## SYLLABUS
(For Candidates to be admitted from 2016 Onwards)

**PG DEPARTMENT OF ZOOLOGY, NATIONAL COLLEGE (AUTONOMOUS)**

NATIONALLY ACCREDITED AT ‘A’ LEVEL BY NAAC, TIRUCHIRAPPALLI-620 001

**POST GRADUATE AND RESEARCH DEPARTMENT OF ZOOLOGY**

M.Sc., Zoology - Programme Structure under CBCS
(For Candidates admitted from the academic year 2016 onwards)

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SYLLABUS
(For Candidates to be admitted from 2016 Onwards)
PG DEPARTMENT OF ZOOLOGY, NATIONAL COLLEGE (AUTONOMOUS)
CC - CORE COURSE, CCE - CORE COURSE ELECTIVE
For the science program oral test will be conducted for the practical papers and 5 marks will be allotted and to be included in the external 75 marks i.e., 70 for the practical lab + 5 for the oral test = 75 marks
UNIT - I : Biology of Invertebrates

UNIT - II
Comparative study of respiration, circulation, excretion, nervous systems of invertebrates.

UNIT - III : Biology of Chordates

UNIT - IV
Respiration in Fishes : Pulmonary respiration in Tetrapods.
Excretory system : Types and evolution of kidneys.
Reproductive system: Accessory reproductive glands
Appendicular skeleton – Pectoral and Pelvic girdles of different classes.

Unit - V: Paleontology
Minor Phyla: Rotifera, Phoronida and Cheatognatha - Invertebrate fossils- Evolutionary trends and Phylogenetic importance of Trilobites, Ammonoids, Belemnoids, Nautiloids, Echinoid fossils and Vertebrate fossils.

References
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CLASS I – M.Sc., Zoology

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UNIT – I: Plasmamembrane and Nucleus

UNIT – II: Mitochondria, Endoplasmic Reticulum, Golgi complex, Lysosome, and Centrosome

UNIT – III: DNA and RNA
Watson and Crick’s model for DNA replication (Meselson and Stahl's experiment) – Enzymes involved in DNA replication (Nuclease, polymerases, ligases) - Types of Non genetic RNA - Mechanism of transcription in prokaryotes and eukaryotes – Mechanism of protein synthesis.

UNIT – IV: Cancer Biology

UNIT – V: Cytological Techniques
Microtomy – Cell fractionation – Autoradiography – Cytochemical staining and detection methods of Carbohydrates, protein, lipids, DNA and RNA.

References
UNIT – I: Genetic interaction, Linkage, and Crossing over
Gene interaction and types (Complementary genes, supplementary genes, Duplicate genes, Lethal genes, and Epistasis) - Mechanism of crossing over and its theories (Chiasma, Breakage, Contact-first, Strain, and differential contraction theories) - Kinds of linkage (Complete and incomplete) - Gene Mapping in Chromosome by crossing over method - Somatic Cell Hybridization.

UNIT – II: Gene concept and regulation of gene expression
Structure of Gene (cistron, muton, recon, introns and exons) - Functions of genes – Genetic code (Wobble hypothesis) - Gene Regulation in Prokaryotes: The Operon concept lac operon, trp operon and ara operon system in bacteria.– Gene regulation in eukaryotes: Short term and long term regulation.

UNIT – III: Mutation and Population genetics
Molecular basis of mutations – Genetic basis of cancer – Chromosomal aberrations – DNA Damage and repair mechanisms (Direct, Excision, Mismatch, and Recombinational repair) – Genes in populations – Hardy-Weinberg principle and gene frequency – Factors affecting Hardy-Weinberg equilibrium.

UNIT – IV: Microbial genetics
Biology of Plasmids – Transposon – Types and mechanism of transposition.
Bacteria: Genetic material – recombination (transformation (Griffith experiments and Avery, Macleod, and Mccarthy experiments), conjugation, sexduction and transduction).
Phages: Genetic material – Lytic and Lysogenic cycle.

