

**Kazi Najrul University**  
**POST GRADUATE SYLLABUS**  
 Department of Zoology  
**With Effect From 2016-2017**

*Summary of the course and credits*

	Core Course		Major Elective Course		Minor Elective Course	Project / Dissertation	Community Outreach Programme	Total credits
	Theory	Practical	Theory	Practical				
<b>Semester - I</b>	16	8	-	-	-	-	-	24
<b>Semester - II</b>	12	6	-	-	4	-	2	24
<b>Semester - III</b>	16	8	-	-	-	-	-	24
<b>Semester - IV</b>	4	2	12	4	-	2	-	24
<b>Total</b>	<b>48</b>	<b>24</b>	<b>12</b>	<b>4</b>	<b>4</b>	<b>2</b>	<b>2</b>	<b>96</b>

**Core Courses:** Every student will take only core courses in the Semesters I and III while they will take elective and other courses in the Semesters II and IV

**Major Elective Courses (Specialization):** Students will opt **one** out of the Major Electives offered by the PG department

**Minor Elective Courses (Interdisciplinary Course):** M.Sc. Zoology students will opt one Minor Elective course of 4 credits in the Semester II offered by other PG Departments

**Community Outreach Programme:** Student will undertake a community outreach programme of 2 credits in the Semester II based on the Major Elective course

**Term Paper/Project Work:** Students will submit one Term paper/Project work of 2 credits based on Major Elective Course in the Semester IV.

**SEMESTER - I [Credits - 24]**

Course Code	Courses	Units	Marks	Credits
MZGT-101	Core/Compulsory Theory	Unit I: Biosystematics and Taxonomy	25	2
		Unit II: Evolution and Population Genetics	25	2
MZGT-102	Core/Compulsory Theory	Unit I: Comparative Anatomy	25	2
		Unit II: Histology and Histochemistry	25	2
MZGT -103	Core/Compulsory Theory	Unit I: Fundamentals of Biochemistry	25	2
		Unit II: Metabolism	25	2
MZGT-104	Core/Compulsory Theory	Unit I: Cell Biology	25	2
		Unit II: Genetics	25	2
MZGP-105	Core/Compulsory Practical	Unit I: Practicals based on 101	25	2
		Unit II: Practicals based on 102	25	2
MZGP-106	Core/Compulsory Practical	Unit I: Practicals based on 103	25	2
		Unit II: Practicals based on 104	25	2

**SEMESTER II [Credits – 24]**

<b>Course Code</b>	<b>Courses</b>	<b>Units</b>	<b>Marks</b>	<b>Credits</b>
MZGT-201	Core/Compulsory Theory	Unit I: Ecology	25	2
		Unit II: Behavioural Biology	25	2
MZGT-202	Core/Compulsory Theory	Unit I: Physiology	25	2
		Unit II: Endocrinology	25	2
MZGT-203	Core/Compulsory Theory	Unit I: Molecular Biology	25	2
		Unit II: Immunology	25	2
MZMI-204	Minor Elective (from other discipline)	Minor Elective	50	4
MZGP-205	Core/Compulsory Practical	Unit I: Practicals based on 201	25	2
		Unit II : Practicals based on 202	25	2
MZGP-206	Core/Compulsory Practical	Practicals based on 203	25	2
MZGP-207	Core/Compulsory Practical	Community outreach (Students will undertake any community service and submit a report that will be evaluated by the internal examiners)	25	2

**SEMESTER III [Credits – 24]**

<b>Course Code</b>	<b>Courses</b>	<b>Units</b>	<b>Marks</b>	<b>Credits</b>
MZGT-301	Core/Compulsory Theory	Unit I: General Entomology	25	2
		Unit II: Applied Entomology	25	2
MZGT-302	Core/Compulsory Theory	Unit I: General Parasitology	25	2
		Unit II: Medical Parasitology	25	2
MZGT-303	Core/Compulsory Theory	Unit I: Fish Biology	25	2
		Unit II: Aquaculture	25	2
MZGT-304	Core/Compulsory Theory	Unit I: Toxicology	25	2
		Unit II: Microbiology	25	2
MZGP-305	Core/Compulsory Practical	Unit I: Practicals based on 301	25	2
		Unit II : Practicals based on 302	25	2
MZGP-306	Core/Compulsory Practical	Unit I: Practicals based on 303	25	2
		Unit II: Practicals based on 304	25	2

**SEMESTER IV [Credits – 24]**

<b>Course Code</b>	<b>Courses</b>	<b>Unit</b>	<b>Marks</b>	<b>Credits</b>
MZGT-401	General Theory	Unit I: Developmental Biology	25	2
		Unit II: Biostatistics and Computational Biology	25	2
MZJT-402	Major Elective Theory	MAJOR ELECTIVE I	50	4
MZJT-403	Major Elective Theory	MAJOR ELECTIVE II	50	4
MZJT-404	Major Elective Theory	MAJOR ELECTIVE III	50	4
MZTP-405	Term paper / Project work	Based on Major Elective opted	25	2
MZGP-406	Core/Compulsory Practical	Practicals based on 401	25	2
MZJP-407	Major Elective Practical	Based on Major Elective opted	50	4

ACRONYMS: M: M.Sc.; MZGT: **Z**OOL**O**G**O**LOGY **G**ENERAL **T**HEORY; MZGP: **Z**OOL**O**G**O**LOGY **G**ENERAL **P**RACTICAL; MZMI: **Z**OOL**O**G**O**LOGY **M**INOR **E**LECTIVE; MZCO: **Z**OOL**O**G**O**LOGY **C**OMMUNITY **O**UTREACH; MZJT: **Z**OOL**O**G**O**LOGY **M**AJOR **E**LECTIVE **T**HEORY; MZTP: **Z**OOL**O**G**O**LOGY **T**ERM **P**APER / **Z**OOL**O**G**O**LOGY **P**ROJECT **W**ORK; MZJP: **Z**OOL**O**G**O**LOGY **M**AJOR **E**LECTIVE **P**RACTICAL

**Unit – I: BIOSYSTEMATICS AND TAXONOMY**

**Full Marks: 25**  
**Lectures: 35**

<i>Taxonomy</i>	2L
History and Importance	
<i>General concepts</i>	4L
Micro- and Macro-taxonomy	
Levels of taxonomic study	
<i>Concepts of species</i>	15L
Types –Typological, Biological and Evolutionary	
Kinds of species, Taxonomic types	
Hierarchy	
<i>New trends in taxonomy</i>	10L
Biochemical, Cytological & Molecular	
<i>Zoological nomenclature</i>	4L
Rules of Nomenclature	

