GURU NANAK COLLEGE (AUTONOMOUS)

(Affiliated to University of Madras and Re-Accredited at 'A' Grade by NAAC)

Velachery Main Road, Velachery, Chennai – 600042.

M.Sc. Zoology

(SEMESTER PATTERN WITH CHOICE BASED CREDIT SYSTEM)

Syllabus

(For the candidates admitted in the Academic year 2016-17 and thereafter)

Vision

- To instill the scientific dogmas of nature; to provoke the interest towards learning science and allied subjects; to equip the students with scientific skills to acquire competency needed for employment; to inculcate professional ethics and value-based education to improve socio-economic status; to impart interdisciplinary approach for identifying and solving real world scientific problems through research.

Mission

1. To facilitate an encouraging and exciting environment to develop the scientific temper in students through a curriculum based on fundamental as well as advanced scientific knowledge.
2. To provide technical skills in the respective disciplines through conducting practical training including internship as well as project, this will hone the skills necessary to become a successful mathematician, physicist, chemist, biotechnologist and visual communication professional.
3. To inculcate interdisciplinary knowledge, elective subjects in various fields are offered, thereby providing an opportunity to the students to identify their interest towards a particular field and pursue the passion.

GURU NANAK COLLEGE (Autonomous)

M.Sc. DEGREE Course in ZOOLOGY

PG & Research Department of Adv. Zoology & Biotechnology

(2016 -18)

Programme Outcome

PO 1: To acquire knowledge on classification and phylogeny of animals.

PO 2: To analyze complex interactions among the various animals of different phyla.

PO 3: To compare the physiological processes of animals and role of organ systems.

PO 4: To perform environmental conservation and protection of endangered species.

PO 5: To establish employment opportunities in Industries, Research and Education, Bioethics, Patenting, Environmental Protection, Conservation, Technical and Medical Profession.

PROGRAMME SPECIFIC OUTCOME

PSO 1 : To Prepare the Students to Compete and clear competitive exams like **CSIR – NET in Life Sciences, GATE, UGC-NET in Environmental Sciences, SET (Life Sciences),** IFS etc.; and to facilitate students in acquiring knowledge to become entrepreneurs in the field of Aquaculture related fields, Ornamental fishes and Entomology.

PSO 2 : To carry out research in the thrust areas of Life Sciences like Fishery biology, Animal diversity, Environmental Monitoring, Cell and Molecular Biology, Biotechnology, Bioinformatics and exposing them to research activities through Training on various Research Methodological tools, Organizing National and International Conferences and Workshops.

M.Sc. ZOOLOGY

COURSE STRUCTURE 2016-2018 Batch

Sem	Part	Subjects	Cdt	Hr	Exam hrs	CIA	ESE	Total
I	Core-1	Functional Morphology and Phylogeny of Invertebrata	4	4	3	50	50	100
	Core-2	Cell and Molecular Biology	4	4	3	50	50	100
	Core-3	Genetics- A Molecular approach	4	4	3	50	50	100
	Elective I	Fish biology & Fisheries	4	5	3	50	50	100
	Core practical-1	Invertebrata ,Chordata, and Fishery Biology	*	6	*	*	*	*
	Core practical-2	Cell &MolBiol, Biophysics, Biotech, Genetics, Biostatistics and Microbiology	*	6	*	*	*	*
	Soft skill	Language and communication skill	2	1	3	-	100	100
		Credit Total	**18**	**30**				
II	Core-4	Functional Morphology and Phylogeny of Chordates	4	4	3	50	50	100
	Core-5	Biophysics and Biostatistics	4	4	3	50	50	100
	Core-6	Microbiology	4	4	3	50	50	100
	Elective II	(IDP) Aquarium Fishes	4	5	3	50	50	100
	Core practical-1	Invertebrata,Chordata, and Fishery Biology	4	6	4	50	50	100
	Core practical-2	Cell &MolBiol, Biophysics, Biotech, Genetics, Biostatistics and Microbiology	4	6	4	50	50	100
	Soft skill	Computing skills	2	1	3	-	100	100
		Internship	2	*	-	-	100	100
		Credit Total	**28**	**30**				
III	Core-7	Bioinformatics and Computer Applications	4	4	3	50	50	100
	Core-8	Developmental and Stem Cell Biology	4	4	3	50	50	100
	Core-9	Environmental Biology and Evolution	4	4	3	50	50	100
	Elective III	Entomology	4	5	3	50	50	100
	Core practical-3	Animal Physiology, Environmental Biology and Biochemistry	*	6	*	*	*	*
	Core practical-4	Developmental Biology, Bioinformatics, Computer Applications, and Entomology	*	6	*	*	*	*
	Soft skill	Managerial skills	2	1	3	-	100	100
		Credit Total	**18**	**30**				
IV	Core-10	Animal Physiology	4	4	3	50	50	100
	Core-11	Biochemistry	4	4	3	50	50	100
	Core-12	Biotechnology	4	4	3	50	50	100
	Core practical-3	Animal Physiology, Environmental Biology and Biochemistry	4	6	4	50	50	100
	Core Practical-4	Developmental Biology, Bioinformatics, Computer Applications, and Entomology	4	6	4	50	50	100
	Soft Skill	Spoken and presentation skills	2	1	3		100	100
		Project	4	5	-	50	50	100
		Credit Total	**26**	**30**				
		Total Credits	**90**	**120**				

M.Sc. ZOOLOGY

SEMESTER - I

FUNCTIONAL MORPHOLOGY AND PHYLOGENY OF INVERTEBRATES

Subject Code: 16PZOOC01	**Core Paper** 1: **Theory**	**Marks: 100**
Semester: I	**Credits: 4**	**Total Hours: 75**

Course Objective: To relate the morphological adaptations with phylogenetic study.

