DEPARTMENT of ZOOLOGY
UNIVERSITY of RAJASTHAN. JAIPUR-302004

**MPAT-2017 (Paper-II)**

SYLLABUS **ZOOLOGY**

## SECTION A

### Biomolecules and Cellular Metabolism

1. Composition, structure and functions of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).
2. Enzyme characteristics, nomenclature and classification, principles and mechanisms of enzyme action, coenzymes and ribozymes.
3. Conformation of proteins (Ramchandran plot, secondary, tertiary and quaternary structure, domains, motifs and folds, chaperones).
4. Conformation of nucleic acids- DNA (A-, B- and Z-DNA ),RNA (m-, r-, t--RNA) and micro RNA.
5. Metabolism of:
   (i) Carbohydrates (Glycolysis, Krebs cycle, oxidative phosphorylation, Pentose phosphate pathway, gluconeogenesis, glycogenolysis and glycogenesis).
   (ii) Lipids (β – oxidation and fatty acids biosynthesis).
   (iii) Proteins (deamination, transamination, transdeamination, urea cycle and fate of carbon skeleton of amino acids).
   (iv) Nucleotides (synthesis of purines and pyrimidines, synthesis and regulation of deoxy- & ribo-nucleotides, degradation and salvage pathways).

### Cell Biology

1. Membrane structure and function: Structure of membrane models, modifications of cell membrane, membrane proteins and lipids, diffusion, osmosis, ion channels, active transport & pumps.
2. Structural organization and functions of cellular organelles: Nucleus, mitochondria, Golgi body, lysosomes, endoplasmic reticulum, peroxisomes, ribosomes, structure & function of cytoskeleton and its role in motility.
3. Chromosomes: Structure of chromatin (organization of nucleosomes) and chromosomes, unique and repetitive DNA, heterochromatin and

euchromatin, C value paradox, reassociation kinetics, Non repetitive DNA complexicity.

4. Cell division: Mitosis, meiosis & their regulation, Cell cycle: eukaryotic cell cycle, control & molecular basis of cell cycle regulation, Cell death: apoptosis –its characteristics, caspases, Extrinsic and intrinsic pathways.
5. DNA replication, repair and recombination in prokaryotes and eukaryotes: Unit of replication, enzymes involved in replication, origin and replication fork, fidelity of replication, extra chromosomal replicons, models for homologous recombination, homologous recombination protein machines, homologous recombination in eukaryotes, DNA damage and repair mechanisms.
6. RNA synthesis and processing in prokaryotes and eukaryotes: Transcription factors and machinery, formation of initiation complex, transcription activators and repressors, RNA polymerases, elongation &termination, RNA processing, Gene silencing.
7. Protein synthesis and processing in prokaryotes and eukaryotes: Formation of initiation complex, initiation factors and their regulation, elongation and its factors, termination, genetic code, translation proof –reading, translational inhibitors and post – translational modification of proteins.
8. Control of gene expression: lac operon & trp operon (prokaryotes).
9. Cell signaling: Hormones and their receptors, cell surface and their receptors, signaling through G-protein coupled receptors, tyrosine kinases and second messenger (cAMP, $IP_3$DAG), signal transduction pathways (MAP kinase, JAK/STAT and TGF-β Smad pathways).

**Cancer**

1. Occurrence and causes of cancer.
2. Cancer of different sex and age groups.
3. Benign and malignant tumors.
4. Early warning signals of different cancers.
5. Oncogenes and tumor suppressor genes.
6. Virus induced cancer.
7. Metastasis.
8. Intervention of cancer cells with normal cells.
9. Prevention and treatment of cancer.

**Immunology**

1. Cell and organs involved in innate and adaptive immunity.



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2. Antigens, antigenicity and immunogenicity, B and T cell epitopes.
3. Structure, types and functions of antibodies.
4. Monoclonal antibodies & hybridoma technology.
5. Antigen-antibody interactions and Complement system.
6. MHC molecules and antigen processing and presentation.
7. Activation and differentiation of B and T cells.
8. Humoral and cell mediated immune responses.
9. Vaccines (traditional & recombinant) and cytokines: Structure, function and related diseases.
10. Hypersensitivity.
11. Autoimmunity and transplantation.