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**Unit –II: EVOLUTION AND POPULATION GENETICS**

**Full Marks: 25**  
**Lectures: 35**

**Population Genetics**

<i>Molecular Population genetics</i>	6L
Neutral theory	
Molecular evolution and Phylogenetics	
<i>Variation and Evolution</i>	10L
Genetic variation in population (Morphological, Chromosomal and Biochemical)	
Quantification of genetic variation in populations	
<i>Quantitative genetics</i>	9L
Hardy–Weinberg equilibrium – Testing population samples	
Factors affecting Hardy – Weinberg equilibrium	

**Evolution**

<i>Natural Selection</i>	8L
Darwinian fitness	
Genetic burden or load	
Polymorphism and balancing Natural Selection	
Diversifying natural selection with examples.	
<i>Macro and Micro evolution</i>	12L
Evolutionary pattern and rate	
Isolating mechanisms and speciation	
Punctuated equilibrium	

**Unit – I: COMPARATIVE ANATOMY**

**Full Marks: 25**  
**Lectures: 35**

<i>Comparative study of invertebrates</i>	
Digestive system	4L
Nervous system	4L
Reproduction and Larval forms	3L
<i>Comparative study of vertebrates</i>	
Stomach	2L
Respiratory system	4L
Brain and sense organs	8L
Thyroid and Adrenal glands	4L
<i>Development, uses and comparative account in vertebrates</i>	
The integument and its derivatives (except glands)	6L

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**Unit –II: HISTOLOGY AND HISTOCHEMISTRY**

**Full Marks: 25**  
**Lectures: 35**

<i>Fixation and related procedures</i>	8L
Types of fixation, Fixation process; fixation of whole tissue; fresh-frozen sections; Decalcification	
<i>Embedding</i>	2L
Gum-sucrose/gelatin and paraffin wax embedding	
<i>Microtomy</i>	3L
Methods, problems and remedies of microtomy including cryostat and freezing microtome	
<i>Structure and function</i>	
Tongue, Intestine and Thymus	6L
<i>Biological dyes and stains</i>	8L
Properties, source and use of haematoxylin, eosin and carmine	
<i>Theoretical basis and application of following histochemical methods:</i>	8L
PAS/AB test for carbohydrates	
Fuelgen reaction for DNA	
Metallic and Azo dye methods for alkaline and acid phosphatase, adenosine tri-phosphatase	

**Unit – I: FUNDAMENTALS OF BIOCHEMISTRY**

**Full Marks: 25**

**Lectures: 35**

<i>Bioenergetics</i>	3L
Laws of thermodynamics and its relevance to biological systems. High-energy phosphate bonds and its role in energy capture and transfer	
<i>Proteins</i>	6L
Amino acid structure of protein Primary and higher orders of protein Protein folding Nitrogenase system	
<i>Enzymes</i>	4L
Classification and general properties Kinetics Mechanisms of enzyme action (chymotrypsin) Regulation of enzyme activities.	
<i>Carbohydrates</i>	8L
Carbohydrates of physiologic significance	
<i>Lipids</i>	8L
Lipids of physiologic significance, membrane lipids, cholesterol	
<i>General topics</i>	6L
Pumps and membrane channels	

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**Unit –II: METABOLISM**

**Full Marks: 25**

**Lectures: 35**

1. Overview of metabolism and metabolic fuels
2. Enzymes: Catalytic & regulatory strategies
3. Glycolysis & Krebs cycle: Pathway & regulation
4. Oxidative metabolism: electron transport chain, oxidative phosphorylation
5. Metabolism of Glycogen
6. Gluconeogenesis, control of blood sugar
7. Hexose monophosphate Shunt
8. Synthesis and Oxidation of fatty acids: Ketogenesis
9. Catabolism of proteins and amino acids
10. Metabolic strategies & integration of metabolic pathways

**Unit – I: CELL BIOLOGY**

**Full Marks: 25**  
**Lectures: 35**

<i>Gene and the genome</i>	6L
Complexity of the genome: eukaryotic genome	
C-value enigma. DNA reassociation kinetics, Cot curves, T <sub>m</sub> values	
Centromeric and telomeric DNA, Telomeric repeats and chromosome-end replication problem, rescue by telomerase	
<i>DNA replication in Eukaryotes</i>	4L
Components and mechanics	
<i>Cell cycle Kinetics</i>	4L
Labeling index and cell cycle duration measurement	
Cell synchronization and cell cycle inhibitors	
<i>Cell-cell communication</i>	7L
Cell signaling molecules	
Cell surface receptors and ion channels	
Signal transduction pathways (DAG and cAMP)	
<i>Cell cycle deregulation and cancer</i>	9L
Hallmark features of cancer	
Cancer critical genes and their role in tumourigenesis	
Carcinogenesis-Two hit- model of Knudson and multi- hit model of Vogelstein	
Cancer-Multifactorial disease	
Hybridoma technology and its application in monoclonal antibody production	
<i>Cell and its environment</i>	5L
Mutagens, clastogens, carcinogens and teratogens	
Mutagenicity test protocols, mammalian <i>in vivo</i> and <i>in vitro</i> test protocols	

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**Unit –II: GENETICS**

**Full Marks: 25**  
**Lectures: 35**

<i>Techniques in molecular genetics</i>	9L
Restriction endonuclease and cloning of genes;	
Cloning vectors; production of recombinant DNA molecules;	
Construction and screening of genomic and cDNA library; DNA sequencing;	
PCR and RT PCR	
<i>Mutation</i>	6L
Molecular basis	
Mutations in human	
Cystic fibrosis	
<i>DNA repair and recombination</i>	6L
NER, PR, SOS, PRR and MMR	
Recombination nodule	
Cleavage and rejoining of DNA molecules	

Gene conversion	
<i>Mitochondrial genome</i>	3L
Comparison between mt-genome and human genome; mt-DNA and limited autonomy of mt-genome	
<i>Genomic imprinting</i>	5L
DNA methylation; genetic basis of human disease: Huntington's chorea	
<i>Human genome project</i>	6L
Methodologies	
Strategies and applications	
Ethics and social implications	



**Unit – I: TAXONOMY**

**Full Marks: 25**

1. Identification of specimens of major animal phyla and/or classes using the key
  2. Identification of specimens of major orders of class insecta using the key
  3. Construction of key from the provided dataset
  4. Retrieval of nucleotide sequences from data bases, sequence alignment
  3. Laboratory note Book
  4. Viva-voce
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**Unit –II: ANATOMY and HISTOLOGY & HISTOCHEMISTRY**

