

SYLLABI FOR ENTRANCE EXAMINATION

(A) Life Sciences

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

DIVERSITY OF MICROBES (marks 4)

Bacteria: Structure, nutrition, reproduction and economic importance, **Cyanobacteria:** General characters; life-history of *Nostoc*.

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* (Phaeophyceae) 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).

CELL BIOLOGY (marks -6)

The Cell Envelopes: Structure and functions of Cell Wall, Plasma Membrane: Fluid mosaic model, various modes of transport across the membrane, mechanism of active and passive transport, endocytosis and exocytosis. Ultrastructure of different cell organelles of animal and plant cells.

Endoplasmic Reticulum: types, role of ER in protein synthesis and transportation in animal cell. **Golgi complex:** Structure, Associated enzymes and role of golgi-complex in animal cell. **Ribosomes:** Types, biogenesis and role in protein synthesis.

Lysosomes: Structure, enzyme and their role; polymorphism, Peroxisomes and Vacuoles

Mitochondria: Mitochondrial DNA; as semiautonomous body, biogenesis, mitochondrial enzymes (only names), role of mitochondria,

Cytoskeleton: Microtubules, microfilaments, centriole and basal body. Cilia and Flagella

Ultra-structure and function of Chloroplast, Nucleus and Nucleolus, Chromosome: Morphology, ultra-structure - kinetochore, centromere and telomere fine structure of chromosomes, nucleosome concept and role of histones, Euchromatin and heterochromatin, lampbrush chromosomes and polytene chromosomes.

Cell Cycle: General account

Cell Division: Mitosis and Meiosis - Stages and Significance

Chromosomal aberrations: Structural and Numerical - deletions, duplications, translocations, inversions, aneuploidy, polyploidy, Sex chromosomes and Sex determination in Plants

Brief account of causes of cancer.

An elementary idea of cellular basis of Immunity.

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 (excluding development) of *Rhynia* (Psilopsida), *Selaginella* (Lycopsida), *Equisetum* (Sphenopsida) and *Pteris* (Pteropsida)

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GENETICS (marks-10)

Elements of Heredity and variations.

Genetic Inheritance: Mendelism: Laws of Segregation and Independent Assortment; Gene interactions: Allelic and non-allelic interactions

Linkage and recombination: Coupling and repulsion hypothesis, crossing-over and chiasma formation; gene mapping.

Sex determination and its mechanism: male and female heterozygous systems, genetic balance system; role of Y - chromosome, male haploidy, cytoplasmic and environmental factors, role of hormones in sex determination.

Sex linked inheritance: Haemophilia and colour blindness in man, eye colour in *Drosophila*, Non-disjunction of sex-chromosome in *Drosophila*; Sex-linked and sex influenced inheritance.

Extra chromosomal and cytoplasmic inheritance: Kappa particles in Paramecium, Shell coiling in snails and Milk factor in mice, Presence and function of Mitochondrial and Plastid DNA; Plasmids.

Multiple allelism: Eye colour in *Drosophila*; A, B, O blood groups in man.

Genetic Material: Nature and function of genetic material; Structure and type of nucleic acids; DNA - the genetic material, DNA structure and replication, DNA-Protein interaction, The Nucleosome Model, Genetic Code, Satellite and Repetitive DNA. Protein synthesis

Genetic Variations: Mutations - spontaneous and induced; transposable genetic elements; gene mutations; chemical basis of mutations; transition, transversion, structural chromosomal aberrations (deletion, duplication, inversion and translocation); Numerical aberrations (autopolyploidy, euploidy and polyploidy in animals)

DNA damage and repair.

Gene Expression: Modern concept of gene; RNA; Ribosomes; Transfer of genetic information - transcription and translation; Structure of proteins; Regulation of gene expression in prokaryotes and eukaryotes

Human genetics: Human karyotype, Chromosomal abnormalities involving autosomes and sex chromosomes, monozygotic and dizygotic twins.

Inborn errors of metabolism (Alcaptonuria, Phenylketonuria, Albinism, sickle-cell anaemia).