**Developmental Biology**

1. Basic concepts of development: Induction, competence, determination and differentiation, morphogenetic gradients, cell fate, cell lineages and cytoplasmic determinants.
2. Gametogenesis,fertilization and early development : Production of gametes, cell surface molecules for gamete recognition, zygote formation, cleavage, blastula &its fate map,gastrulation & fate of germinal layers, implantation, placentation and extra embryonic membranes.
3. Organogenesis: Morphogenetic processes in epithelia and mesenchyme in organ formation, morphogenesis of brain, neural crest cells and their accessory organs.
4. Neoteny and metamorphosis in amphibians.
5. Regeneration: Types of regeneration (physiological, reparative and compensatory hypertrophy), regenerative ability in chordates, morphological and histological processes in amphibian limb regeneration and origin of cells for regeneration.

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## SECTION B

### Physiology

1. Digestive system: Nature of food-stuff, various types of digestive enzymes and their action in alimentary canal, absorption and assimilation of food, nervous and hormonal control of digestion.
2. Circulatory system : Composition and function of blood &lymph, haemopoiesis, blood clotting, blood volume, blood volume regulation, homeostasis, comparative anatomy of heart structure ,myogenic heart, ECG – its principle and significance, cardiac cycle, heartbeat, blood pressure, blood groups & lymph nodes.
3. Respiratory system : Respiratory organs (gills, trachea and lungs), respiratory pigments, mechanism of breathing, physiology of respiration, control of breathing, aerodynamics, BMR and response to high altitude and hypoxia.
4. Nervous system: Functional architecture of neurons, origin and propagation of nerve impulse through axon, synaptic transmission, reflex arc, reflex action & gross neuroanatomy of the brain and spinal cord.
5. Excretory system: Functional architecture of kidney and nephron, nitrogenous end products, formation of urine and its hormonal control and role of kidney in osmoregulation, urine concentration, Electrolyte balance, acid-base balance.
6. Muscular system: Types and properties of muscles, functional architecture of skeletal muscles, biophysical and biochemical events during muscular activity and characteristics of skeleton muscles.
7. Sense organs: Structure of eyes and ears and mechanism of vision and hearing.
8. Thermoregulation and cold tolerance: Heat balance and exchange, endotherms Vs ectotherms, counter-current heat exchanger, torpor, hibernation and aestivation and adaptations to extreme climate.
9. Stress: Basic concepts of environmental stress and strain, homeostasis, physiological response to body exercise, meditation, yoga and their effects.
10. Endocrinology: Properties, biochemical nature &mechanism of hormone action, endocrine glands in vertebrates, their hormones and related diseases.
11. Reproduction: Reproductive cycles, implantation, gestation, parturition, lactation, neuroendocrine regulators in insects and mammals, pheromones, endocrine disruptors and teratological effects of xenobiotics.

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**Genetics**

1. Mendel's law's, their significance and current status, fine structure of gene, linkage and crossing over, gene mapping with molecular markers, gene interactions, cytoplasmic inheritance, methods of genetic transfers in microbes : Transformation, conjugation, transduction, sex-duction, lysogeny and lytic cycle.
2. Quantitative genetics: Polygenic inheritance, heritability and its measurement and QTL measurement.
3. Mutations: Types and causes of mutations.
4. Human genetics: Trisomy, deletion, translocation, sex chromosomes linked genetic disorders, single gene disorders, eugenics, prenatal diagnosis and genetic counseling.

**Diversity of life forms -I**

1. Principles and method of taxonomy: Concept of kingdom schemes, species and hierarchial taxa, theories of biological nomenclature and classification, Modern trends of taxonomy-kinds, merits & demerits, International code of zoological nomenclature.
2. Levels of structural organization: unicellular, colonial and multicellular forms, levels of organization of tissues, organs &systems and basis of classification.
3. Outline classification of animals: Important criteria used for classification in each taxon, classification of animals (Non-Chordates and Chordates – up to orders).
4. Locomotory mechanisms in invertebrates: Amoeboid, ciliary, flagellar movement, involvement of myonemes and muscles fibres & locomotion in relation to hydrostatics.
5. Feeding mechanism: Amoeboid, ciliary, filter feeding, parasitic mode of feeding, feeding mechanisms in insects and echinoderms.
6. Larval forms and their significance.

**Diversity of life forms -I**

1. Interrelationship of Hemichordata, Urochordata and Cephalochordata and their relations with other Deuterostomes.
2. Comparative anatomy: Osteology (vertebrae, pectoral & pelvic girdles, fore limbs and hind limb: Amphibian, Reptiles, Aves and Mammals).