**Full Marks: 25**

1. ANATOMY
  - a. Afferent branchial system of Channa sp.
  - b. Ninth (IX) and tenth (X) cranial nervous system of Channa sp.
  - c. Digestive and nervous system of Vespa sp.
  - d. Nervous system of prawn
2. HISTOLOGY
  - a. Fixation, dehydration, embedding, section cutting, staining and mounting of different animal tissues. (Haematoxylin and Eosin, Mallory's Triple)
  - b. Identification of histological preparations of different animal tissues.
  - c. SEM demonstration
2. HISTOCHEMISTRY

Histochemical reactions for: Carbohydrates, Protein, Lipid, DNA/RNA and Alkaline phosphatases
3. Submission of permanent slides prepared for histological and histochemical studies of different tissues
4. Laboratory records
5. Viva-voce

**Unit – I: BIOCHEMISTRY**

**Full Marks: 25**

1. Biochemical estimation of protein (Lowry's method), DNA and RNA
2. Study of the enzyme kinetics
3. Study of the action of catalase, SOD and other enzymes
4. Separation of small molecules by dialysis
5. Desalting column chromatography (Gel Filtration)
6. TLC for separation of steroid and other secondary metabolites
7. Haemoglobin electrophoresis by cellulose acetate
8. Estimation of Lipid profile from blood
9. Biochemical detection of sugars by Osazone formation test
10. Separation of amino acids by paper chromatography
11. Laboratory note book
12. Viva-voce

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**Unit –II: CELL BIOLOGY & GENETICS**

**Full Marks: 25**

1. CELL BIOLOGY
  - a. Preparation of meiotic chromosomes from the Grasshopper testes: Identification of stages
  - b. Preparation of somatic chromosome (untreated and treated) from mouse/rat: Identification of chromosomes and determination of mitotic index
  - c. Preparation of polytene chromosomes from Chironomid/*Drosophila*/mosquito larvae: Identification of various land marks
  - d. Identification of slides on human chromosomal abnormalities and various genetic diseases
2. GENETICS
  - a. Identification of mutants of *Drosophila*, setting up of genetic crosses (monohybrid, dihybrid, test crosses; Detection of lethal mutation
  - b. Analysis of human pedigree and construction of pedigree chart
  - c. Analysis of human karyotypes
  - d. Isolation of DNA from *Drosophila*/mosquito /Rat/Goat (liver tissue)
3. Submission of prepared slides and Laboratory record.
4. Viva-voce

**Unit – I: ECOLOGY**

**Full Marks: 25**  
**Lectures: 35**

<i>The concept of ecosystem, the Gaia Hypothesis, stability in the ecosystem, ecological habitat and niche</i>	2L
<i>Factors of the environment</i>	3L
Concept of limiting factors	
Biotic factors: effects of predators, parasites and symbionts	
Abiotic factors: effects of temperature, moisture, light and fire	
<i>Population dynamics</i>	4L
Population attributes, growth forms, life tables,	
Density-dependent and density-independent factors in the population regulation, interspecific competition and coexistence,	
<i>Communities and biodiversity</i>	4L
Community organization and structure, relative abundance, species diversity, diversity indices and ecosystem development	
<i>Ecoenergetics and biogeochemical cycles</i>	5L
Concepts of primary productivity and secondary production, food-chains and food webs, energy flow through trophic levels;	
Global cycling of water, carbon and nitrogen	
<i>A brief survey of major Indian biomes</i>	3L
Tropical Rain Forests	
Mangrove ecosystem	
<i>Animal behaviour</i>	5L
Concepts of Ethology	
Stereotyped and acquired behaviour	
Social behaviour, altruistic behaviour, orientation and echolocation;	
Biological rhythms	
<i>Environmental pollution</i>	5L
Sources and effects of primary and secondary air pollutants, acid rain, green house effects, water pollution and its control, anti-pollution laws	
<i>Conservation ecology</i>	4L
Conservation of natural resources and wildlife	
<i>in situ</i> and <i>ex situ</i> conservations	
Red Data Book	
Conservation of wetlands	

**Unit –II: BEHAVIOURAL BIOLOGY**

**Full Marks: 25**  
**Lectures: 35**

<i>Ethology</i>	10L
Introduction to Ethology	
Proximate and ultimate reasoning	

Development of behavior	
Social communication and dominance	
Approaches and methods in study of behavior	
Altruism and evolution-group selection, kin selection, reciprocal altruism	
<i>Learning</i>	7L
Neural basis of learning, memory, cognition, sleep and arousal	
Biological clocks: Basic components, Functions and Regulations	
<i>Territoriality and foraging behaviour</i>	8L
Use of space and territoriality	
Mating systems, parental investment and reproductive success	
Parental care	
Aggressive behavior	
Habitat selection and optimality in foraging	
Migration, orientation and navigation	

**Unit – I: PHYSIOLOGY**

**Full Marks: 25**  
**Lectures: 35**

<i>Basic concepts: Homeostasis, Acclimatization and Adaptation</i>	2L
<i>Circulation</i>	8L
Blood cells: ultrastructure, pigments, and formation	
Hemostasis: platelet activation cascades, regulation	
Lymph: composition and dynamics	
<i>Respiration</i>	7L
General idea: Total and partial air pressure, Gas solubility and diffusion in air and water.	
Aquatic: Gill architecture; ram ventilation, dual pump, gas exchange (counter current mechanism)	
Terrestrial: Lung ventilation (amphibians, reptiles, birds, mammals), Lung mechanics (human): Respiratory muscles, lung volumes, elastic properties, compliance, surface tension, pulmonary surfactants.	
Regulation (human): Respiratory centers, receptors, integration.	
<i>Excretion &amp; Osmoregulation</i>	8L
Mammalian kidney, Urea cycle and Aquaporins	
Ultra structure of nephron	
Urine formation – Glomerular filtration and tubular reabsorption, Importance as osmoregulatory organ.	
External osmoregulatory organs: Salt glands, Fish gills	
Water and electrolyte balance (Na, K, Mg), Acid-base regulation, Endocrine regulation	
<i>Thermoregulation</i>	4L
Endothermy and Ectothermy	
Thermoregulatory organs, responses to high and low temperature	
Thermogenesis, Characteristics of fever	
Neural Control	
<i>Sensory</i>	6L
Neuron: types; synapse (excitatory and inhibitory post synaptic potential)	
Genesis of membrane potential	
Neurotransmitters (Acetylcholine, GABA), chemical transmission through synapse	

