

# SYLLABUS FOR COMMON ENTRANCE EXAM FOR M.SC. LIFE SCIENCE COURSES

## A BIOMOLECULES

(Marks-5)

Biomolecules present in living cells., Structure of atoms, molecules and chemical bonds.  
Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins  
Stabilizing interactions (van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.).  
Principles of catalysis, enzymes and enzyme regulation, isozymes, Conformation of proteins (Ramachandran plot, secondary structure, domains, motif and folds).  
Conformation of nucleic acids (Structural characteristics of A, B and Z DNA; RNA conformation).

## B CELLULAR ORGANISATION

(Marks-7)

Ultrastructure of plant and animal cell : Cell wall, physical structure of model membranes in prokaryotes and eukaryotes, lipid bilayer, membrane proteins, diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes. Structural organization and function of intracellular organelles : Nucleus and its organization and dynamics, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility. Organization of genes and chromosomes : Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons. Cell division and cell cycle : Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle, apoptosis, necrosis and autophagy.

## C DEVELOPMENTAL BIOLOGY

(Marks-5)

Basic concepts of development  
Potency, commitment, specification, induction, competence, determination and differentiation, morphogenetic gradients, cell fate and cell lineages, stem cells, genomic equivalence and the cytoplasmic determinants, imprinting, mutants and transgenics in analysis of development.  
Gametogenesis, fertilization and early development  
Production of gametes, cell surface molecules in sperm-egg recognition in animals, zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals.  
Male gametophyte development, embryo sac development and double fertilization in plants, embryogenesis, establishment of symmetry in plants, seed formation, embryo and endosperm developmental dynamics and germination.  
Morphogenesis and organogenesis in animals ,Morphogenesis and organogenesis in plants,  
Programmed cell death, aging and senescence in animals and plants

## D. DIVERSITY OF MICROBES

(Marks-5)

Bacteria: Structure, nutrition, reproduction and economic importance, of Nostoc. Cyanobacteria: General characters; life-history  
Algae: General characters, classification (upto classes) and economic importance; General account of algal blooms, Important features and life-history (excluding development) of Volvox, Oedogonium (Chlorophyceae), Vaucheria (Xanthophyceae), Ectocarpus (Phacophyceae) and Polysiphonia (Rhodophyceae).  
Viruses: General account of Viruses including structure of TMV and Bacteriophages Fungi: General characters, classification (upto classes) and economic importance; General account of Lichens, Important features and life-history of Phytophthora (Mastigomycotina), Mucor (Zygomycotina), Penicillium (Ascomycotina), Puccinia, Agaricus (Basidiomycotina), Colletotrichum (Deuteromycotina).

## E .DIVERSITY OF LIFE FORMS

(Marks-5)

Principles & Methods of Taxonomy  
Concepts of species and hierarchical taxa, biological nomenclature, classical & quantitative methods of taxonomy of plants, animals and microorganisms.  
**Protists:** Algae; Protozoa; Slime molds and water molds;  
**Fungi :** Diversity of fungal groups ;Important fungal pathogens of plants and humans.

## **F. DIVERSITY OF ARCHEGONIATES**

**(Marks-5)**

Bryophyta- General characters, classification (upto classes), alternation of generations, evolution of sporophytes and economic importance, Structure and reproduction (excluding development) of Marchantia (Hepaticopsida), Anthoceros (Anthocerotopsida) and Funaria (Bryopsida).

Pteridophyta- General characters, classification (upto classes), alternation of generations, heterospory, apospory, apogamy and economic importance; General account of stellar evolution, Structure and reproduction . Economic importance of plants, Photosynthesis, Photoperiodism, Vernalization, and Biogeochemical cycle

## **G. BIOLOGY AND DIVERSITY OF SEED PLANTS**

**(Marks-7)**

General characters, origin and evolution of Gymnosperms, Geological Time Table: Evolution of Seed Habit, Pilger and Melchior's (1954) system of classification of Gymnosperms.

Palaeobotany- Fossils and Fossilization (Process involved, types of fossils and importance of fossils);

Reconstruction of the fossil plants: *Lvinopteris*, *Williamsonia*, *Cycadeoidea* (= *Bennettites*)

Gymnosperms: Morphology and anatomy of root, stem, leaf/leaflet and reproductive parts including mode of reproduction, life-cycle and economic importance of *Cycas*, *Pinus* and *Ephedra* Angiosperms: Economic importance of Gymnosperms, General characters. origin and evolution

Taxonomy and Systematics, fundamental components of taxonomy (identification, classification, description, nomenclature and phylogeny), Role of chemotaxonomy, cytotaxonomy and taxometrics in relation to taxonomy, Botanical Nomenclature. principles and rules, principle of priority, Keys to identification of plants. Type concept, taxonomic ranks, Salient features of the systems of classification of angiosperms proposed by Bentham & Hooker and Engler & Prantl. Floral Terms and Types of Inflorescence

Diversity of Flowering Plants: Diagnostic features and economic importance of the following families:

Ranunculaceae, Brassicaceae, Malvaceae, Euphorbiaceae, Rutaceae, Fabaceae, Cucurbitaceae, Apiaceae, Asclepiadaceae, Lamiaceae, Solanaceae, Asteraceae, Liliaceae and Poaceae.