UNIT – V: Human genetics

Reference Books
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1. INVERTEBRATES AND CHORDATES.

A. Mounting : Teleost – Scales
   Honey bee - sting.
B. Dissection : Frog - V Cranial and spinal nerves using virtual laboratory.
   Spotters: Frog – V Cranial and spinal nerves.

2. CELL BIOLOGY

A. Cytological techniques : Micrometry – Measurements using ocular and stage micrometers
   – cell volume (Embryonic Cells separated from early gastrula of frog)
   Spotters: Ocular micrometer and Stage micrometer.
B. Histochemical techniques : Fixation – Chemical fixation – Freezing, Drying, Freeze-drying, staining, Conventional and cytochemical. – Histochemical localization of DNA, RNA, Lipids, proteins vital staining.
C. Study of different types of cells. – Blood cells – Differential count in human samples.

3. MOLECULAR BIOLOGY

Isolation of DNA from animal tissue.
Isolation of plasmid DNA from Bacteria (Demo)

4. GENETICS

Drosophila Culture – Identification of mutants and sexes –
ABO Blood groups & Rh- genetic significance.
Human Karyotyping and Pedigree analysis
Hardy – Weinberg Law and calculation of gene frequency.
Spotters: Drosophila - male and female, Human karyotyping - male and female.
UNIT – I: Analytical instruments
Principles and uses of analytical instruments: Balances, pH meter, Spectrophotometer, Densitometric Scanner, Radioactive counters (Geiger Muller and Scintillation counters), Microscopic principles and applications (SEM, TEM). Principle of centrifuges.

UNIT – II: Separation techniques
Molecular separation by Chromatography, (Paper, Column, Thin Layer, Adsorption, Ion Exchange, HPLC), Electrophoresis, (native, SDS, PAGE, AGAROSE), Organelle separation by centrifugation.

UNIT – III: Physiological Measuring System

UNIT – IV: Research Methodology
Research: Definition, Sources for Literature collection, Selection of research theories, Experimental Design, Components of research report (Introduction, Materials and Methods, Results and Discussion, Summary, References), Presentation of results (in the form of Tables, Figures), Evaluation of Data (Statistical Analysis).

UNIT – V: Journals and Online browsing of research articles
Details of Popular Magazines and periodicals (monthly, quarterly and half-yearly journals and reviews). Online browsing of research articles: infonet, inflibnet and Pubmed. Peer-reviewed journals, indexed and non-indexed journals.

References
2. Veerakumari, L. Bioinstrumentation.
UNIT - I: Thermoregulation and Osmoregulation
Classification of animals based on thermoregulation – Temperature compensation in poikilotherms - Temperature regulation in homeotherms.
Mechanism of osmoregulation in freshwater animals - Mechanism of osmoregulation in marine animals.

UNIT – II: Nervous coordination

UNIT - III: Excretion and Receptors
Ammonia toxicity – detoxification pathways – excretion to different habitat.
Chemoreceptors, Olfactoreceptors, Photoreceptors (Photochemistry of vision) - Mechanoreceptors (Tangoreceptors, Phonoreceptors, and Rheoreceptors).

UNIT - IV: Bioluminescence and Chronobiology
Biological rhythms: Circadian, Lunar, Circannual rhythms - Biological clock.

UNIT - V: Physiology of Reproduction
Mammalian reproductive physiology – Reproductive cycles - Hormonal control – Molecular mechanism of hormone action - Prostaglandins, Reproductive disorders.

Reference
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**UNIT - I: Introduction to Biotechnology**

**UNIT - II: Enzyme Biotechnology**

**UNIT - III: Pharmaceutical Biotechnology**
Monoclonal Antibodies Production (Hybridoma Technology) – Pharmaceutical products of DNA Technology – Insulin, Human Growth hormone, Interferon. Recombinant vaccines (Subunit, DNA and Attenuated vaccines).