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**Unit –II: ENDOCRINOLOGY**

**Full Marks: 25**  
**Lectures: 28**

<i>Hormones</i>	6L
General classes of hormones, concept of receptors	
Mechanisms of hormone action – second messenger, IP <sub>3</sub> and DAG	
Neuroendocrine integration	
<i>Hypothalamic and Pituitary hormones</i>	6L

Hypothalamic hormones – structure and functions	
Hypophyseal hormones – structure and functions	
<i>Thyroid hormones</i>	6L
Biosynthesis and function of T <sub>3</sub> /T <sub>4</sub>	
Role of thyroid hormones in metabolism	
<i>Pancreatic hormones</i>	6L
Structure and biosynthesis: insulin and glucagon	
Role of hormones in glucose metabolism	
<i>Adrenal hormones</i>	5L
Structure and functions of cortical hormones	
Structure and functions of medullary hormones	
<i>Reproductive hormones</i>	6L
Sex steroids: Structure, source, role and receptors	

**Unit – I: MOLECULAR BIOLOGY**

**Full Marks: 25**  
**Lectures: 42**

<i>Regulation of Gene Expression</i>	4L
<i>Post transcriptional modification and splicing and RNA editing</i>	3L
<i>Protein synthesis and post translational modification and trafficking</i>	3L
<i>Transposons</i>	2L
<i>DNA damage and repair mechanisms</i>	3L
<i>Cloning and Recombinant DNA Technology</i>	4L
<i>Aging and senescence</i>	3L
<i>Methods in Molecular Biology</i>	3L
PAGE, Western Blotting, Chromatography, Spectroscopy	

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**Unit –II: IMMUNOLOGY**

**Full Marks: 25**  
**Lectures: 35**

<i>Types of Immunity: Innate and Acquired</i>	1L
<i>Cells and Organs of the immune system</i>	2L
<i>Elements of Innate immunity</i>	2L
<i>Antigens and Immunogens</i>	3L
Definition and properties	
Antigenic determinants of immunoglobulin (Isotype, allotype & idiotype)	
<i>Antibodies</i>	2L
Structure, classes and biological activities	
Organization and expression of immunoglobulin genes	3L
<i>T Cell receptors (TCR) and TCR Complex</i>	3L
Structure and roles	
Organization and rearrangement of TCR genes	
<i>Major histocompatibility complex (MHC)</i>	2L
General organization; Structure and Functions of MHC molecules	
<i>Cytokines</i>	2L
General properties and functional categories	
<i>Complement</i>	2L
Activation pathways, Biological functions and Regulation	
<i>Maturation, activation and differentiation of T and B lymphocytes</i>	4L
<i>Immune effector mechanisms</i>	3L
Antibody mediated functions	
Cell mediated effector responses	
<i>Antigen-antibody interaction</i>	2L
Molecular basis	
Secondary interactions – Agglutination, precipitation.	
<i>Hypersensitivity reactions</i>	2L





**Unit – I: ECOLOGY**

**Full Marks: 25**

1. Quantitative estimation of some Physico-chemical parameters in the aquatic ecosystem: Temperature, pH, dissolved oxygen, carbon dioxide and chloride contents
2. Quantitative estimation of some factors of soil and the sediment: soil moisture, pH, nitrates, phosphates and organic matter
3. The study of aquatic and terrestrial habitats: Identification and characterization of zooplankton and ecotypes inhabiting terrestrial and aquatic environments
4. Laboratory note book and class records
5. Viva –voce

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**Unit –II: PHYSIOLOGY & ENDOCRINOLOGY**

**Full Marks: 25**

1. PHYSIOLOGY
  - a. Detection of haemoglobin percent, C.T. and B.T.
  - b. Quantitative estimation of Ascorbic acid by titration.
  - c. Biochemical estimation of Cholesterol and Sugar from mammalian blood
  - d. Total count of RBC and WBC
2. ENDOCRINOLOGY
  - a. Estimation of Steroid and thyroid hormone by ELISA
  - b. Demonstration of ovariectomy, orchidectomy and their effects in laboratory animals
  - c. Quantitative estimation of Ascorbic acid content of ovary as an assay of LH
  - d. Demonstration of Adrenalectomy in rat
  - e. Identification of stages of Oestrous cycle by vaginal smear preparation in rat
3. Submission of laboratory record.
4. Viva–voce

**Unit – I: MOLECULAR BIOLOGY**

**Full Marks: 25**

1. Identification of different common mutant variants of *Drosophila*, Preparation of *Drosophila* food
2. Extraction of RNA from animal tissue
3. Western blotting for the study of gene expression
4. Karyotype and idiogram preparation (G, C banding), human lymphocyte culture
5. Sex chromatin study
6. Cell fractionation and isolation of mitochondria
7. Zymography for the expression of Proteases
8. Laboratory records
9. Viva-voce

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**Unit –II: IMMUNOLOGY**

**Full Marks: 25**

1. Separation of protein by Ion Exchange Chromatography
2. Single and double immunodiffusion (Ouchterlony)
3. Preparation of Cell suspension from the lymphoid tissue (primary/secondary) of mouse for the estimation of live and dead cells
4. Separation of macrophages from the peritoneal exudates
5. Immunization procedure and collection of antiserum from rabbit
6. Ammonium sulphate precipitation of immunoglobulin
7. ELISA, Coombs test, Widal test
8. Agglutination reactions
9. Laboratory records
10. Viva-voce

**COMMUNITY OUTREACH**

**Full Marks: 25**

**Unit – I: GENERAL ENTOMOLOGY**

**Full Marks: 25**

**Lectures: 35**

<i>General characters of Class Insecta, diversity and adaptive features of insect</i>	3L
<i>Outline classification up to orders with examples</i>	7L
<i>Structure of insect</i>	8L
Structure of head - sutures - types of head in various insects	
Components of mouthparts and types	
Structure of leg - articulation - modification with reference to mobility	
Structure and modifications of eyes and antenna	
Origin and development of wings - venation – types and modifications – mechanism of flight - wing coupling	
Formation and modification of cuticle	
<i>Internal organs</i>	5L
Digestive structure and their modifications and functions	
Circulatory system	
Organs of circulation	
Haemolymph	
Haemocytes with functions	
Mechanism of circulation	
Fat-Body	
Excretory system	
Principal organs	
Physiology of excretion	
Excretory products	
<i>Metamorphosis</i>	4L
Introduction – Types with examples	
Larva and pupa – structure and types	
<i>Insect behaviour</i>	4L
Feeding behaviour: types of feeding and damage, host range, specialization and host selection	
Reproductive behaviour: mate location, mating frequency and oviposition	
<i>Social Insects</i>	4L
Life cycle and Social organization of termites, honeybees and ants	