UNIT I **(15 hrs)**

Protozoa: Economic importance- Parasitic protozoa-Reproduction in Protozoa. Origin and Evolution of Metazoa-theories. Symmetry and its significance in animal organisation. Neuromotor system in ciliates.

Porifera: Reproduction in sponges- Economic importance of Sponges.

UNIT II **(20 hrs)**

Coelenterata: Structural Pecularities of Metridium. Polymorphism; Coral and Coral Reefs and their Theories. Origin of Bilateria; Origin and Types of Coelom; Origin of Metamerism. **Platyhelminthes**: Parasitism in Platyhelminthes; Reproduction in Platyhelminthes.

UNIT III **(10 hrs)**

Annelida: Trocophore larva and its Significance – Nephridia and Coelomoducts-Adaptive Radiation in Polychaetes.

Arthropoda: Polymorphism; Crustacean Larvae and their Significance; Pheromones in insects-Endocrine organs in Crustacea.

UNIT IV **(10 hrs)**

Mollusca: Filter Feeding in Mollusca; Advanced features of Cephalopods; Torsion in Gastropoda; Adaptive Radiation in Mollusca.

Echinodermata: Larval forms and their Evolutionary Significance.

UNIT V **(20 hrs)**

Minor Phyla: Rotifera, Gastrotricha ,Acanthocephala, Ectoprocta, Entoprocta, Phoronida, Brachiopoda, Chaetognatha. Invertebrate fossils. Trilobites and cephalopods. Regeneration in invertebrates- Sedentary invertebrates.

TEXT BOOK:

1. Barrington, E.J. W. 1969. Invertebrate Structure and Functions. English Language, Book Society.

REFERENCE BOOKS:

1. Barnes: Invertebrate Zoology – Toppan International Co.,
2. Hyman L. H. The Invertebrata, Vol. I to IV.
3. Carter, G. S. A General Zoology of Invertebrates, (Sidewick and Jackson Ltd., London).
4. Borradile, L. A. The Invertebrata. Cambridge University Press.
5. Gardinar, M. S. 1972 Biology of the Invertebrates, Mc Graw Hill Book Co., New York.
6. R. L. Kotpal: Protozoa, Porifera, Coelenterata, Helminthes, Annelida, Arthropoda, Mollusca, Echinodermata and Minor Phyla. Rastogi Publilcations.
7. Moore, R. C. Lalilcker, C.G. and Fisher, A. G. Invertebrate Fossils, Mc. Graw Hill Book Co., NewYork.

Question paper pattern:

Section	Question Component	Numbers	Marks	Total
Section A	Definition / Principles Answer any 10 out of 12 questions	1 – 12	2	20
Section B	Short Answer (Answer any 5 out of 8 questions)	13 - 20	8	40
Section C	Essay Answer any 2 out of 4 question	21 - 24	20	40
	Total Marks			100

Distribution of Questions:

Sections	Units	No. of Questions	
		Theory	Problems
Section A	Unit – 1	2	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	3	
	Unit – 5	2	
Section B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	1	
	Unit – 5	2	
Section C	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	-	
	Unit - 5	1	

TITLE OF THE PAPER: CELL AND MOLECULAR BIOLOGY

Subject Code: 16PZOOC02	**Core Paper** 2: **Theory**	**Marks: 100**
Semester: I	**Credits: 4**	**Total Hours: 75**

Course Objective: To impart knowledge of genome, cancer and signaling concepts in cell and molecular biology.

UNIT I **(10 hrs)**

Cell structure and Genome structure: Brief account of eukaryotic animal cell. Chromatin, Euchromatin, Heterochromatin, Chromosomes, Centromere, Telomere.

UNIT II **(15hrs)**

Cancer: Cancer cell- Characteristics, Differences between normal and cancer cell, Membrane and Biochemical changes in cancer cells, Nuclear and Chromosome changes, Carcinogenesis - Tumor viruses, Oncogenes, Tumor Suppressor Genes, Hormones in relation to cancer, Treatment of cancer at molecular level.

UNIT III **(20 hrs)**

Informational macromolecules: Chemistry of DNA, Polymorphism of DNA, Mechanism and Enzymology of DNA Replication- Role of Helicases, Primases, Nucleases, Ligases, and Telomerases. Chemistry of RNA, Different types of RNA - mRNA, tRNA, rRNA and their functions- Mechanism and Enzymology of RNA Replication.

UNIT IV **(20 hrs)**

Information transfer: Genetic code and its characteristic features. Information transfer in prokaryotes and eukaryotes. Transcription – promoters, initiators and terminators. RNA processing – trimming of introns, splicing of exons, Ribozyme.

UNIT V **(10 hrs)**

Cell Signalling: Signalling molecules and their receptors – Functions of cell surface receptors – Pathways of intracellular signal transduction.

TEXT BOOK:

1. Cooper: The Cell A Molecular approach.

REFERENCE BOOKS:

1. David Frifielder: Molecular Biology.
2. Gerald Karp: Cell Biology- Mc Graw Hill.
3. Lodish, Berk, Zipursky, Matsudaria and Baltimore, Molecular cell biology – IV edition. W.H.Freeman and Company.
4. Watson : Molecular Biology of the Gene

Question paper pattern:

Section	Question Component	Numbers	Marks	Total
Section A	Definition / Principles Answer any 10 out of 12 questions	1 – 12	2	20
Section B	Short Answer (Answer any 5 out of 8 questions)	13 - 20	8	40
Section C	Essay Answer any 2 out of 4 question	21 - 24	20	40
	Total Marks			100

Distribution of Questions:

Sections	Units	No. of Questions	
		Theory	Problems
Section A	Unit – 1	2	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	3	
	Unit – 5	2	
Section B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	1	
	Unit – 5	2	
Section C	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	-	
	Unit – 4	1	
	Unit - 5	1	

TITLE OF THE PAPER: GENETICS – A MOLECULAR APPROACH

Subject Code: 16PZOOC03	**Core Paper** 3: **Theory**	**Marks: 100**
Semester: I	**Credits: 4**	**Total Hours: 75**

Course Objective: To understand the modern concepts of gene, genome, mutation at the molecular level and its functions.

