none"> • Plants of Economic & Medical Importance 	<ul style="list-style-type: none"> • Economically important food plants • Economically valuable medicinal plants • Ornamental plants

BIO 003 (Microbiology)

(3 Units)

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

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S/N	TOPIC	SUB TOPIC	SPECIFIC DETAILS
1	History of the Discovery of Microorganisms	<ul style="list-style-type: none"> Spontaneous Generations Microorganisms as the Cause of some Diseases 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Seven Levels of Classification Prokaryotic Cells Eukaryotic Cells 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Morphology and Structures of Microbial Cells Biochemical Characterization Reproduction, Growth Types and Phases 	<ul style="list-style-type: none"> 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

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		<ul style="list-style-type: none"> phases Practical class- cultivation and identification of bacteria from soil, water and decomposing food
4	Microbial Ecology	<ul style="list-style-type: none"> 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 Microorganisms and their Application in Biotechnology	<ul style="list-style-type: none"> Genetic Materials Mutation and Mutagenesis Biotechnological Application of Microorganism in Various Fields 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 Biotechnological use of microorganisms in <ul style="list-style-type: none"> - Food industry, - Environment, - Pharmaceuticals, Medical, and - Agricultural fields.

BIO 004 (Introductory 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.

1	Diversity and General Characteristics of Animals	<ul style="list-style-type: none"> • What Is Zoology? What are Animals? • Scope and Areas in Zoology • Importance of Zoology 	<ul style="list-style-type: none"> • General characteristics of animals • Diversity of lifestyles, habitats • Categories of animals
2	Systematics (Taxonomy) of Animals	<ul style="list-style-type: none"> • Classification of Animals • Basis of Animal Classification • Levels of Animal Organization • Phyla of Animals • Tissues and Organs in Animals 	<ul style="list-style-type: none"> • Unicellular levels of organization- protozoa • Cellular levels of organization- eumetazoa • Multicellular levels of organization- metazoan • Classification of invertebrates <ul style="list-style-type: none"> - 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- <ul style="list-style-type: none"> - Identification and classification of animal specimens in the different phyla - Dissection of selected animals- cockroaches, fish, frog, rat, etc.
3	Evolution of Animals	<ul style="list-style-type: none"> • History and Origin of Animals • Major Evolutionary Adaptation of Animals 	<ul style="list-style-type: none"> • Adaptation of animals in water • Adaptation of animals on land • Adaptation of animals in air
4	Invertebrates	<ul style="list-style-type: none"> • Phylum Protozoa • Phylum Porifera • Phylum Cnidaria (Coelenterata) • Phylum Platyhelminthes • Phylum Nematoda • Phylum Annelida • Phylum Arthropoda 	<ul style="list-style-type: none"> • Taxonomy, characteristics, diversity, lifestyles, morphology and life cycle providing named representative examples in each order • Free living flat worms • Parasitic flat worms (trematodes)

	<ul style="list-style-type: none"> • Phylum Mollusca • Phylum Echinodermata 	<p>and cestodes) of medical and veterinary importance</p> <ul style="list-style-type: none"> • Emphasize the body plan • Why arthropods are successful.
5	<p>Introduction to Chordates</p> <ul style="list-style-type: none"> • Adaptation of Chordates to Water, Land and Air. • Protochordates • Class Pisces • Class Amphibia • Class Reptilia • Class Aves • Class Mammalia 	<ul style="list-style-type: none"> • 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.
7	<p>Ecologic and Economic Importance of Animals</p> <p>Diverse Economic Importance of Animals</p> <ul style="list-style-type: none"> - Invertebrates - Vertebrates <p>Ecological Importance of Animals</p>	<ul style="list-style-type: none"> • Benefits of animals to man • Economic importance of arthropods
8	<p>Physiological Processes</p> <p>Nutrition in Animals</p>	<ul style="list-style-type: none"> • 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
	<p>Respiration in Mammals</p>	<ul style="list-style-type: none"> • Lung as a respiratory organ • Role of circulatory system in respiration
	<p>Skeletal System</p>	<ul style="list-style-type: none"> • Morphology and function of human skeleton • Forms of skeleton • Components of and differences between bone and cartilage • Parts of mammalian endoskeleton • Definition and types of joint

<p>Transport of Substances across Membranes</p>	<p>Reproduction</p>	<ul style="list-style-type: none"> • Vertebrate reproduction • Structure and function of human female and male reproductive system.
	<p>Excretion</p>	<ul style="list-style-type: none"> • Morphology of the excretory system • Osmoregulation • Structure and function of the nephron – ultrafiltration, selective reabsorption and excretion. • The effects of weather on excretion.
	<p>Circulatory System</p>	<ul style="list-style-type: none"> • human circulatory/transport system • blood as agent of transport • Components of blood • The functions of blood • Types of circulation
	<p>Growth and Development</p>	<ul style="list-style-type: none"> • Principles of development- stages in embryology.
	<ul style="list-style-type: none"> • Diffusion • Osmosis • Plasmolysis • Flaccidity • Haemolysis • Crenation • Turgidity 	<ul style="list-style-type: none"> • Osmotic balance • Selective transport of substances across membranes • Osmotic pressure • Turgor pressure • Active transport • Practical class- experiment demonstrating diffusion, osmosis and plasmolysis

RECOMMENDED TEXTS

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1. Vines A. E. and Rees N. *Plant and Animal biology* (6th edition) Bath Great Britain, Pitman Press.
2. Muller, W. H. *Botany A Functional Approach* (4th Edition). New York, Macmillan.
3. Dutta, A C. *Botany for degree students* (6th Edition) Oxford United Kingdom, University Presss.
4. Michael, T. Madigan et al., *Brock Biology of Microorganism* 13th Edition. New York, Pearson Education.
5. *Laboratory Manuals* as applicable in different Departments of study
6. Dytham, C. *Choosing and using statistic, a biologist guide.* (3rd Edition) United Kingdom, Wiley Blackwell.
7. Tamarin, R. H. *Principles of Genetics* McGraw-Hill, United States of America.
8. Klug, W. S. et al., *Essentials of genetics* Pearson Benjamin Cummings (7th Edition), United States of America.