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GUJARAT UNIVERSITY, AHMEDABAD.

ZOOLOGY (NEW COURSE)

M.SC PART II

PAPER - IV

DEVELOPMENTAL BIOLOGY, ANIMAL BEHAVIOUR AND EVOLUTION

1. Developmental Biology:
Historical review:
Cytophysiology of gametes.
- Fertilization - Natural and Artificial, in-vitro fertilization and embryo transfer.
- Cleavage patterns, Gastrulation. Fate maps and their significance,
- Embryonic Induction, Inductors, chemical nature of induction,
- Formation of rudimentary organs of chordates
Gradients.
- Organogenesis.
- Differentiation and development:
Cytological, genetical and chemical basis of differentiation and its regulation; Epithelial - mesenchymal interaction.
Embryological development of Amphioxus, Frog, Chick and Mammal.
Growth patterns: Dynamics of growth; Types; Physiological mechanisms.
Regeneration: In non-chordates and chordates; Factors affecting regeneration; Regeneration fields.
Physiological gradients and polarity concerned with regeneration.

2. Animal Behaviour:
   1. Introduction of Ethology.
   2. The sensory world of animals:
      Behavioural Equipment (Senses, Organs).
   3. Patterns of Behaviour.
      a) Individual behavioural pattern.
      b) Homing behaviour.
   4. Genetics of Behaviour:
      a) Genetic basis of behaviour.
      b) Learning behaviour.
   5. Evolutionary approach to behaviour; Levels of natural selection.
   6. Reproductive behavioural patterns:
      a) Courtship and ritual behaviour.
      b) Mating.
      c) Parental investment.
      d) Stickle back behaviour.
   7. Social organization:
      a) Dominance Hierarchies.
      b) Social competition.
      c) Territoriality.
   8. Individual social interactions:
      a) Animal Communications.
      b) Dance Language of the honey bees.
      c) Aggregation.
      d) Social facilitation.
   9. Comparative aspects of learning:
      a) Definition and forms of learning behaviour; Development of learning.
      b) Mechanisms of learning.
      c) Imprinting.
   10. Human ethology - General aspects.

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3. Evolution:
Concept of Evolution; Origin of Life on Earth;
Origin of prokaryotic and eukaryotic cells;
Sources of evolution,
Variations; Role of Mutations; Recombination, Polyploidy;
Isolation; Natural selection, Evolution in Action;
Species concept and speciation, Molecular phylogeny;
Mimicry; Polymorphism, population Genetics;
Genetic Drift;
Hardy - Weinberg Law;
Tempo of Evolution, Macro and Micro-Evolution.
Evolution of Man
Trends in Evolution
Evolution - Future prospects

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ZOOLOGY (NEW COURSE)

GUJARAT UNIVERSITY, AHMEDABAD.

M.SC. PART - II

ZOOLOGY

SPECIAL PAPER V

MOLECULAR CELL BIOLOGY, CYTOGENETICS AND BIOTECHNOLOGY

1. The evolution of the cell:
   - From molelcules to first cell.
   - From prokaryotes to Eukaryotes.
   - From single cells to multicellular organisms.
   - Cell colony, cell cohesion, cell-cell communication, internal environment or homeostasis of cell.

2. Small molecules, Energy and biosynthesis:
   Sugars, fatty acids, amino acids and nucleotides.

3. Macromolecules: Structure, shape and information:
   - Protein structure and function.
   - Nucleic acids and function.

4. How cells are studied:
   a) Microscopy:
      Phase contrast and Fluorescence
      - Special EM Techniques - SEM, High resolution EM.
      - Freeze fracture and freeze etch techniques.
      - Negative staining and cryoelectron microscopy.
      - X-ray diffraction.
      - Immunofluorescence.
      - Image Analysis technique.
   b) Cell separation, Fractionation, and Culture:
      - Centrifugation- density gradient, differential and ultra-centrifugation.
      - Chromatography - Paper, TLC, HPLC.
      - Electrophoresis SDS PAGE, 2-D PAGE, Capillary Electrophoresis
      - Cell, tissue and organ culture, suspension and monolayer cultures.
   c) Study of cell using tracer techniques with Radioactive isotopes and antibodies.
      - autoradiography.
   d) - DNA separation/isolation.
      - DNA sequencing.
      - Southern and Northern blotting, Western Blotting.
      - In-situ hybridization technique.
   e) Other methods: Flow cytometry.