UNIT I **(15 hrs)**

Gene Structure and Function: Fine structure of the gene. The Cis-trans test, Phage T4, rII locus, gene-linear set of nucleotide pairs – Colinearity of gene. One gene – One enzyme hypothesis (Neurospora, Eye pigmentation in Drosophila) One gene – One polypeptide concept (Human haemoglobin). The Lactose Operon in E. coli. Induction and Repression – Activator and Repressor proteins and their control. Regulatory components of the lac system. Chemical modification of histones – DNA methylation and Genomic imprinting. X Chromosome inactivation in mammals.

UNIT II **(10 hrs)**

Human Genetics: Cytogenetic mapping Karyotype, Preparation, Banding techniques and importance. Idiogram. Variations in human karyotypes (autosomal and sex chromosomal, structural and numerical). Genetic counseling. Principles and methods of pedigree analysis (autosomal dominant, autosomal recessive ,x- linked and mitochondrial).

Unit III **(15 hrs)**

Molecular basis of mutations: Radiation induced mutation, chemically induced mutation, mutagens, mutable, mutator genes and mutation frequency - Transposons as mutational elements – Oligonucleotide - directed Mutagenesis – PCR – amplified oligonucleotide – directed mutagenesis. Biological repair mechanisms – Direct reversal of damaged DNA, Alkyltransferases and Photolyase. Excision repair, Post replication repair.

Unit IV **(15 hrs)**

Gene Therapy: Human diseases treated for gene therapy. Virus as vectors, non- viral DNA delivery systems. Embryo therapy, *Ex vivo* therapy. *In vivo* therapy, antisense gene therapy. Target tissue of choice for gene delivery systems. Somatic gene therapy for genetic and acquired diseases. Nanotechnology for drug targeting.

Unit V **(20 hrs)**

Genomes and mapping: Human genome project, Goals, Structure of eukaryotic nuclear genome – The repetitive DNA, Microsatellites, minisatellites, Interspersed repeats. Linkage map, Physical map – Restriction map, FISH map– Radiation map.

TEXT BOOK:

1. Peter J. Russel W.W. Genetics. Benjamin Cummings. 2002. Website **www.geneticsplace.com**

REFERENCE BOOKS:

1. Anna.C.Pai: Foundation Genetics, Mc Graw Hill Book Company.
2. Burns, G.W.- The Sciences of Genetics. Mac millan Publishing Co. New
3. Gardner: Principles of Genetics. 8TH Edition. John Wiley and sons
4. Ursula Goodenough: Genetics. Saunders College Publishing.
5. Benjamin Lewin Gene VII (2000). Oxford University press.
6. Griffiths,Gelbart, Lewontin and Miller.Modern Genetic Analysis. W.H. Freeman and Company.
7. P.K.Gupta. Biotechnology and Genomics. Rastogi publications.

Question paper pattern:

Section	Question Component	Numbers	Marks	Total
Section A	Definition / Principles Answer any 10 out of 12 questions	1 – 12	2	20
Section B	Short Answer (Answer any 5 out of 8 questions)	13 - 20	8	40
Section C	Essay Answer any 2 out of 4 question	21 - 24	20	40
	Total Marks			100

Distribution of Questions:

Sections	Units	No. of Questions	
		Theory	Problems
Section A	Unit – 1	2	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	3	
	Unit – 5	2	
Section B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	1	
	Unit – 5	2	
Section C	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit - 5	-	

FISH BIOLOGY & FISHERIES

Subject Code: 16PZOOE01	ELECTIVE –I **/ Theory**	**Marks: 100**
Semester: I	**Credits: 4**	**Total Hours: 80**

Course Objective: This subject gives the in depth knowledge about fishes and fish farming.

UNIT I: INTRODUCTION OF FISH (16hrs)

Definition – salient features of the fishes-classification-Berg's classification-evolution and phylogeny of fishes-locomotion-locomotion due to the movement of appendages-general principles of locomotion-types of locomotion-special modes of locomotion-migration in fishes-types of migration-factors influencing fish migration-advantages of fish migration.

UNIT II: DIGESTION, GILL RESPIRATION & RESPIRATORY ORGANS (16hrs)

Food and feeding-food quality-alimentary canal-digestive glands-physiology of digestion-adaptive modifications in digestive tract of fishes-types of gills-structure of gill-specialized cells of gills of fishes-mechanism of gill respiration-air bladder and Weberian apparatus-function of air bladder-Weberian ossicles and their function.

UNIT III: REPRODUCTION & GROWTH STUDIES (16hrs)

Role of hormones in reproduction and induced breeding - maturity stages - morphological and histological observation of gonads – cryopreservation-growth-factors influencing growth -- length-weight relationship-condition factor- age determination

UNIT IV: FISH GENETICS AND IMMUNOLOGY (12hrs)

Sex determination in fish – monosex production - hormonal and chromosomal methods - hybridization techniques in aquaculture, androgenesis and gynogenesis- fish immune system.