Applied genetics: Eugènics, eugenics and euphenics; genetic counseling, pre-natal diagnostics, DNA-finger printing, transgenic animals

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, mode of infection and pathogenicity of *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 and 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 gastropoda, 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*

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BIOLOGY AND DIVERSITY OF SEED PLANTS (marks-8)

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: *Lyginopteris*, *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* Economic importance of Gymnosperms,

Angiosperms: General characters, origin and evolution

Taxonomy and Systematics, fundamental components of taxonomy (identification, classification, description, nomenclature and phylogeny), Role of chemotaxonomy, cytotoxicity 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.

PLANT ANATOMY & PLANT EMBRYOLOGY (marks 4)

Tissues - meristematic and permanent (simple, complex and secretory) Tissue systems (Epidermal, ground and vascular). The Shoot system - shoot apical meristem and its histological organizations. Cambium - structure and functions. Secondary growth in dicot stem; characteristics of growth rings; sap wood and heart wood, periderm; Anomalous secondary growth (*Dracaena*, *Boerhaavia* and *Achyranthes*), Leaf: Types of leaves (simple and compound); phyllotaxy. Epidermis-uniseriate and uliseriate, epidermal appendages and their morphological types., Anatomy of typical Monocot and Dicot leaf and cell inclusions in leaves, leaf abscission, Stomatal apparatus and their morphological types, Root system: Root apical meristem; histological organization Secondary growth in dicot root, Structural modifications in roots: Storage (*Beta*), Respiratory (*Rhizophora*), Epiphytic (*Vanda*).

Flower-a modified shoot, Microsporangium, its wall and dehiscence mechanism, Microsporogenesis, pollen grains and its structure (pollen wall). Pollen germination (microgametogenesis), Male gametophyte, Pollen-pistil interaction; self incompatibility. Pollination: types and agencies. Structure of Megasporangium (ovule), its curvatures; Megasporeogenesis and Megagametogenesis, Female gametophyte (mono, bi and tetrasporic), Double fertilization, Endosperm types and its biological importance. Embryogenesis in Dicot and Monocot; Polyembryony, Structure of Dicot and Monocot seed, Fruit types; Dispersal mechanisms in fruits and seeds.

LIFE AND DIVERSITY OF CHORDATES (marks-8)

Chordates: 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

Amphibia: Origin, Evolutionary tree. Type study of frog (*Rana tigrina*), Parental Care in Amphibia

Reptilia: Type study of Lizard (*Hemidactylus*), Origin, Evolutionary tree. Extinct reptiles: Poisonous and non-poisonous snakes; Poison apparatus in snakes.

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. **Note:** Type study includes detailed study of various systems of the animal.

MAMMALIAN PHYSIOLOGY (marks-10)

Introduction, Classification, Structure, function and general properties of carbohydrates and lipids. Introduction, Classification, Structure, function and general properties of proteins; Nomenclature, Classification and mechanisms of enzyme action, Transport through biomembranes (Active and Passive), buffers

Nutrition: Nutritional components; Carbohydrates, fats, lipids, Vitamins and Minerals. Types of nutrition & feeding, Digestion of dietary constituents, viz. lipids, proteins, carbohydrates & nucleic acids; symbiotic digestion. Absorption of nutrients & assimilation; control of enzyme secretion.

Muscles: Types of muscles, ultra-structure of skeletal muscle. Bio-chemical and physical events during muscle contraction; single muscle twitch, tetanus, muscle fatigue muscle, tone, oxygen debt., Cori's cycle, single unit smooth muscles, their physical and functional properties.

Bones: Structure and types, classification, bone growth and resorption, effect of ageing on skeletal system and bone disorders.

Circulation: Origin, conduction and regulation of heart beat, cardiac cycle, electrocardiogram, cardiac output, fluid pressure and flow pressure in closed and open circulatory system; Composition and functions of blood & lymph; Mechanism of coagulation of blood, coagulation factors; anticoagulants, haemopoiesis

Respiration: Exchange of respiratory gases, transport of gases, lung air volumes, oxygen dissociation curve of hemoglobin, Bohr's effect, Haldane's phenomenon (Chloride shift), control / regulation of respiration.

Excretion: Patterns of excretory products viz. Ammonotelic, ureotelic, uricotelic, ornithine cycle (Krebs-Henseleit cycle) for urea formation in liver.

Excretion: Urine formation, counter-current mechanism of urine concentration, osmoregulation, micturition.