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**Unit –II: APPLIED ENTOMOLOGY**

**Full Marks: 25**

**Lectures: 35**

<i>Sound production</i>	6L
Structure of the organs	
Mechanism of sound production	
Significance	
<i>Bioluminescence</i>	6L

Structure of organs	
Brief mechanism of light production	
Significance	
Chemical Communication	3L
Pheromones, kairomones, allomones, synomones	
Insect-plants interactions	3L
Plant structure and chemistry,	
Insects and host-plant interactions	
Insect control	3L
Classification of insecticides,	
evaluation of toxicity,	
insecticide resistance	
Integrated Pest Management	4L
General Concept	
Economic Injury Level, Economic Threshold; dynamics	
Degree Day concept	
Biotechnological control of pests	2L
Transgenic plants and agents	
Forensic entomology	2L
Basic idea, legal cases	
Insect succession,	
Post mortem interval	
Medical and Veterinary Entomology	3L
Lice, myiasis	
Applications of molecular tools in control and management	
Insect molecular Biology	3L
Transgenic insects	
Insect genome projects and its applications	

**Unit – I: GENERAL PARASITOLOGY**

**Full Marks: 25**

**Lectures: 35**

<i>General idea</i>	3L
Symbionts, parasites, vectors and hosts	
<i>Host-Parasite interaction</i>	8L
Host–parasite interactions, adherence/colonization, virulence factor secretion systems, exotoxins, quorum sensing, pathogenicity islands	
<i>Intestinal Sarcodina and Flagellates</i>	8L
General account, structure, life cycle, pathogenicity and control of <i>Entamoeba histolytica</i> and <i>Giardia lamblia</i>	
<i>Haemoflagellates</i>	8L
Ultrastructure and morphological stages; morphology, life cycle, clinical features and control of <i>Trypanosoma cruzi</i> and <i>Leishmania donovani</i>	
<i>Haemosporina</i>	8L
Zoonosis	
Evolution of malarial parasites	
Morphology, life cycle, clinical features and control of <i>Plasmodium falciparum</i>	

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**Unit –II: MEDICAL PARASITOLOGY**

**Full Marks: 25**

**Lectures: 35**

<i>Classification of parasitic helminthes</i>	2L
<i>General morphology (including ultrastructure) of parasitic Platyhelminthes.</i>	6L
<i>Morphology, life history, pathogenicity and control</i>	12L
<i>Paragonimus westermani, Schistosoma haematobium, Taenia saginata, Trichinella spiralis, Dracunculus medinensis, Ancylostoma duodenale</i>	
<i>Biology, importance and control</i>	10L
Sand fly, Black fly, Tabanid flies, <i>Anopheles</i> , Ticks and Mites	
<i>Vector- microbe interaction</i>	5L
Symbiotic association of microbes with vectors	
Role of microbes as controlling agents of vectors	

**Unit – I: FISH BIOLOGY**

**Full Marks: 25**

**Lectures: 35**

<i>Classification of fishes</i>	9L
Principles of classification, extinct fish groups, Detailed study of major fish orders: Cypriniformes, Clupeiformes, Ophiocephaliformes, Perciformes, Mastacembeliformes.	
<i>Structure, development, comparative account and functions</i>	9L
Bioluminescent organ Poison gland Acoustico-lateralis system	
<i>Structure and functions</i>	8L
Digestive systems, olfactory organ and chemoreception, Osmoregulatory and Circulatory systems, Electric organs, Endocrine glands (Pituitary and Thyroid), Caudal neurosecretory organ	
<i>Reproduction and Development</i>	7L
Structure and functions of reproductive organs, Types of reproduction, Breeding and Parental care	
<i>Fish migration – types and regulation</i>	2L

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**Unit –II: AQUACULTURE**

**Full Marks: 25**

**Lectures: 35**

<i>Concepts of fisheries and aquaculture</i>	6L
Present status, scope and possibilities of further development Different culture systems (extensive, intensive, semi-intensive, fresh water, brackish water, coastal, hill stream, cage, pen, race way)	
<i>Inland fisheries</i>	7L
Pond management for carp culture, induced breeding of prawn and air breathing fishes, Composite culture of air breathing fishes	
<i>Shell fisheries</i>	6L
Edible oysters, chank fishery, pearl fishery	
<i>Ornamental fish culture and aquarium management</i>	3L
<i>Fish biotechnology: Production of transgenic fish</i>	3L
<i>Marine fisheries</i>	10L
Resources, <i>Hilsa</i> fishery, pomfrets and flat fishes Elasmobranch fishery (major groups, fishery methods, importance)	

**Unit – I: TOXICOLOGY**

**Full Marks: 25**

**Lectures: 35**

<i>Concept, history and scope of toxicology</i>	2L
<i>Fundamentals of toxicology</i>	8L
Types of toxic substances (including natural toxins, concept of xenobiotics)	
Disposition and biotransformation (phase I and phase II reactions)	
Drugs as toxic substance (Paracetamol, Aspirin, Thalidomide)	
<i>Effects of toxic substances</i>	4L
Biochemical and physiological effects	
Interactive effects: additive effects, potentiation and synergism	
<i>Toxicity tests</i>	4L
Dose, dosage, dose response	
Acute toxicity tests: Bioassay, LC <sub>50</sub> and LD <sub>50</sub> , Probit analysis and Significance	
Chronic toxicity tests: Methods, Significance	
<i>Pesticides</i>	7L
Concept and classification	
Insecticides and herbicides: Types (including bioinsecticides), sources, effects and kinetics in the environment	
Mechanism of action: Organochlorine, Organophosphate, Carbamates, Paraquat, Phenoxy herbicides	
<i>Metal toxicity</i>	6L
Source, exposure, disposition and effects of heavy metals (Cd, Hg, Pb) and lighter elements (As, Se)	
Metal chelation	
<i>Applied toxicology</i>	4L
Clinical toxicology	
Forensic toxicology	

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**Unit –II: MICROBIOLOGY**

**Full Marks: 25**

**Lectures: 35**

<i>History and development of Microbiology</i>	2L
Contributions of Leeuwenhoek, Koch, Pasteur, Jenner and Flemming	