**UNIT - IV: Molecular Markers and Gene Therapy**
Diagnosis of genetic disorders by RFLP, PCR, OLR assay and Northern, Southern and Western Blotting – Treatment of Cancer – Bone marrow transplantation – GVH diseases, Gene Therapy: *Ex vivo* and *in vivo* gene therapy, Embryonic stem cell methods, Gene silencing.

**UNIT - V: Nanobiotechnology**
Introduction to Nanobiotechnology – Nanobiotechnological devices – Types and applications of Nanobiosensors - Drug delivery technologies – Cancer diagnosis and therapy – Preparation and uses of DNA microarrays.

**Reference Books**
UNIT - I: Characteristics of Microorganisms
General Features and Classification of Bacteria, Virus, Yeast, Actinomycetes and Fungi.
Structure of Bacteria (E. coli) - Structure of Virus: T4 Bacteriophage, Adenovirus.

UNIT - II: Culture Techniques
Bacterial growth and nutritional requirements - Types of culture media - preparation of culture media - methods of maintenance of culture - culture characteristics of bacteria: Gram’s staining techniques.

UNIT - III: Food Microbiology
Microbial examination of food – Food Spoilage (Meat, Fish, milk, egg, and bread) – Food Poisoning (Botulism, Staphylococcal poisoning, and Mycotoxicosis) – Food Preservation – Bacteriology of Milk – Bacteriological examination of Milk – Pasteurization of Milk.

UNIT - IV: Industrial and Agricultural Microbiology
Fermentation technology – Stages of fermentation - Fermentation products (alcohol, vinegar, pharmaceuticals, organic acids, amino acids, and fuels).
Biological nitrogen fixation; Nif genes, Nitrogen fixers – Bio fertilizers (Rhizobium, Azotobacter, Azospirillum, VAM) - Bio pesticides (Bacterial, Fungal, Viral).

UNIT - V: Medicinal Microbiology

Reference Books
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A. ANIMAL PHYSIOLOGY

Quantitative estimation of amylase activity.
Quantitative estimation of ammonia and urea.
Rate of salt loss and salt gain in fish using different experimental media.

B. BIOTECHNOLOGY

Demonstration of Agarose gel electrophoresis, SDS PAGE
Spotters: Models of PCR, Southern Blotting, Vectors.

C. MICROBIOLOGY

Culture techniques: Culture of bacteria – Bacterial growth curve- Antibiotic sensitivity (Gram staining +ve and –ve), Differential staining. Preparation of culture media- Agar medium.
Serial dilution technique & pour plate. Culturing of bacterial broth, slants, plating, streaking.
Spotters:- Inoculation loop – Autoclave – Laminar flow hood.
Analysis:- Estimation of coliform bacilli in sewage water and drinking water, Replica plating.

Reference Books:

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BIO-STATISTICS

UNIT – I: Sampling and Presentation of data

UNIT – II: Testing Hypothesis
Test of hypothesis and test of significance (Null hypothesis and Alternative hypothesis): Student’s t test (paired and unpaired tests). Chi square test, One way and two way analyses of variance (F-values) – Regression analysis.

BIOINFORMATICS

UNIT – III: Bioinformatic Tools
Bioinformatics: Definition, Scope, Data base, Sequence Databases – Nucleotide and Protein. Sequencing Analysis: Genomics and Proteomics, Tools of Bioinformatics: FASTA and BLAST format, NCBI, GENE BANK.

UNIT – IV: Biological Sequence Analysis
Biological sequence analysis: Pair-wise sequence alignment (Dot matrix method), Dynamic programming (Optimal global alignment and optimal local alignment) – Word method. Multiple sequence alignment (dynamic programming, progressive method, and iterative method). Database - Drug Discovery.

UNIT- V: Phylogenetic Analysis
Homology, Phylogeny and Evolutionary Tree: Homology and Similarity, Phylogeny and relationships, Molecular Approaches to Phylogeny and Phylogenetic Analysis.