UNIT V: CULTURE & CAPTURE FISHERY OF INDIA (20hrs)

Types of culture-fresh water-brackish water-mariculture-pond culture-extensive-semi-intensive & intensive-construction and maintenance of fish farm-composite fish culture of Indian major carps & exotic carps-hatchery techniques-integrated fish culture-paddy cum fish-paddy cum prawn-fresh water prawn culture.

Fishery zones of India and the type of fishery in these zones-fisheries of Oil-sardine, Indian mackerel, Bombay-duck and Hilsa-fishing crafts and gears-preservation and processing- by-products of fishery industry.

REFERENCE/BOOKS:

1. Gupta, S.M., 2010. Text book of fishery, Ann Backer, Mumbai.
2. Hanifa, M.A, 2011. Aquatic resources and aquaculture, Dominent, New Delhi.
3. Pandey.K and Shukla, J.P.2010. Fish and fisheries,Rastogi Publications,Meerut.
4. Parihar, R.P. 1996. A text book of fish biology and Indian fisheries,central publishing house, Allahabad, India.
5. Khanna, S.S., and Singh H.R.2012.A text book of fish biology & fisheries,Narendra publishing house.
6. Baluyut, E. A. (1989). Aquaculture systems and Practices. A selected review Publishing House, New Delhi.
7. Chondar. A (1970). Handbook of breeding of Indian major carps by pituitary harm one injection. Agra Satisdh Book Enterprise.
8. Day. F (1958). Fishes of India, Vol. I and Vol. II. William Sawson and Sons Ltd., Londan.
9. Jhingran, C. G. (1981). Fish and Fisheries of India. Hindustan Publilcating Co., India.

Question paper pattern:

Section	Question Component	Numbers	Marks	Total
Section A	Definition / Principles Answer any 10 out of 12 questions	1 – 12	2	20
Section B	Short Answer (Answer any 5 out of 8 questions)	13 - 20	8	40
Section C	Essay Answer any 2 out of 4 question	21 - 24	20	40
	Total Marks			100

Distribution of Questions:

Sections	Units	No. of Questions	
		Theory	Problems
Section A	Unit – 1	2	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	3	
	Unit – 5	2	
Section B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	1	
	Unit – 5	2	
Section C	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	-	
	Unit - 5	1	

SEMESTER - II

TITTLE OF THE PAPER: FUNCTIONAL MORPHOLOGY AND PHYLOGENY OF CHORDATES

Subject Code: 16PZOOC06	**Core Paper** 4: **Theory**	**Marks: 100**
Semester: II	**Credits: 4**	**Total Hours: 75**

Course Objectives: To enhance knowledge of the chordates and their evolutionary significance.

UNIT I **(15 hrs)**

Geological time scale – Fossil records in the various strata. Origin of Chordates- Theories. Broad classification of Chordates – Phylogenetic Affinities of Cephalochordata and Urochordata.

UNIT II **(20hrs)**

Evolutionary and structural pecularities of Cyclostomata and affinities – Petromyzon – Myxine. Elasmobranch evolution –Dipnoi structural pecuilarities, Discontinuous distribution and their affinities. Coelocanth fishes. Economic importance of fishes. Parental care in fishes.

UNIT III **(10 hrs)**

Amphibia- Origin and evolution. Adaptive radiation in Amphibia.

Reptilia - Origin and evolution of reptiles. Adaptive radiation of modern reptiles; Dinosaurs- reasons for extinction.Sphenodon.

UNIT IV **(10 hrs)**

Aves - Origin and evolution - Origin and distribution Ratitae.

Mammals – Origin and evolution - critical account of Prototheria, Metatheria and Eutheria. Adaptive radiation in mammals.

UNIT V **(20hrs)**

Comparative anatomy – Comparative study of Integumental derivatives , Jaw suspension – Fate of visceral arches. Respiratory organs, Vertebrate Kidney , Urinogenital organs, Brain, Heart and Aortic arches.

TEXT BOOK:

1. Newman, The Phylum Chordata, Mac Millan and Co.

REFERENCE BOOKS:

1. Colbert, E.H. Evolution of Vertebrates. Wiley Eastern Limited.
2. Hyman, L.H – Comparative Vertebrate Zoology. University of Chicago Press
3. Romer, A.S. Vertebrate body. Saunder‟s company
4. Young, J.A- Life of Vertebrates. Oxford press.
5. Waterman, A.J – Chordate structure and Function. Mac Millian and co.

Question paper pattern:

Section	Question Component	Numbers	Marks	Total
Section A	Definition / Principles Answer any 10 out of 12 questions	1 – 12	2	20
Section B	Short Answer (Answer any 5 out of 8 questions)	13 - 20	8	40
Section C	Essay Answer any 2 out of 4 question	21 - 24	20	40
	Total Marks			100

Distribution of Questions:

Sections	Units	No. of Questions	
		Theory	Problems
Section A	Unit – 1	2	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	3	
	Unit – 5	2	
Section B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	1	
	Unit – 5	2	
Section C	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	-	
	Unit - 5	1	

TITLE OF THE PAPER: BIOPHYSICS AND BIOSTATISTICS

Subject Code: 16PZOOC07	**Core Paper** 5: **Theory & Problems**	**Marks: 100**
Semester: II	**Credits: 4**	**Total Hours: 75**

Course Objective: To highlight the statistical applications in biological sciences and to enhance theprinciples of physics in biology.

UNIT I **(15 hrs)**

Principles of light Microscopy and Electron Microscopy and their applications; Principles and methods of Histology and Histochemistry, Freeze-drying, Freezing Microtome and Cryostat.