## **H. LIFE AND DIVERSITY FROM PROTOZOA TO HEMICHORDATA**

**(Marks-5)**

Phylum- Protozoa: General characters and classification up to order level, Biodiversity and economic importance, Type study of *Plasmodium*; Parasitic protozoans: Life history,

*Entamoeba*, *Trypanosoma*, *Leishmania* and *Giardia*. Phylum- Porifera: General characters and classification up to order

level, Biodiversity and economic importance, Type study *Sycon*., Canal system in sponges, Spicules in sponges, Phylum -Coelentrata: General characters and classification up to order level, Biodiversity, economic importance, Type

Study *Obelia*, Corals and coral reefs, Polymorphism in Siphonophores, Phylum Helminths: General characters and classification up to order level, Biodiversity, economic importance, Type study *Fasciola hepatica*, Helminths parasites:

Brief account of life history, mode of infection and pathogenesis of *Schistosoma*, *Ancylostoma*, *Trichinella*, *Wuchereria*

and *Oxyuris*, Phylum Annelida: General characters and classification up to order level, Biodiversity and economic importance of Annelida, Type study - *Pheretima* (Earthworm), Metamerism in Annelida, Trochophore larva: Affinities,

evolutionary significance, Phylum - Arthropoda: General characters and classification up to order level, Biodiversity

economic importance of insects, Type study - *Periplaneta*, Phylum - Mollusca: General characters and classification up to order level, Biodiversity and economic importance, Type study - *Pila*, Torsion and detorsion in Mollusca, Respiration and foot, Phylum Echinodermata: General characters and classification up to order level, Biodiversity and economic importance, Type Study - *Asterias* (Sea Star), Echinoderm larvae, Aristotle's Lantern, Phylum

Hemichordata, Type study: *Balanoglossus*

## **I. LIFE AND DIVERSITY OF CHORDATES**

**(Marks 7)**

Principles of classification; Origin and Evolutionary tree; Role of amnion in evolution; Salient features of chordates: Functional morphology of the types with examples emphasizing their biodiversity, economic importance and conservation measures where required, General characters and classification of phyla upto orders with examples emphasizing their biodiversity, economic importance and conservation measures where required.

Protochordates: Systematic position, distribution, ecology, morphology and affinities Urochordata: *Herdmania* – type study, Cephalochordata; *Amphioxus* - type study, General characters and classification of phyla upto orders with examples emphasizing their biodiversity, economic importance and conservation measures where required.

Cyclostomes: Classification and ecological significance, Type study of *Petromyzon*, General characters and classification of all phyla upto orders with examples emphasizing their biodiversity, economic importance and

conservation measures where required. Pisces: Scales & Fins. Parental care in fishes, fish migration. Types study of Labeo. Reptilia: Type study of Lizard (Hemidactylus), Origin, Evolutionary tree. Extinct reptiles; Poisonous and non-poisonous Snakes; Poison apparatus in snakes. Amphibia: Origin, Evolutionary tree. Type study of frog (Rana trigrina), Parental Care in Amphibia Aves: Type study of Pigeon (Columba livia); Flight adaptation, Principles of aerodynamics in Bird flight, migration in birds. Mammals: Classification, type study of Rat; Adaptive radiations of mammals and dentition.

## **J PLANT PHYSIOLOGY**

**(Marks 5)**

Photosynthesis :Light harvesting complexes, mechanisms of electron transport, photoprotective mechanisms, CO<sub>2</sub> fixation – C<sub>3</sub>, C<sub>4</sub> and CAM pathways.

Respiration and photorespiration :Citric acid cycle, plant mitochondrial electron transport and ATP synthesis, alternate oxidase, photorespiratory pathway.

Nitrogen metabolism :Nitrate and ammonium assimilation; amino acid biosynthesis, biological nitrogen fixation.

Plant hormones :Biosynthesis, storage, breakdown and transport, physiological effects and mechanisms of action, photoperiodism and biological clock.

Stress physiology :Physiological and molecular responses of plants to biotic and abiotic stresses,

## **K ANIMAL PHYSIOLOGY**

**(Marks 5)**

Blood and circulation :Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis.

Cardiovascular system: Comparative anatomy of heart structure, myogenic heart, specialized tissue,

Respiratory system :Comparison of respiration in different species, anatomical considerations, Process of gaseous exchange in tissues and lungs, respiratory adaption to high altitude. Difference between hemoglobin and myoglobin, waste elimination, neural and chemical regulation of respiration.

Nervous system :Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture.

Sense organs: Vision, hearing and tactile responses.

Excretory system :Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.

Digestive system: Digestion, absorption, energy balance, BMR.

Endocrinology and reproduction: Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation, neuroendocrine regulation.