<i>Bacteria</i>	8L
Structure and function of capsule, pili, flagella, cell wall, cell membrane, outer membrane, reserve materials, cytoplasmic inclusions, plasmid and bacterial chromosome	
<i>Bacterial endospore</i>	4L
Structure, properties, spore -formation and germination	
<i>Virus</i>	8L
Structural organization of viruses	
Prions and Viroids	
Lytic cycle of bacteriophages with reference to <i>E. coli</i> and T4	
Lysogeny, lysogenic conversion, induction and significance	
<i>Control of microorganisms</i>	5L







and antibiotics  
*Medical Microbiology*  
Microbial virulence  
Mode of transmission, pathogenicity and prevention of microbial diseases:  
Air-borne (Tuberculosis and Influenza), Food and waterborne (Typhoid  
and Cholera) and Arthropod borne (Dengue, JE and Yellow fever)

8L

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**MZGP- 305**

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**Unit – I: ENTOMOLOGY**

**Full Marks: 25**

1. Digestive system of Grasshopper / Honey bee
  2. Nervous system of Grasshopper / Honey bee
  3. Mounting: Mouthparts of grasshopper, mosquito; wings of Ephemeroptera, Odonata, Dictyoptera, Hemiptera, Hymenoptera, Diptera, Lepidoptera, Coleoptera; legs of gressorial, cursorial, saltatorial, fossorial, natatorial, clasporial and raptorial; antennae: filiform, setaceous, plumose, pilose, pectinate, clavate, geniculate, aristate, serrate, moniliform
  4. Identification of common pests: Paddy (*Nilaparvata lugens*, *Nephotettix nigropictus/virescens*, *Leptocorisa acuta/varicornis*, *Scirpophaga incertulas/innotata*); Jute (*Apion corchori*, *Dasychira mendosa*); vegetables (*Epilachna dodecastigma*, *Bemisia tabaci*, *Leucinodes orbonalis*); stored grains (*Sitophilus oryzae*, *Callosobruchus chinensis/maculatus*, *Tribolium castaneum*)
  5. Social Insects: Morphological studies of social insects (Honey bee and termite)
  6. Laboratory records
  7. Submission of prepared slides
  8. Viva-voce
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## **Unit -II: PARASITOLOGY**

**Full Marks: 25**

1. Smear preparation and staining of parasitic Protozoa
2. Drawing and staining of blood films for parasitic Protozoa and microfilaria
3. Whole mount preparation of trematode and arthropod parasites
4. Staining of scolex and proglottids of cestodes
5. Whole mount preparation of mosquito vectors (*Anopheles*, *Culex* and *Stegomyia*)
6. Identification of parasites and vectors
7. Laboratory records
8. Submission of prepared slides
9. Viva-voce

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**MZGP- 306**

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## **Unit - I: FISH BIOLOGY**

**Full Marks: 25**

1. Study of bucco-pharynx, gill rakers and gut content analysis in relation to food habits of teleosts
  2. Urinogenital, olfactory and digestive systems in teleosts
  3. Histological preparation of testis, ovary, kidney, pituitary, hepatopancreas, and intestine of fish
  4. Identification of different fish
  5. Laboratory records
  6. Submission of prepared slides
  7. Viva-voce
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## **Unit –II: TOXICOLOGY AND MICROBIOLOGY**

**Full Marks: 25**

1. TOXICOLOGY:
  - a. Determination of LC<sub>50</sub> and LD<sub>50</sub>
  - b. Morphological deformities (study of symmetry) in biological organisms due to toxicant exposure
2. MICROBIOLOGY:
  - a. Preparation of liquid media (broth) and solid media for routine cultivation of bacteria
  - b. Preparation of slant and stab
  - c. Pure culture techniques: Spread plate, pour plate and streak plate
  - d. Isolation and enumeration of bacteria from natural sources: soil, air and water
  - e. Simple staining of bacteria and study of cell types; differential staining: Gram staining, endospore staining and acid-fast staining
  - f. Biochemical tests for characterization: Catalase, Nitrate reduction, Indole production, Methyl red and Voges–Proskauer test
  - g. Sugar fermentation test
3. Laboratory note book
4. Viva-voce

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**MZGT- 401**

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## **Unit – I: DEVELOPMENTAL BIOLOGY**

**Full Marks: 25**  
**Lectures: 35**

<i>Overview</i>	3L
Scope of Developmental Biology & Future impact	
Totipotency	
Cell surface proteins, Extra cellular matrix	
Signaling	
<i>Techniques &amp; experimental biology</i>	5L
Cell labeling & genetical methods	
Model systems ( <i>Dictyostelium</i> , <i>C. elegans</i> , <i>Drosophila</i> & Chick)	
<i>Gametogenesis</i>	4L
Spermatogenesis: phases, cellular changes	
Oogenesis: types, stages, ooteleosis & luteinization	
<i>Fertilization in mammals</i>	3L
Recognition of gametes and acrosomal reaction	
Gamete fusion	
Activation of egg	
<i>Cleavage</i>	2L
Mechanism: molecular aspects	
<i>Gastrulation</i>	5L
Cell lineages	
Gastrulation in vertebrate embryos	
Formation of germ layers in amphibia and birds	
Induction, Determination and Differentiation	
<i>Pattern formation</i>	4L
Anterior-Posterior & Dorsal- Ventral polarity in <i>Drosophila</i> ;	
Molecular control of segmentation and homeotic genes	
Gap genes, HOX genes in vertebrate, Niuekwoop centre & ventral organizer	
Neurogenesis and Neural tube in vertebrates	
<i>General Topics</i>	9L
Mesoderm induction & patterning	
Regeneration	
<i>In vitro</i> fertilization in human	
Embryonic stem cell & their application	

## Unit -II: BIOSTATISTICS & COMPUTATIONAL BIOLOGY

**Full Marks: 25**

**Lectures: 25**

### 1. BIOSTATISTICS

<i>Populations and samples</i>	2L
Populations, Samples from populations, Random sampling, Parameters and Statistics, Standard deviation and error, Coefficient of variation	
<i>Hypothesis testing</i>	2L
<i>Parametric and Non-parametric tests, One sample hypothesis</i>	
<i>Two sample hypothesis</i>	
<i>Multisample hypothesis: The Analysis of Variance</i>	2L
Single factor analysis of variance, confidence limits for population mean	
<i>Power and sample size in ANOVA, Homogeneity of variances</i>	
<i>Homogeneity of coefficients of variation</i>	
<i>Multiple comparisons</i>	2L