UNIT II **(15hrs)**

Electronic configuration of an atom ; Vander Waal‟s forces – Hydrophobic and hydrophilic interactions; Principles and different types of Chromatography and Electrophoresis; Principles and applications of Colorimetry, Spectroscopy, Ultra violet and Infra-red Spectroscopy in Biological investigations.

UNIT III **(15 hrs)**

Phenomenon of Radioactivity: Isotopes and their use in biological investigations. Biological effects of radiation- Determination and measurement of radio activity-Geiger Muller and scintillation counter- Biological applications of radio isotopes and autoradiography.

UNIT IV **(12 hrs)**

Sampling and sample Designs- Definitions – Theoretical basis-Laws – Methods. Sampling and Non-sampling errors. Variables-Qualitative and Quantitative, Discrete and Continuous. Types of classification-Qualitative and Quantitative. Qualitative- chronological, geographical etc, Quantitative –Frequency distribution, Discrete and Continuous frequency distribution. Diagrammatic and Graphical representation of Data-Bar diagrams-Pie diagrams- Cartograms. Frequency distribution-Histograms, Frequency Polygon, Frequency Curve

UNIT V **(18 hrs)**

Measures of central tendency. Arithmetic Mean, Median and Mode. Definition and computation for different types of data (ungrouped, discrete and continuous frequency distribution). Measures of Dispersion: standard deviation. Definition-computation for different types of data (ungrouped data, discrete and continuous frequency distribution). Correlation- Definition and Types. Scatter diagram. Computations of Karl Pearsons coefficient of correlation. Students – 't' test and Chi square analysis.

TEXT BOOKS:

1. Dr.S.P.Gupta, Statistical Methods. (1984) Sultan Chand and Sons, New Delhi
2. M.A Subramanian, Biophysics Principles and Techniques (2005), MJP Publishers.

REFERENCE BOOKS:

1. Pillai, R.S.N.and Bagawathi.V Statistical Theory and practice (1989).
2. Sokal, R.R and Roulf, F.J - Biometry. The Principles and Practice of Statistics in Biological Research. (1969).

Question paper pattern:

Section	Question Component	Numbers	Marks	Total
Section A	Definition / Principles Answer any 10 out of 12 questions	1 – 12	2	20
Section B	Short Answer (Answer any 5 out of 8 questions)	13 - 20	8	40
Section C	Essay Answer any 2 out of 4 question	21 - 24	20	40
	Total Marks			100

Distribution of Questions:

Sections	Units	No. of Questions	
		Theory	Problems
Section A	Unit – 1	2	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	3	
	Unit – 5	1	1
Section B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	1	
	Unit – 5	1	1
Section C	Unit – 1	-	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	-	1
	Unit - 5	-	1

TITLE OF THE PAPER: MICROBIOLOGY

Subject Code: 16PZOOC08	**Core Paper** 6: **Theory**	**Marks: 100**
Semester: II	**Credits: 4**	**Total Hours: 75**

Course Objective: To understand the structural details of the microbes and correlate with microbial diseases. To understand the role of microbes in the environment and in the field of food production, biotechnology etc.

UNIT I **(18 hrs)**

History and Scope: Mile stones in microbiology - Microbial Taxonomy-Classification system- Phenetic – Numerical – Phylogenetic. Major characteristics- Classical and Molecular, Phylogenetic tree, Domain kingdom – DNA and Ribosomal RNA analysis Characterization and identification- Serological and Gene probe method.

Morphology-Ultra structure of Bacteria, Fungi and Viruses- Bacterial physiology-Growth and Nutrition-Nutritional requirements-Kinetics of growth.

Enumeration of bacteria – Viable plate count-MPN procedure.

UNIT II **(18 hrs)**

Medical microbiology- Pathogenic Microbes Bacterial –Tuberculosis, Whooping cough and Tetanus, Viral- Measles, Hepatitis, and HIV, Fungal –Candid. Protozoan Diseases – Amoebiasis and Malaria. Cure, Control and Prevention.

UNIT III **(12 hrs)**

Microbial Ecology and Environmental Microbiology-Role of microorganisms in carbon, nitrogen and sulphur cycle. Population interaction – commensalisms, co –metabolism, epiphyte, synergism, mutualism, competition, predation, and parasitism.

UNIT IV **(12 hrs)**

Food and Dairy Microbiology- Microbes in food, Role of microorganisms in food production, dairy and non-dairy-Fermented food and Alcoholic beverages. Microorganisms and Food spoilage.

UNIT V **(15 hrs)**

Industrial Microbiology- Industrial uses of microbes- Fermentation products. Production of Pencillin, Ethanol, Vinegar, Vitamin B_{12}, Citric acid and Protease. Methods of Immobilisation: Types of Reactors: Animal and Plant Cell Bioreactors.

TEXT BOOK:

1. Michael. J. Pelczar Jr, Chan. E.C.S, Kriej, Noel.R- Microbiology. Tata Mac Graw hill.

REFERENCE BOOKS:

1. Dubey, R.C. and Maheswari, D.K, A text book of Microbiology.
2. Lansing, M. Prescott, John P.Harley and Donald A. Klein. Microbiology Mc Graw Hill (1999):
3. Patel, A.H. - Industrial Microbiology (2001). MacMillan india Limited.
4. Powar and Daginwala: General Microbiology - Vol II Microbiology-fourth edition
5. Ronald, M. Atlas, Principles of Microbiology (1997)
6. Sharma. P.D, Microbiology- A text book for university students

Question paper pattern:

Section	Question Component	Numbers	Marks	Total
Section A	Definition / Principles Answer any 10 out of 12 questions	1 – 12	2	20
Section B	Short Answer (Answer any 5 out of 8 questions)	13 - 20	8	40
Section C	Essay Answer any 2 out of 4 question	21 - 24	20	40
	Total Marks			100

Distribution of Questions:

Sections	Units	No. of Questions	
		Theory	Problems
Section A	Unit – 1	2	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	3	
	Unit – 5	2	
Section B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	1	
	Unit – 5	2	
Section C	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	-	
	Unit - 5	1	

Elective II - TITLE OF THE PAPER: AQUARIUM FISHES (IDP)

Subject Code: 16PZOOE02	Elective II: **Theory**	**Marks: 100**
Semester: II	**Credits: 4**	**Total Hours: 80**

Course Objective: To provide basic information on common aquarium fishes of India and its export potential.