Neural Integration: Nature, origin and propagation of nerve impulse along with myelinated & non-myelinated nerve fibre, conduction of nerve impulse across synapse.

Chemical integration of Endocrinology: Structure and mechanism of hormone action; physiology of hypothalamus, pituitary, thyroid, parathyroid, adrenal, pancreas and gonads.

Reproduction: Spermatogenesis, Capacitation of spermatozoa, ovulation, formation of corpus luteum, oestrous-anoestrous cycle, Menstrual cycle in human; fertilization, implantation and gestation.

PLANT PHYSIOLOGY (marks-10)

Plant-water relations: Importance of water to plant life; physical properties of water; imbibition, diffusion and osmosis; absorption and transport of water; transpiration; physiology of stomata.

Mineral nutrition: Essential macro and micro elements and their role; mineral uptake; deficiency symptoms.

Transport of organic substances: Mechanism of phloem transport; source-sink relationship; factors affecting translocation.

Photosynthesis : significance; historical aspects; photosynthetic pigments; action spectra and enhancement effects; concept of two photosystems; Z-scheme; photo-phosphorylation; Calvin cycle; C₄ pathway; CAM plants; photorespiration.

Growth and development : Definitions; phases of growth and development; seed dormancy; plant movements; the concept of photoperiodism; physiology of flowering; florigen concept; physiology of senescence; fruit ripening;

Plant hormones- auxins, gibberellins, cytokinins, abscisic acid and ethylene, history of their discovery, mechanism of action; photo-morphogenesis;

Phytochromes and their discovery, physiological role and mechanism of action.

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ECOLOGY & EVOLUTION (marks-6)

Introduction to Ecology: Definition; scope and importance; levels of organization . **Environment:** Introduction; environmental factors- climatic (water, humidity, wind, light, temperature), edaphic (soil profile, physico-chemical properties), topographic and biotic factors (species interaction). Adaptations of plants to water stress and salinity (morphological and anatomical features of hydrophytes, xerophytes and halophytes).

Population ecology: Basic concept; characteristics; biotic potential, growth curves; ecotypes and ecads.

Community ecology: Concepts; characteristics (qualitative and quantitative-analytical and synthetic); methods of analysis; ecological succession.

Ecosystem: Structure (components) and functions (trophic levels, food chains, food webs, ecological pyramids and energy flow)

Biogeochemical cycles: Carbon, nitrogen, phosphorus and hydrological cycle.

Phyto-geography: Phyto- geographical regions of India; vegetation types of India (forests). **Environmental pollution:** Sources, types and control of air and water pollution.

Global change: Greenhouse effect and greenhouse gases; impacts of global warming; carbon trading; Ozone layer depletion; Biomagnification

Population: Growth and regulation.

Origin of life, Concept and evidences of organic evolution,Theories of organic evolution, Concept of microevolution and concept of species, Concept of macro-and mega-evolution, Phylogeny of horse, Evolution of man.

BIOCHEMISTRY AND BIOTECHNOLOGY (marks-15)

Basics of Enzymology: Discovery and nomenclature; characteristics of enzymes; concept of holoenzyme, apoenzyme, coenzyme and co-factors; regulation of enzyme activity; mechanism of action.

Respiration: ATP – the biological energy currency; aerobic and anaerobic respiration; Krebs cycle; electron transport mechanism (chemiosmotic theory); redox -potential; oxidative phosphorylation; pentose phosphate pathway.

Lipid metabolism: Structure and functions of lipids; fatty acid biosynthesis; β -oxidation; saturated and unsaturated fatty acids; storage and mobilization of fatty acids.

Nitrogen metabolism: Biology of nitrogen fixation; importance of nitrate reductase and its regulation; ammonium assimilation.

Genetic engineering and Biotechnology: Tools and techniques of recombinant DNA technology; cloning vectors; genomic and cDNA library; transposable elements; aspects of plant tissue culture; cellular totipotency, differentiation and morphogenesis; biology of *Agrobacterium*; vectors for gene delivery and marker genes. Transgenic plants & animals.