Tukey test	
<i>Linear regression</i>	3L
<i>Regression vs. Correlation, Correlation coefficient, Simple linear regression equation</i>	
<i>Testing the significance of relation (<math>r^2</math>)</i>	
<i>Testing for goodness of fit</i>	2L
<i>Chi-Square goodness of fit, Heterogeneity chi-Square, Log-Likelihood ratio</i>	
<i>Chi-Square analysis of contingency table</i>	
2. COMPUTATIONAL BIOLOGY	
<i>Basic components of computers</i>	2L
<i>Hardware</i>	
CPU, input, output, storage devices, Microprocessor	
<i>Communication port</i>	
<i>Operating system</i>	2L
<i>Concept and function of OS, open source OS</i>	
<i>Command type and GUI application, LINUX</i>	
<i>Programming Concept</i>	2L
<i>Logical operators, Flow chart and Algorithm, Concept of C – programming</i>	
<i>Data Structure, Common RDMBS platform: SQL, Oracle</i>	2L
<i>Computer Networking and Internet</i>	
<i>Biological databases</i>	2L
<i>Nucleic acid and Protein database</i>	
<i>Sequence Alignment, Protein prediction and pattern search tools</i>	
<i>Molecular modeling and docking</i>	2L

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**MZJT- 402**

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**MAJOR ELECTIVE: ENTOMOLOGY**

**Full Marks: 50**  
**Lectures: 70**

**Insect Anatomy**

<i>Morphology and Biology of the orders</i>	15L
	15L
Collembola, Orthoptera, Thysanoptera, Hemiptera, Siphonaptera, Lepidoptera, Coleoptera, Diptera, Strepsiptera & Hymenoptera	
<i>Integument</i>	8L
Structure and functions of cuticle	
Cuticular modifications	
Moulting	
<i>Head</i>	8L
Head segmentation and evolution	
Generalized Pterygote Head	
Modified Mouthparts (Orthopteroid, Hemipteroid and Neuropteroid)	
<i>Thorax</i>	8L
Generalized thoracic structure	
Structure and morphological variation of wing	
Appendages of thorax	
<i>Abdomen</i>	6L
Segmentation	
Skeletal composition	
<i>Vision</i>	10L
The dorsal ocelli	
The stemmata	
Structure of compound eye	
Formation of image	
<i>Perception</i>	10L
Chemoreception: structure of cuticular and contact receptors, distribution & functions	
Mechanoreception: Structure and functions of cuticular, cellular, proprioceptors. chordotonal and tympanal organs.	
<i>Exocrine glands</i>	5L
Important exocrine glands: origin, structure and functions	

**MAJOR ELECTIVE: AQUACULTURE AND FISHERIES**

**Full Marks: 50**  
**Lectures: 70**

## **Fresh Water Aquaculture**

<i>Inland fisheries resources in India and their principal species.</i>	4L
<i>Food fishes and their economic importance</i>	18L
Indian Major carps: <i>Catla catla</i> , <i>Labeo rohita</i> , <i>Cirrhinus mrigala</i>	
Exotic carps: <i>Hypophthalmichthys molitrix</i> , <i>Ctenopharyngodon idella</i> , <i>Cyprinus carpio</i>	
Cat fishes : <i>Clarias batrachus</i> , <i>Heteropneustes fossilis</i>	
Other groups: <i>Anabas testudineus</i> , <i>Channa striatus</i> , <i>Etroplus suratensis</i>	
<i>Fish culture practices</i>	20L
Collection of spawn, fries and fingerlings and their subsequent transport	
Culture of air-breathing fishes	
Integrated aquaculture: crop-livestock-fish farming	
Paddy-cum-fish culture	
Sewage-fed fish culture	
Impact of invasive fish species	
Cold water fisheries: resources, management and development.	
<i>Fish breeding</i>	14L
Neuro-endocrine control of fish reproduction	
Induced breeding in carps and catfishes	
Ecological requirements for induced breeding	
<i>Hybridization and genetic manipulation</i>	14L
Selective breeding (Intergeneric, interspecific)	
Ploidy manipulation, Androgenesis, Gynogenesis	
Transgenesis: Transgene delivery, integration, expression	

**Full Marks: 50**  
**Lectures: 70**

**Insect Physiology**

<i>Digestive system</i>	10L
The alimentary canal	
The salivary glands	
Mechanism of digestion	
Micro-organisms and their role in digestion	
Nutritional requirements	
<i>Respiratory system</i>	10L
Structure of respiratory organs	
Mechanism of gaseous exchange	
Aquatic respiratory organs	
Physiology of gill and plastron respiration	
<i>Excretory system</i>	10L
Types of excretory systems	
Organs of excretion	
Accessory organs of excretion	
Physiology of excretion	
Composition of insect urine	
Vitamins in Malpighian tubules	
<i>Nervous system</i>	6L
The neurons	
The central nervous system	
The brain	
The Sympathetic nervous system	
<i>Reproduction</i>	10L
Male and Female reproductive system	
Special types of reproduction	
Factors controlling fecundity and fertility	
Swarming and oviposition	
Egg maturation	
<i>Development</i>	8L
The insect egg	
Embryonic development and dynamics	
Post-embryonic development and metamorphosis	
<i>Endocrine system</i>	8L
Anatomical organization	
Structure and hormones	
Endocrine control of metamorphosis, diapause	
<i>Gall formation</i>	8L
Insects involved in formation of galls	
Mechanism of galls formation	
Importance of galls	

**MAJOR ELECTIVE: AQUACULTURE AND FISHERIES**

**Full Marks: 50**  
**Lectures: 70**

**Fresh Water & Brackish Water Aquaculture**

<i>Nutrition and supplementary feeding</i>	20L
Nutritional requirements	
Intermediary metabolism and bioenergetics	
Feed types, composition, ingredients, formulation	
Feeding schedules, feed dispensing methods	
Storage and quality control of feed	
<i>Maintenance of Fish Farm</i>	15L
Productivity of freshwater bodies	
Limnological methods and their application (oxygen and carbon-di-oxide)	
Pond fertilization	
Control of aquatic weeds, insects, predatory and weed fishes	
<i>Aquaculture hazards</i>	12L
Common diseases of fish: Causative organisms, effects and control	
Shrimp diseases and treatment	
Pollution: sources, effects and control	
<i>Present status of brackish water fish farming in India</i>	8L
Mixed culture of brackish water fish species	
Estuarine fisheries	
<i>Spoilage of fresh water and brackish water fishes</i>	8L
Aminoacid changes	
Breakdown products indicative of spoilage	
Other substances	
<i>Development strategies</i>	7L
Fish conservation	
Fish marketing: imports and exports	