UNIT I **(13 hrs)**

Introduction: Taxonomy and biology of some common Fresh water and Marine Ornamental Fishes.

UNIT II **(18 hrs)**

Food and Feeding Management: Live feed organisms (Daphnia, Tubifex, Cyclops, Brachionus, Chlorella etc.) - Formulated feed (Freeze dried tubifex, liver, vegetable food, etc.) – Method of preparation of commercial feed and quality assessment of feed.

UNIT III **(18 hrs)**

Aquarium Keeping and Management: Setting up of an aquarium tank – Selection of stone and gravel – Decors - Aquarium plants – Water quality management – Aeration – Illumination devices - Salinity – pH - Temperature maintenance – Filtration (Mechanical and Biological filters). Safety measures and devices for maintenances.

UNIT IV **(18 hrs)**

Breeding techniques and Health assessment: Development of brood stocks – Selection of brood fishes - Breeding of Egg layers and Live bearers – Common diseases of aquarium fishes and their control – Microbial: Bacterial, Viral and Fungal diseases; Non – microbial – Protozoans, Trematodes, Cestodes, Nematodes and Crustaceans.

UNIT V **(13 hrs)**

Prospects of ornamental fishes: Export and industrial importance - Hobby and household industry – List of fresh water and marine ornamental fishes available in India for export with its indicative prices - Role of women in ornamental fish culture.

TEXT BOOK:

1. Donald Wilkie, Aquarium fish (1985). Pelhem Book, Ltd.

REFERENCE BOOKS:

1. Boulenger, E.G., Keep an Aquarium (1939).
2. Dey V.K., Ornamental fishes-MPEDA Hand book of Aquafarming
3. Harvey Jack Hims. Georg, F., A guide to fresh water Aquarium fishes. Hamylnn publications, 1973.
4. Gregory C. Bateman, Fresh water Aquaria - 7th edition. Revised by Jack Hen.
5. Hornell, J.Guide to Madras aquaria (1921).
6. John G. Shedd, Aquarium (1933).
7. Stephen Spotte, Marine Aquarium keeping. The Science, Animals and Art. (1973).John Wiley & Sons.
8. William T. Innes, The aquarium (1932).
9. Robert Goldstein, Diseases of aquarium fishes (1971). T.F.H. Publication.

Question paper pattern:

Section	Question Component	Numbers	Marks	Total
Section A	Definition / Principles Answer any 10 out of 12 questions	1 – 12	2	20
Section B	Short Answer (Answer any 5 out of 8 questions)	13 - 20	8	40
Section C	Essay Answer any 2 out of 4 question	21 - 24	20	40
	Total Marks			100

Distribution of Questions:

Sections	Units	No. of Questions	
		Theory	Problems
Section A	Unit – 1	2	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	3	
	Unit – 5	2	
Section B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	1	
	Unit – 5	2	
Section C	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	-	
	Unit - 5	1	

TITLE OF THE PAPER: PRACTICAL – INVERTEBRATA, CHORDATA ANDFISHERY BIOLOGY

Subject Code: 16PZOOC04P	Core – Practical - I	**Marks: 100**
Semester: I & II	**Credits: 4**	**Total Hours: 60**

INVERTEBRATA

1. Identification and study of selected Protozoans and Helminthes of medical importance.
2. Identification and study of sections of certain animals from Coelenterata, Aschelminthes and Annelida to understand the evolution of different types of coelom.
3. Identification and study of Larval Forms from all Major Phyla of Invertebrates.
4. Identification and study of Invertebrate Fossils (specimens).
5. Dissection and mounting of Digestive, Nervous and Reproductive Systems in
   1. Scorpion 2. Gryllotalpa and 3. Grasshopper.
6. Dissection of the Nervous system in 1. Mytilus and 2. Sepia
7. Mounting of Pedicellariae and Aristotle lantern in Sea Urchin.

CHORDATA

1. Dissection of internal ear in Shark.
2. Dissection of aortic arches in Shark
3. Dissection and Display of Arterial and Venous System, in Teleost fish

DEMONSTRATION

4. Identification of important Prochordates, South Indian Fishes, Amphibians, Reptiles, Birds and Mammals.

FISHERY BIOLOGY

1. Fish Morphology – Morphometric characters: Head Structure, Types of scales in fishes.
2. Identification of: a) Marine, fresh water and estuarine fishes up to species level.
   b) Cultivable prawns.
3. Commercially important invertebrates: Crab, Lobsters, Pearl oyster, Edible Oyster,

Mytilus, Sepia and Loligo – their economic importance.

4. Age determination – Scale method.
5. Observation of maturity stages of gonads and determination of Gonadosomatic index and fecundity.
6. Gut content analysis of some important fishes in relation to feeding habits.
7. Observation of Gears and Crafts.
8. Observation of fish parasites.
9. Observation of Larvivorous fishes and Aquarium fishes.
10. Observation of seaweed species – their economic importance.
11. Observation of Live feed organisms.