5. Molecular organization and functions of:
   - Plasma membrane.
   - Mitochondria.
   - Golgi complex.
   - Endoplasmic reticulum.
   - Ribosomes.
   - Lysosomes and disease.
   - Peroxisomes.
   - Nucleus, Nucleolus.
   - Cytoskeleton: Microtubules and Intermediate filaments.
   - Cell adhesions, and cell junctions.

6. Dynamics of cell growth and Division:
   - Cell cycle, Cell division -molecular aspects, mechanics, regulation.
   - Cell growth; Growth factors.

7. Cellular interaction:
   - Cell - Cell communication, receptor ligand interaction; Signal transduction, role of second messengers and G-proteins;
   - Ion, Calcium channels.
   - Extra and Intra cellular interactions.
   - Cell aggregations.
   - Cell ageing and senescence.

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M.SC. PART-II

ZOOLOGY

SPECIAL PAPER V

MOLECULAR ENDOCRINOLOGY AND REPRODUCTIVE PHYSIOLOGY

Chemical Nature of hormones:
Steroid hormones.
- Amino acid derived hormones.
- Peptide hormones.
- Biogenic amines.

Biosynthesis, Storage, and Metabolism of hormones:

Origin and evolution of hormones.

Homeostasis and feed back regulation of hormones.

Mechanism of hormone action:
- Membrane bound and intracellular receptors, steroid hormone-receptors, hormone receptor interaction and signal transduction.
- Second messengers in hormone action.
- Role of cyclic nucleotides, C-AMP- Ca^{2+} interaction.
Receptopsomes and recycling of receptors.

- Neuro Endocrine integration.
- Role of classic and peptide neuromediators in the neuroendocrine regulation of anterior pituitary hormonal release.
- Hypothalamo - hypophysial complex.
- Role of pineal in transduction of environmental cues.
- Neurcendocrine inter-relationships in regulation of seasonal reproduction.
Rhythms in reproduction
- Role of hypothalamus and the higher brain centres.

Extragonadal influences in reproduction.
- Thyroid
- Adrenal
- Prostaglandins

Hormones of extra endocrine sites.
- GI tract
- Kidney
- Heart
- Lung
- Liver

Hormonal regulation of metabolism:
- Carbohydrate, Lipid, Water and electrolyte balance, mineral metabolism, Osmoregulation.

Hormonal control of:
- Migration, aestivation, hibernation, pigmentation.
- Reproductive behaviour and its control.
- Male and female sexual behaviour;
- Maternal behaviour
- Endocrine basis of communication in reproduction and aggression.
- Pheromones and mammalian reproduction.

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M.SC. PART-II

ZOOLOGY

SPECIAL PAPER - V

FISHERY SCIENCE AND WILDLIFE

Unit-1:

- General characters and classification of fishes with distinguish characters and important examples of the principal sub-divisions.
- Methods of fish and prawn identification.
- Marine capture fisheries including crustacean and molluscan fisheries.
- Inland capture fisheries.
- Exclusive Economic Zone (EEZ).
- Seaweeds of economic importance;

Unit-2:

- Population, growth and age.
- Spawning and Fecundity.
- Methods of fishing
- Techniques employed in preservation of fish and prawn.
- Fish Transport and Marketing in India.
- Fish conservation and management.

Unit-3.

- Food, Feeding and Breeding habits.
- Life histories of important cultivable species of freshwater and brackishwater fishes and prawns.
- Natural, wet and dry bundh techniques for breeding of Indian major carps; Induced Breeding in carps.
- Brief review of piscicultural practices in southeast Asia.
- Fish, prawn and pearl culture methods used in India.
- Status and potential of mariculture in India.

Unit-4.

- Fish pathology - symptoms, aetiology, prophylaxis and treatment of common diseases.
- Exotic fishes.
- Larvivorous fishes.
- Adaptations in fishes.
- Fish as food.
- Fish products and byproducts.

Unit-5.

- Major fishery exports from India.
- Fisheries education, training and extension in India.
- Fishermen communities and organisation of fisheries cooperatives.
- Legislation.
- Sea exploration.
- Fisheries by 2000.