**MAJOR ELECTIVE: ENTOMOLOGY**

**Full Marks: 50**  
**Lectures: 70**

**Applied Entomology**

<i>Crop Husbandry</i>	10L
Morphology, Bionomics and Management of pests of paddy, wheat, jute, sugarcane, mango, oil-seed crops, pulses, vegetables and stored grains	
Distribution, bionomics and control of polyphagous pest: locusts and termites	
<i>Control/Management of insect pests</i>	20L
Integrated pest Management:	
Concept of injury level, Economic level of injury, Economic threshold level, IPM.	
Chemical control: Organochlorines, Organophosphates, Carbamates, Pyrethroids and Botanicals	
Biological Control. Predators, Parasitoids and Nematodes	
Hormonal control: Concept, use of juvenoids, ecdysoids and Insect growth regulators (IGRs)	
Genetic control: Methods of genetic manipulation and field trials.	
Biotechnological control- use of transgenic plants, transgenic agents and impact of environment on the method.	
<i>Non-insecticidal method</i>	
Insect attractants, fumigants, repellents and antifeedants	
<i>Forest Entomology</i>	5L
Insects common to forests and their damage	
Defoliators, borers and sapsuckers.	
<b>Forensic Entomology</b>	<b>5L</b>
Insects associated with the corpses and carrions	
Forensic entomological techniques	
<i>Industrial Entomology</i>	10L
Non-Mulberry sericulture-Tasar, muga and eri.	
Lac culture: Lac insects, Life history, Industrial importance.	
Honey bees and Apiculture	
<i>Medical Entomology</i>	10L
Insects of medical importance - naming with its status in Entomology	
Morphology of mosquitoes, house flies, human lice and rat fleas with role in disease transmission and control	
<i>Insect molecular genetics</i>	10L
Insect genome organization	
Transgenic pest and application	

## MAJOR ELECTIVE: AQUACULTURE AND FISHERIES

Full Marks: 50  
Lectures: 70

### Marine Fisheries

<i>General survey of marine fisheries in India</i>	4L
<i>Marine biology and oceanography in relation to fisheries</i>	6L
<i>Principal marine fisheries and exploited species</i>	14L
14L	
Oil sardine and lesser sardines, Indian Mackerel, Bombay duck, Pomfrets, Prawns, Molluscs	
<i>Fishing crafts and Gears</i>	4L
4L	
Types of Indigenous crafts and gears, designing Modernization of craft, Preservation	
<i>Life in sea</i>	5L
	5L
Phytoplankton, Zooplankton Nekton and fisheries	
<i>Fluctuation in marine fisheries</i>	4L
Causes of fluctuation, overfishing problem Rational exploitation of fisheries	
<i>Preservation and processing</i>	5L
Chemical composition of fish Drying and salting, Chilling and freezing, Smoking and canning	
<i>Mariculture</i>	8L
Cultivable fin-fishes, Cultivable crustaceans, Cultivable mollusca	
<i>Fish in human nutrition</i>	
10L	
Nutritive value of fish protein, Fish oils, fatty acids and nutrition Fish as a source of mineral, Fish as a source of vitamins	
<i>Fish by-products, Marketing of fish and aquaculture products</i>	6L
<i>Conservation of marine environment through establishing National marine reserves</i>	4L

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**MZTP- 405**

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**Full Marks: 25**

**Term Paper / Project Work (based on special paper)**

**[Submission (within 10,000 words) & Seminar presentation – 20 (=15+5); Discussion –5]**



**DEVELOPMENTAL BIOLOGY & COMPUTATIONAL BIOLOGY**

**Full Marks: 25**

1. DEVELOPMENTAL BIOLOGY

- a. Culture and Regeneration of *Hydra*
- b. Morphological studies on the developmental stages of snail, fish, frog, chick and mouse
- c. Histological slides of various organs and systems during development using stained serial sections
- d. Identification of whole mounts and histological sections of embryos larvae, pupae and nymphs
- e. Submissions of preparations of different stages of development

2. COMPUTATIONAL BIOLOGY

- a. Unix operation: File management, net work commands, shell programming
- b. C- Programming: Data structure, string function, array and variations
- c. Sequence retrieval – nucleotide and protein
- d. BLAST search
- e. Protein pattern search, Motif search

3. Laboratory note book

4. Viva-voce

**MAJOR ELECTIVE: ENTOMOLOGY**

1. Anatomy

- a. Cockroach: Sympathetic Nervous and male reproductive system
- b. Blue bottle fly: Digestive and Nervous systems
- c. Butterfly: Digestive and Reproductive system
- d. Any coleopteran: Nervous system
- e. Mounting: antenna, scales, spiracles, tympanum, wings (small insects-at least 5 types), legs (at least 5 types) and mouthparts at least two types

2. Taxonomy

- a. Study of insect collecting devices
- b. Methods of insect collection and preservation
- c. Identification (up to family) with reasons of Apterygote and Exopterygote (Hemimetabolans) and Endopterygote (Holometabolans) insects
- d. Study of insects of economic importance (5 species)

3. Physiology

- a. Preparation insect blood smear and identification of blood cells under microscope after proper staining
- b. Detection of amino acids by chromatography
- c. Chitosan test of cuticle

4. Toxicology

- a. Preparation of insecticidal formulation (emulsion, dust and suspension)
- b. Study of insect infestations (at least 5) in grains and forest trees
- c. Study of LC<sub>50</sub> of two common insecticides against any two pests (graphical representation)

5. Study (life cycle, damage etc.) of at least 2 types of pests

6. Field Entomology-Laboratory Note Book and submission of collected Apterygote and Exopterygote (Hemimetabolans) and endopterygote (Holometabolans) insects

7. Viva-voce

## **MAJOR ELECTIVE: AQUACULTURE AND FISHERIES**

1. Dissection of different organ systems
2. Studies of life histories of cultivated freshwater fishes, preparation and mounting of the various stages and their identification
3. Techniques of induced breeding
4. Detection of food and feeding habit by analyzing gill rakers, buccopharynx and gut content
5. Systematic identification of fishes
6. Separation of amino acids by paper and thin layer chromatography
7. Histological studies of different tissues and their identification
8. Limnological studies
9. Biochemical estimation of protein, lipid and carbohydrate from fish tissues
10. Qualitative and quantitative detection of digestive enzymes
11. Identification and mounting of some common freshwater Zooplankton, benthos, aquatic weeds and insects)
12. Electrophoretic separation of proteins and nucleic acids
13. Field study Laboratory Note and class records, submission of prepared slides
14. Viva voce