TITLE OF THE PAPER: PRACTICAL II: CELL AND MOLECULAR BIOLOGY, BIOPHYSICS, BIOTECHNOLOGY, GENETICS, BIOSTATISTICS AND MICROBIOLOGY

Subject Code: 16PZOOC05P	**Core – Practical - II**	**Marks: 100**
Semester: I & II	**Credits: 4**	**Total Hours: 60**

CELL AND MOLECULAR BIOLOGY

1. Cytological techniques

Micrometry: Microscopic caliberation and Measurements of cell size using ocular and stage micrometers.

2. Study of different types of cells

Blood cells –Differential count in man, fish**.**

1. Histochemical techniques

Demonstration: Fixation, Dehydration, Embedding, staining (vital staining) and Mounting.

Histochemical localisation of

a. DNA
b. Lipids
c. Proteins

BIOPHYSICS

Demonstration:

1. Spectrophotometry: Principle and application
2. Electrophoresis: Description and applications.

BIOTECHNOLOGY

Demonstration:

a. Isolation of genomic DNA.
b. Isolation of plasmid DNA from bacteria.
c. Agarose gel Electrophoresis of DNA.

GENETICS

1. Preparation of culture medium and culture of Drosophila-methods of maintenance.
2. Identification of Drosophila species and mutants.
3. Identification of human blood groups and Rh typing.
4. Preparation of Human karyotypes – Analysis of Normal and abnormal karyotypes (Down‟s syndrome, Turner‟s syndrome, Klinefelter‟s syndrome).

BIOSTATISTICS

1. Problems relating to mean, mode and median.
2. Problems relating to standard deviation.
3. Problems relating to standard error.
4. Problems relating to Chi- square method for testing genetic ratios.

MICROBIOLOGY

1. Microscopic observation for identification and characterization of microorganisms relevant to theory syllabus.
   a. *Staphylococcus aureus*
   b. *Escherischia coli*
   c. *Rhizopus*
   d. *Aspergillus niger*
   e. *Aspergillus flavus*
   f. *Penicillium*
   g. *Nostoc*
   h. *Oscillatoria*
   i. *Volvox*
2. Culture medium and preparation.
   i. Preparation of peptone water
   ii. Preparation of nutrient broth
   iii. Preparation of solid media.
      1. Slant
      2. Stab
      3. Plate.
3. Simple and Differential staining of bacteria.

SEMESTER-III

TITLE OF THE PAPER: BIOINFORMATICS AND COMPUTER APPLICATIONS

Subject Code: 16PZOOC09	**Core Paper** 7: **Theory**	**Marks: 100**
Semester: III	**Credits: 4**	**Total Hours: 60**

Course Objective: To impart knowledge and techniques of computers and to provide biologically important predictions from annotated data and transformation of their for DNA analysis.

UNIT I **(10hrs)**

Computer Hardware: Input Devices: Punched cards, Punched papers, tape, key board, barcodes, magnetic ink character readers, light pen, mouse, optical mark reader.

Output Devices – Printers, visual display unit, memory devices- primary memory devices – ROM and RAM, secondary memory devices – magnetic tapes, floppy disk, hard disk, CD.

UNIT II **(10hrs)**

Computer Software: Operating system –Windows. Ms Office - Ms Word, Power point, Ms Excel.

UNIT III **(10hrs)**

Internet: The concept of networking computers –LAN and WAN – Internet explorer - Use of the internet- Browsing and mailing –Multimedia.

UNIT IV **(15hrs)**

Bioinformatics: Genomics, Proteomics, Human Genome project, DNA arrays , the need for computers in biology.

UNIT V **(15hrs)**

Bioinformatics: Computers in medical imaging- CAT and MRI. DNA Sequence Analysis, Protein Sequence Analysis and Structure determination. Computers in drug design.

TEXT BOOK:

1. V. Rajaraman, Fundamentals of computers (1985) Prentice Hall of India. Pvt,

REFERENCE BOOKS:

1. Alan Fielding, Computing for Biologists (1985) Benjamin Cuming Publishing Co.
2. D. Heams and M.P.Bakers, Computer graphics (1990) -Prentice Hall of India Pvt , Ltd.
3. J.P.Lamoitier, Basic exercises for the IBM personal computer (1985). Sybex Inc., Berkely, U.S.A..

Question paper pattern:

Section	Question Component	Numbers	Marks	Total
Section A	Definition / Principles Answer any 10 out of 12 questions	1 – 12	2	20
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	Total Marks			100

Distribution of Questions:

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Section A	Unit – 1	2	
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	Unit – 3	2	
	Unit – 4	3	
	Unit – 5	2	
Section B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	1	
	Unit – 5	2	
Section C	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	-	
	Unit - 5	1	

TITLE OF THE PAPER: DEVELOPMENTAL AND STEM CELL BIOLOGY

Subject Code: 16PZOOC10	**Core Paper** 8: **Theory**	**Marks: 100**
Semester: III	**Credits: 4**	**Total Hours: 75**

Course Objective: To understand the use of ― Cells as medicine ― instead of drugs stem cells can alleviate the side effects of chemotherapy and repair the damaged organs, developmental biology helps to understand the ontogeny of animals.

UNIT I **(15 hrs)**

Definition – Explants- Balanced salt solution- Culture media – Maintenance of aseptic conditions – Culture of animal tissues – Isolated cells – Storage – Applications – Cryobanks – Breeding rare species – Test tube babies.

UNIT II **(15 hrs)**

Definition and measuring of stem cell- origin and functions of stem cells- Asymmetric division of stem cells – Types of stem cells-HSCS-MSCS-NSCS-ESCS-Adult stem cells vs embryonic stem cells-Migration- Therapeutic cloning- Ethical issues- Stem cell therapy.