Reference Books:
UNIT – I: Reproduction and Assisted Reproductive Technologies
Ultra structure of human sperm and egg. Fertilization - Activation of egg cytoplasm, Infertility (Male and Female) - Artificial Insemination, Intra Cytoplasmic Sperm Injection, Gamete Intra Fallopian tube Transfer, Embryo Transfer, Invitro Fertilization.

UNIT – II: Metamorphosis and Regeneration

UNIT – III: Cell Differentiation

UNIT – IV: Origin of Life and its Theories
Origin of Life: Process and Theories. Population genetics and evolution: Classical model hypothesis, Balance model hypothesis, Natural mutation model hypothesis, Genetic drift. Selection in action in evolution

UNIT – V: Adaptive patterns and Speciation

References
UNIT – I: Proteins and Lipids
Lipids : Classification, Fatty acids, Triglycerides, Compound lipids, Phospholipids, Sphingolipids, Glycolipids, Steroids, Prostaglandins, Oxidation of fatty acids and Ketosis.

UNIT – II: Carbohydrates
Classification – Structure and Properties of monosaccharides, disaccharides (Maltose, Lactose, Sucrose), and polysaccharides (Starch, Glycogen, Chitin, Proteoglycan, Glycoproteins) – Acid Mucopolysaccharides. Biosynthesis of Glycogen, Glycolysis, Kreb’s cycle, HMP pathway, and Gluconeogenesis.

UNIT – III: Enzymes and Hormones
Hormones: Hypothalamic releasing hormones and function. Mechanism of hormone action, Peptide hormones, Adenylate cyclase, cyclic AMP mechanism- Ca++, Phosphoinositol, Steroid hormones and Transcriptional control.

UNIT – IV: Thermodynamics and Radioactive isotopes
Concept of free energy: Laws of Thermodynamics, Biological energy transducers. Radiation biophysics, Ionizing radiation, Interaction of radiation with matter, Measurement of radiation (Dosimetry), Radioactive isotopes (Radio nuclides), Biological effects of radiation, Radiation protection and Therapy.

UNIT – V: Microscopy and Spectroscopy

References
SYLLABUS
(For Candidates to be admitted from 2016 Onwards)
PG DEPARTMENT OF ZOOLOGY, NATIONAL COLLEGE (AUTONOMOUS)

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**Developmental Biology**

Preparation of sperm suspension in frog / bull and observation of the spermatozoa, Sperm motility study in frog semen. Storage methods (Theory).
Effect of thyroxin or iodine on metamorphosis of frog (Demonstration only).
Spotters: Regeneration in Tadpole, Frog spermatozoa, and Cryopreservation tank.

**Evolution**

Spotters: Fossils (Nautiloid, Ammonoid, and Trilobite).

**Biochemistry**

Preparation of solutions – normality, molarity, percentage.
Buffer preparation – determination of pH using pH meter and Paper
Quantitative estimation of amino acid, protein, carbohydrate and lipids in tissue samples.

**Biophysics**

Colorimeter : Determination of optical density of samples using standards. Draw a standard curve.
Experimental verification : Beer and Lambert’s law.
Chromatography – Separation of aminoacids in different samples (Paper) and TLC
Electrophoresis: Separation of serum proteins (Demonstration only).
UNIT – I: Introduction to Aquaculture
Scope of Aquaculture, Cultivable species of fishes and shrimps, Advantages of Aquaculture, Production trends - National and International Scenario.

UNIT – II: Hatchery and Farming Techniques

UNIT – III: Ornamental fish and Pearl Oyster culture
Requirements for an aquarium – Aquarium fishes (Gold, Angel, Fight, Koi, Tiger Barb). Types of pearls - Pearl oyster culture.