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3. Comparative anatomy: Digestive, Integumentary, Respiratory, Circulatory & Urinogenital systems &Brain (Pisces, Amphibia, Reptiles, Aves & Mammals).

## SECTION C

### Environmental Biology

1. Environment: Biotic & abiotic components, concept of habitat and ecological niche.
2. Ecosystem: Structure & functions, energy flow, bioaccumulation, biomagnifications and bioremediation, aquatic and terrestrial ecosystems.
3. Population: Characteristics of population, growth curves and regulation, methods of estimating population density in animals.
4. Community: Characteristics, composition and stratification of natural communities, ecotone, edge effect and ecological succession.
5. Biogeography: Major terrestrial biomes, biogeographical zones of India and their characteristic fauna.
6. Applied ecology: Environmental pollution, loss of tropical forest, global warming and green house effect, biodiversity in India (with special reference to Rajasthan) & its management and space ecology.
7. Environment management: Solid waste, e-waste and hazardous waste legislative approach, Bioterrorism.
8. Wild Life in India: Causes of extinction of species, concept of threatened species, conservation of Wild life, National parks and sanctuaries in India, Project Tiger, biosphere reserves, wild life organizations, *ex-situ* & *in - situ* conservation, natural resources and their management.

### Evolution

1. Concepts and theories of evolution.
2. Emergence of Non-Darwinism-neutral hypothesis.
3. Hardy-Weinberg Law of genetic equilibrium and destabilizing forces.
4. Adaptive radiation and modifications.
5. Isolating mechanisms, speciation (allopatric, sympatric and parapatric).
6. Convergent evolution, Sexual selection, co-evolution, micro-and macro-evolution, molecular drive, molecular clocks, evolution of gene and gene families.

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7. Molecular tools and phylogeny (amino acids and nucleotides sequence analysis).
8. Geological time scale.
9. Evolution of man.

**Ethology**

1. Concepts of ethology.
2. Brain & behavior.
3. Sociobiology.
4. Altruism and eusociality.
5. Mating and courtship behavior.
6. Biological clocks.
7. Communication.
8. Parental care.
9. Migration, navigation and social organization (monkey).

**Applied Biology**

1. Economic Zoology: Important human and vertebrate parasites (Protozoans, helminthes & arthropods), insect pests of agricultural importance and management, vermiculture, apiculture, sericulture, lac culture, pearl culture, prawn culture, pisiculture and induced breeding, Poultry keeping, Leather, wool and fur industry, Pharmaceuticals from animals.
2. Contraceptive methods and assisted reproductive technology (ART).
3. Genomics and its application to health including gene therapy.
4. Bioremediation and phytoremediation.

**Biostatistics**

1. Measures of central tendency.
2. Standard deviation and standard error.
3. Probability distributions (Binomial, Poisson and normal).
4. Hypothesis, errors (type I & II) and levels of significance.
5. Difference between parametric and non-parametric statistics, confidence limits.
6. Regression and correlation.
7. t-test, analysis of variance (One way & Two way).
8. Chi Square ($\chi^2$) test and Yate's correction.



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**Tools and Techniques**

1. Principles and applications of microscopy (light, bright field and dark field, phase contrast, fluorescence and electron microscopes: transmission and scanning) and micrometry.
2. Types and chemical basis of fixation (for light and electron microscopy), stains (nuclear and cytoplasmic) and histological preparation of tissues.
3. Principles, types and application of centrifugation, electrophoresis, chromatography, freeze techniques (freeze- drying, freeze substitution, freeze fracture & freeze etch) and flow cytometry.
4. Lambert-Beer's law, principles and applications of colorimeter and spectrophotometer, (UV, NMR, atomic absorption and fluorescence).
5. Autoradiography, types of radio isotopes used in biology, their detection and measurement, Units of radioactivity, Radioactive decay & RIA (radio immunoassay).
6. Genetic engineering: Techniques and essential enzymes, cloning vectors and strategies, generation of genomic and cDNA libraries in plasmid, phage cosmid BAC and YAC vectors, DNA sequencing methods, strategies for genome sequencing, RFLP, RAPD and AFLP techniques.
7. Histochemical and immunotechniques: Antibody generation, ELISA, Northern, Southern and Western blot, Dot and Slot blot, *in situ* localization by techniques FISH and GISH.