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M.SC. PART-II

ZOOLOGY

SPECIAL PAPER - V

ENVIRONMENTAL AND ANIMAL TOXICOLOGY

1. General principles:
Introduction to toxicology, Principles of toxicology, Definition of toxicity and related terminology, Types of toxicity, Factors affecting toxicity, Acute, Sub-acute and chronic toxicity, Classification of toxicants, Criteria for selection of chemical for testing, Dose, Dose-response curves, Toxicity testing route of administration, Absorption, Distribution, excretion, Metabolism and biotransformation of xerobiotics.

2. Toxic Agents and mode of action:
(1)Pesticides, (2)Metals, (3)Solvents and vapours, (4)Radiation and Radioactive materials, (5)Chemical carcinogens, (6)Teratogens, (7)Poisons and Toxins of animal and plant origin.

3. Environmental Toxicology:
Food additives and contaminants air pollutants, Water and soil pollutants, Inhalation toxicology, Synthetics biomaterials.

4. Principles of systemic toxicology:
Toxicology of blood, Cutaneous, Development, Endocrine, Reproductive systems, Immune system, Intestinal, Liver, Kidney, Nervous system, Sense organs.
-Genotoxicology:
-Principles, Mutagenesis, Mutagens carcinogenesis-

5. Statistical methods in toxicology.

6. Toxic residues and analysis:
- Persistence.
- General procedures and techniques.

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M.SC. PART-II

ZOOLOGY

SPECIAL PAPER VI

MOLECULAR CELL BIOLOGY, CYTOGENETICS AND BIOTECHNOLOGY

1. Organisation of the genome:
DNA, Histones, non-histone proteins, nucleosomes; heterochromatin and euchromatin;
Chromosome identification; karyotyping.

2. Genetic disorders:
Chromosome number; chromosomal aberrations, and variation chromosomes and disease; chromosomes and evolution;

3. Molecular genetics:
Chemistry of the gene;
DNA replication; DNA modification, restriction and repair mechanism.
DNA synthesis.
Transfer of information from DNA,
Gene expression and regulation of gene expression in eukaryotes.
Isolation of gene.

4. Biotechnology:
Overview, scope and importance;
Recombinant DNA Technology and Gene cloning; Vectors, restriction enzymes, molecular probes; construction & screening of gene libraries: genome library, DNA library. PCR system and gene amplification, RELP analysis and restriction mapping, DNA fingerprinting.
Chromosome walking; chromosome jumping.

5. Biotechnology in Medicine and Biology:
Transfection methods and transgenic animals; Production of hormones, Vaccines; Gene therapy.

6. Immunogenetics and Immunotechnology:
Immunoglobulins; Types, fine structure, generation and functional properties, cellular diversity in immune response; Hybridoma technology.
- Cellular basis of immunity.

7. Cell transformation:
- Characteristics and molecular genetics of cancer; Oncogenes, retroviruses.

8. Effects of radiations, Chemicals, mutagens, pollutants, drugs and toxins on the cell.

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M.SC. PART-II ZOOLOGY

SPECIAL PAPER VI

MOLECULAR ENDOCRINOLOGY AND REPRODUCTIVE PHYSIOLOGY

- Embryology of the gonads and the genital ducts:
- Factors controlling sex determination.
- Genetic control of sex determination.
- Endocrinology of the foetal gonads.

Structure and function of the adult mammalian ovary.
- Histology.
- Folliculogenesis and its hormonal control.
- Ovogenesis; The mammalian ovum.
- Follicular steroidogenesis and its control.

Follicular selection and its control.
- Ovulation; Mechanisms; Hormonal factors.
- Luteinization.

Corpus luteum and its control:

Factors regulating luteolysis:

Local non-steroidal regulators of ovarian function
Inhibin; relaxin
Reproductive cycles and their hormonal regulation.
- exteroceptive and enteroceptive factors.
- Gamete and Zygote transport.

Biology of implantation:
- Nidation, decidualization.
- Placentation and its regulation
- Types of placentation
- Placental hormones and their regulation
- Foetoplacental unit as an endocrine entity.

Parturition and its regulation:
Structure of mammary gland
- Hormonal regulation of its development and differentiation.
- Maintenance of lactation.
- Suckling and control of gonadotropin secretion.
- Ovarian and adrenal functions during lactation.