UNIT – IV: Farm management

UNIT – V: Fish diseases and Government Organisations
Protozoan diseases (White spot, Whirling disease, Cryptobiosis.) - Fungal diseases (Fungal Gill Rot, Saprolegniasis) - Bacterial diseases (Bacterial Gill Rot, Erythroderma, Enteritis) - Viral Diseases (Epizootic Ulcerative Syndrome, Infectious Pancreatic Necrosis, Infectious Dropsy). Government organizations : MPEDA, CIBA, CIFAn, NIOT, NIO and CMFRI.

References
UNIT – I: Environmental Factors and Animal Relationships

UNIT – II : Ecosystem Ecology

UNIT – III: Population Ecology and Biodiversity

UNIT – IV: Applied Ecology
Pollution: Types, Biological effects and control. Air pollution, Water pollution, Sewage and Solid waste disposal and management, Green House Effect, Ozone layer and its significance. Global warming, Acid rain. Biomagnification, Eutrophication, Environmental Impact Assessment (EIA), Biological indicators and their role in environmental monitoring, Bioremediation, Biodegradation of heavy metals and oil pollution.

UNIT – V: Radiation Biology
Scope of Radiation Biology – Sources of natural radiation (Terrestrial and cosmic) - Types of radiation (Alpha, Beta & Gamma) - Properties of Radiation (external emitters and internal emitters) - Man made radiation: Medical (occupational, diagnostic) - Nuclear activities (Nuclear fuel cycle, Nuclear test, Nuclear accidents, Mining) – Radiation Units (Becquerel, RAD, Gray & Curie).

Reference Books
UNIT – I: Lymphoid organs

UNIT – II: Antigens and Immunoglobulins
Antigen: Antigenic determinants, Types.
Antibody: Immunoglobulins – structure and functions.
Complement: Nomenclature, classification activation and function.

UNIT – III: Immune response
Immune response: Primary and secondary, Mechanism of humoral and cell mediated., Immunity to infections- bacterial and viral. Immunoprophylaxis: Toxoids and Vaccine, Immunization schedule.

UNIT – IV: Immune Disorders

UNIT – V: Immunotechniques
Antigen-Antibody reactions – Precipitation reaction (Immunodiffusion, Immunelectrophoresis), VDRL test. Agglutination reaction (Slide and Tube Agglutination), Widal test - Immunofluorescence. Radioimmunoassay, Enzyme Linked Immunosorbant Assay (ELISA).

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UNIT – I: Insects Taxonomy and Morphology

UNIT – II: Physiology of Insects

UNIT – III: Physiology of Insects
Excretory system: Malpighian tubules and their functions
Nervous system: Structure, Neurotransmitters, Structure and function of compound eye.
Reproductive system: Male and female reproductive systems.
Endocrine system: Endocrine control of moulting and metamorphosis, Role of hormones in male and female reproduction. Neuroendocrine system of insects.

UNIT – IV: Economic importance of insects
Biology of honey bee, Silk moth and Lac insect. Culture methods (Apiculture, Sericulture, Lac culture) and problems related to their cultures.
Biology, damage caused and control methods of common insect pests of agricultural importance: Paddy, Sugarcane, Coconut, Brinjal and Pests of stored products.

UNIT – V: Pest Control Methods

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UNIT – I: Wildlife Conservation
Wildlife concept, Importance of Wildlife conservation:- ecological, ethical, educational, scientific, commercial, aesthetic, and recreational.
Conservation methods:- In situ conservation-sanctuaries, national parks, biosphere reserves, Ex situ conservation-captive breeding, modern zoo, safari, nocturnal zoo.

UNIT – II: Inventory studies of animals
Inventory studies:-Total species list, total genera or families list, parallel-line searches, encounter rates, documenting rarities, sample collection: labeling, preservatives, collection of plants, collection of fungi, collection of invertebrates, collection of fishes, collection of amphibians, collection of reptiles, collection of birds and collection of mammals.

UNIT – III: Conservation priorities

UNIT – IV: Wildlife census techniques

UNIT – V: Conservation projects

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A dissertation should be submitted.