DEVELOPMENTAL BIOLOGY (marks-3)

Historical perspectives, aims and scope of developmental biology, Generalized structure of mammalian ovum & sperm. Spermatogenesis and Oogenesis, Fertilization, parthenogenesis, different types of eggs and patterns of cleavage in invertebrates and vertebrates, Fate-map construction in frog and chick, Gastrulation in invertebrates and vertebrates, Gastrulation & formation of three germinal layers in frog and chick, Elementary knowledge of primary organizers, Extra embryonic membranes: structure & significance in birds and mammals, Concepts of competence, determination and differentiation, Concept of regeneration.

ECONOMIC BOTANY (marks -3)

Vavilov's centres of origin of crop plants, Origin, distribution, botanical description, brief idea of cultivation and economic uses of the Food plants - cereals (rice, wheat and maize), pulses (gram, arhar and pea), vegetables (potato, tomato and onion).

Origin, distribution, botanical description, brief idea of cultivation and economic uses of the Fibers- cotton, jute and flax. Oils- groundnut, mustard, sunflower and coconut.

Morphological description, brief idea of cultivation and economic uses of the Spices- coriander, ferula, ginger, turmeric, cloves.

Medicinal plants- *Cinchona*, *Rauwolfia*, *Atropa*, *Opium*, *Cannabis*, *Azadirachta*, *Withania*.

Botanical description, processing and uses of: Beverages- tea and coffee; Rubber - *Hevea*;

Sugar- sugarcane General account and sources of timber; energy plantations and bio-fuels.

FISH AND FISHERIES AND ENTOMOLOGY (marks-3)

Introduction of world fisheries: Production, utilization and demand **Fresh Water fishes of India:** River system, reservoir, pond, tank fisheries; captive and culture fisheries, cold water fisheries, Fishing crafts and gears, Fin fishes, Crustaceans, Molluscs and their culture. **Seed production:** Natural seed resources – its assessment, collection, Hatchery production. **Nutrition:** Sources of food (Natural, Artificial) and feed composition (Calorie and Chemical ingredients). **Field Culture:** Ponds-running water, recycled water, cage, culture; poly culture. **Culture technology:** Biotechnology, gene manipulation and cryopreservation of gametes.

Study of important insect pests of crops and vegetables: **Sugarcane:** Sugarcane leaf-hopper (*Pyrilla perpusilla*), Sugarcane Whitefly (*Aleurolobus barodensis*), Sugarcane top borer (*Scirpophaga nivella*), Sugarcane root borer (*Emmalocera depressella*), Gurdaspur borer (*Bissetia steniellus*) With their systematic position, habits and nature of damage caused. Life cycle and control of *Pyrilla perpusilla* only. **Cotton:** Pink bollworm (*Pectinophora gossypiella*), Red cotton bug (*Dysdercus Cingulatus*), Cotton grey weevil (*Mylocerus undecimpustulatus*), Cotton Jassid (*Amrasca devastans*), With their systematic position, habits and nature of damage caused. Life cycle and control of *Pectinophora gossypiella*. **Wheat:** Wheat stem borer (*Sesamia inferens*) with its systematics position, habits, nature of damage caused. Life cycle and control, **Paddy:** Gundhi bug (*Leptocorisa acuta*), Rice grasshopper (*Hieroglyphus banian*), Rice stem borer (*Scirpophaga incertullus*), Rice Hispa (*Diceladispera armigera*) With their systematic position, habits and nature of damage caused. Life cycle and control of *Leptocorisa acuta*, **Vegetables** *Raphidopalpa faveicollis* – The Red pumpkin beetle, *Dacus cucurbitas* – The pumpkin fruit fly. *Tetranychus tecarius* – The vegetable mite, *Epilachna* – The Hadda beetle, Their systematics position, habits and nature of damage caused. Life cycle and control of *Aulacophora faveicollis*. **Stored grains:** Pulse beetle (*Callosobruchus maculatus*), Rice weevil (*Sitophilus oryzae*), Wheat weevil (*Trogoderma granarium*), Rust Red Flour beetles (*Tribolium castaneum*), Lesser grain borer (*Rhizopertha dominica*), Grain & Flour moth (*Sitotroga cerealella*), Their systematic position, habits and nature of damage caused. Life cycle and control of *Trogoderma granarium*. **Insect control:** Biological control, its history, requirement and precautions and feasibility of biological agents for control, Chemical control: History, Categories of pesticides. Important pesticides from each category to pests against which they can be used. Insect repellants and attractants, Integrated pest management, Important bird and rodent pests of agriculture & their management.