The Male reproductive System:
- Structure and function of the adult mammalian testis.
- Spermatogenesis and its hormonal control.
- Sertoli Cells:
  endocrine/paracrine functions of the Sertoli cells; interactions in spermatogenesis.
- Structure and functions of Leydig cells, interactions between peritubular cells, Leydig cells and Sertoli cells in relation to spermatogenesis.
  Testicular steroidogenesis.
- Structure, function and regulation of male accessory, reproductive organs, Efferent ducts, epididymis, vas deferens,
- Seminal vesicles, coagulating gland, prostatic complex, Cowper's gland, preputial gland.
- Structure of sperm, biochemistry of semen, capacitation of spermatozoa.
- Fertilization, acrosome reaction.
- Tests for sperm viability and function.
- Onset of puberty.
- Reproduction and senescence
- Principles and techniques of fertility regulation in male and female.

SPE. PAPER VI -MOLECULAR ENDOCRINOLOGY AND REPRODUCTIVE PHYSIOLOGY:

- Immuno contraception, gamete antigens, hormonal antigen.
- Designing experiments for the study of breeding and fertility of laboratory animals, Care of Laboratory animals.
- Surgical techniques in the study of mammalian reproduction.
- Principles of bio-assay and application.
- Techniques of RIA, EIA and radio receptor assay.
- In-vitro fertilization, embryo transfer technique, collection and preservation of gametes.
- Use of polyclonal and monoclonal antibodies in the study of reproduction.

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M.SC. PART-II

ZOOLOGY

SPECIAL PAPER - VI

FISHERY SCIENCE AND WILDLIFE

Unit-1:
- Classification of mammals and review of major groups with reference to Wildlife - Primates, Carnivora, Artiodactyla, Perissodactyla and Proboscidea.
- Review of Indian Avifauna - inland, coastal, resident and migratory birds.
- Wildlife habitat definition and importance of habitat studies. Habitat requirements of important wildlife species of India.
- Habitat Suitability Index (HSI).
- Habitat Evaluation Procedures (HEP).
- Habitat Mapping.

Unit-2:
Ecological sub-divisions of Indian Wildlife:
- Himalayan mountain systems
- Indian deserts
- Peninsular India
- Tropical evergreen forests
- Andaman and Nicobar Islands
- Mangrove forests
- Methods of studying birds and mammals in their natural habitats

Unit-3:
- Wildlife management in important National Parks, Sanctuaries and Biosphere Reserves of India.
- Wildlife management in Protected Areas of Gujarat
- Endangered and threatened species
- International Trade in Endangered species
- Causes of Wildlife depletion
- Legislation - Wildlife Protection Act and Forest Act.

Unit-4:
- Wildlife management
- Instruments used for management
- Identification of damage and control measures
- Afforestation
- Social forestry
- Wasteland and Pasture Development Projects in India

Unit-5:
Wildlife conservation projects of Government of India, their scope and success:
- Great Indian Bustard and Lesser Florican Projects
- Project Tiger
- Gir Lion Project
- Hangul Project
- Crocodile Project
- Musk Deer Project

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M.SC. PART-II

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ZOOLOGY

SPECIAL PAPER - VI

ENVIRONMENTAL AND ANIMAL TOXICOLOGY

1. Application of toxicology:
   a) Analytical toxicology.
   b) Clinical toxicology.
   c) Occupational toxicology.
   d) Forensic science.
   e) Wild life.
   f) Reproductive.
   g) Industrial.

2. Eco-toxicology:
   (A) Biogeochemical cycles.
   - Carbon cycle.
   - Phosphorus cycle.
   - Nitrogen "
   - Oxygen "
   - Ozone depletion.
   - Greenhouse effect.
   - Global warning
   - Acid rain.

3. Influence of human activities on Environment:
   - Industrialization.
   - Deforestation.
   - Pollution - air & water.

4. Environmental Policy - Social, economic and legal aspects. Consumer product safety Commission.

5. Environmental impact assessment.

6. National and International standards of tolerance and residual levels of pollutants and contaminants. Regulatory Toxicology.

7. Human Toxicology and Medical Ethics:
   1. Ethical considerations.
   2. Human Health.
   3. Monitoring for exposure.