## **L INHERITANCE BIOLOGY**

**(Marks 7)**

Chromosomal and extrachromosomal inheritance :Principles of Mendelian inheritance, codominance, incomplete dominance, penetrance and expressivity, gene interactions, pleiotropy, genomic imprinting, linkage and cross-over, sex-linked inheritance, inheritance of mitochondrial and chloroplast genes, maternal inheritance.

Genes and mutations :Allele, multiple alleles, pseudoallele, complementation tests; Mutation types, causes and detection; mutant types – lethal, conditional, biochemical, loss of function, gain of function, dominant-negative; germinal verses somatic mutations.

Genetic analysis :Linkage maps, mapping with molecular markers in plants, animals and bacteria, tetrad analysis, gene transfer in bacteria: transformation, conjugation, transduction, sex-duction, fine structure analysis of gene, development of mapping population in plants.

Human genetics :Pedigree analysis, LOD score for linkage testing, karyotypes, genetic disorders.

Quantitative genetics :Population genetics and Hardy-Weinberg equilibrium, polygenic inheritance, heritability and its measurements, molecular mapping.

Structural and numerical alterations of chromosomes :Recombination, deletion, duplication, inversion, translocation, ploidy and their genetic implications.

## **M ECOLOGY**

**(Marks 5)**

Ecology and Environment: Biosphere, Organizational levels of biosphere, Ecosystem: Structure and Types, Food Chain and Energy Flow, Population and Community Ecology, Biodiversity and its Conservation.

Global Environmental issues: Ozone depletion and Global warming, Acid rain and Smog, Sustainable Development. Environmental Pollution: Air, Water, Soil, Noise Pollution- Sources, Causes, Effects,

Consequences. Waste Management: Solid waste - disposal, Management; Waste to energy conversion

## **N BIOCHEMISTRY & METHODS IN BIOLOGY**

**(Marks 10)**

Carbohydrates and lipids, their importance in cells. Proteins: Amino acids and peptides; primary, secondary, tertiary and quaternary structures; protein – protein interactions;

Enzymes: Units of activity, coenzymes and metal cofactors, temperature and pH effects, MichaelisMenten kinetics, inhibitors and activators, active site and mechanism of enzyme action, allosteric enzymes, Organization of metabolic systems: enzyme chains, multienzyme complexes and multifunctional enzymes, regulatory enzymes and feedback control of metabolic pathways.

Carbohydrate metabolism: Glycolysis, gluconeogenesis, glycogenolysis, glycogenolysis and pentose phosphate pathway; hormonal control. TCA cycle and oxidative phosphorylation.

B-oxidation and biosynthesis of fatty acids., urea cycle.Purine and pyrimidine biosynthesis.

**Methods in Biology :** Principles and applications of chromatography, spectroscopy, microscopy, electrophoresis, centrifugation, blotting, PCR & radioisotope techniques

## **O MICROBIOLOGY & IMMUNOLOGY**

**( Marks 7)**

Diversity of microbes, bacterial reproduction antimicrobial agents Viruses; Structure of a typical plant (TMV), Animal (polio) and Bacterial (T4) Viruses; Bacteriophages (Lytic & lysogenic cycles)

Role of microorganisms in biogeochemical cycles of Nitrogen and Carbon. Biological nitrogen fixation with special reference to Rhizobium. Industrial application of microorganisms

Methods in Microbiology – staining, sterilization method culture media, pure culture methods, methods for population estimation, growth determination.

Immunology: Immunity, Immune system in Human: Active and Passive Immunity, Antigens, Antibodies, Classes of Immunoglobulins, Antigen – Antibody reaction, B-cells and T-cells and their role in immunity to infection, Autoimmunity. Immunity to infectious agents; AIDS and other immunodeficiencies, Vaccines, Hybridoma Technology and Monoclonal antibodies, Gene TherapyStructure and functions of different classes of immunoglobulins, humoral, cell-mediated and innate immune responses .

Different types of hypersensitivity, and the importance of conventional vs. recombinant vaccines.

## **P BIOTECHNOLOGY & GENETIC ENGINEERING**

**(Marks 10)**

DNA as genetic material, Structure and Biological importance of DNA; Types of RNA and their structure; Replication of DNA. Genetic code, Central Dogma, Transcription, Translation, RNA editing, DNA repair.

Introduction: Plasmids and bacteriophages: Cosmids, M13, Shuttle vectors and lamda of E. coli, Applications of genetic engineering in medicine, industry and agriculture. Enzymes for RDT: polymerase, restriction endonucleases, ligases, Introduction of r-DNA into living cells – Transformation and Transfection, Identification of recombinants

Techniques in Genetic Engineering : PCR, Gene Sequencing – Maxam Gilbert method & Sanger method, Electrophoresis, Southern and northern blotting techniques. Transgenic plants and animals, Gene therapy, Intellectual Property Rights, Bioethicsmedicine, industry and agriculture, animal & plant cell culture, environmental biotechnology