UNIT III **(15 hrs)**

Chemodifferentiation- Nucleus of cleavage cells- Distribution of cytoplasmic substances in the egg during cleavage – Role of egg cortex – Role of maternal genes during early development.

UNIT IV **(15 hrs)**

Gene activity during gastrulation- Involvement of paternal genes in the control of development – Hybrid andromerogones- Exogastrulation- Arrested gastrulation- Amniotic and Allantoic fluids- Nucleocytoplasmic interactions- Control of differentiation by the intra organismic environment- Control of the reactive ability of tissues by the genotype.

UNIT V **(15 hrs)**

Determination of primary organ rudiments- Speemann‟s primary organiser- Analysis of the nature of induction- Gradients in the determination of the organ rudiments in vertebrates – Human cloning and its ethical applications- Ageing and developmental potential.

TEXT BOOK:

1. Balinsky B.I., An introduction to Embryology. (1981) Saunders,Philadelphia.

REFERENCE BOOKS:

1. M.J. Berrill–Developmental Biology. (1986) Tata Mc Graw Hill ,publications Ltd.
2. Raven : An outline of developmental physiology. Porgaman press.
3. Robert S.RughThe frog Reproduction. (1951) Tata Mc Graw Hill publications Ltd.
4. P.K.Gupa, Biotechnology and genomics.

Question paper pattern:

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	Unit – 3	2	
	Unit – 4	3	
	Unit – 5	2	
Section B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	1	
	Unit – 5	2	
Section C	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	-	
	Unit - 5	1	

TITLE OF THE PAPER: ENVIRONMENTAL BIOLOGY AND EVOLUTION

Subject Code: 16PZOOC11	**Core Paper** 9: **Theory**	**Marks: 100**
Semester: III	**Credits: 4**	**Total Hours: 75**

Course Objective: To study the interaction between living organism and the environment. The environmental biotechnology is an advanced branch of biology having application in environmental science.

UNIT I **(15hrs)**

Habitat Ecology-Fresh water habitat- Lotic and lentic adaptations- Marine habitat- Zonation of sea –Plankton, Importance of planktons in productivity, as indicator organisms. Nekton and Benthos.

Estuarine adaptations and its role in productivity. Major Biomes with special reference to rain forest and high altitudes. Deserts and Mangrooves.

UNIT II **(15hrs)**

Resources Ecology and Management –Renewable and Non-renewable Natural Resources. Aquatic and Animal resources, Wild life Conservation and Management. National Parks and Sanctuaries in India.

UNIT III **(15hrs)**

Biodiversity-Types of Environmental Pollution and their Biological Effects –Air and Water, Industrial and Noise - Control measures. Laws Related to Environment. Space ecology and Radiation ecology and its effects on Biosphere.

UNIT IV **(15hrs)**

Darwinism – Darwinian postulates – Natural selection – Define : Present status of the concept of natural selection: Types – Normalizing , Balancing and Directional Natural Selection. Group selection –Kin selection.

Evolutionary trend: Orthoselection . Genetic drift and Gene flow – Founder principle – Micro, Macro and Mega Evolution. Mimicry and Colouration .

UNIT V **(15hrs)**

Molecular evolution- Amino acid substitution – Evolution of mammalian Antidiuretic hormone – Cytochrome –C – Haemoglobin regulating genes.

Phylogenetic analysis- chromosome phylogenies – Electrophoretic phylogenies-

TEXT BOOKS:

1. Anantha krishnan, T.N., Bioresources Ecology. (1982) Oxford- IBH Publishing Co, New Delhi.
2. Theodosis Dobzhansky , Francisco J .Ayala, G.Ledyard Stebbins, James W.Valentine, Evolution (1977) W.H.Freeman and Co.

REFERENCE BOOKS:

ENVIRONMENTAL BIOLOGY

1. Began M.J.L.Harper and C.R.Town Send (1990), Ecology, individuals, populations and communities. Blackwell Scientific Publication, London.
2. Clarke, G. L., Elements of Ecology (1954), John Wiley, New York.
3. Odum .E.P. Fundamentals of Ecology (1971) 3rd Edition, W.B.Saunder Co, Philadelphia.
4. Elton,C. Animal Ecology, (1971), Metheun company.
5. Rastogi, V.B. and Jayaraj, M. S., Animal ecology and distribution of animals, (1990) Kedra nath Ramnath, Merrut.
6. Chapman, R. N. 1931 Animal Ecology, Mc Graw Hill. New York.

EVOLUTION

1. Moody. P.A., Introduction to Evolution, (1978) Harper International .
2. Peter Volpe.E., Understanding and patterns in Evolution (1998), Oxford University Press.
3. Charlottee.J. Avers, Process and Pattern in Evolution (1989) Oxford University Press.

Question paper pattern:

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	Unit – 3	2	
	Unit – 4	3	
	Unit – 5	2	
Section B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	1	
	Unit – 5	2	
Section C	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	-	
	Unit - 5	1	

ELECTIVE III: ENTOMOLOGY

Subject Code: 16PZOOE03	ELECTIVE III: Theory	Marks: 100
Semester: III	Credits: 4	Total Hours: 80

Course Objective:

To study about the insects and their habitats and physiology.

To study about the economic importance of insects.

UNIT I: **(13 hrs)**

Biology of an insect with special reference to the following: Nutrition, Development, Reproduction and Endocrinology. Insects and their interrelationships with environments (interspecific and intraspecific).

UNIT II: **(13 hrs)**

Insects as pollinators, predators, parasitoids, scavengers, weedkillers, etc.,

Biology of Honeybees, Lac insects and their management.

Prospects of Sericulture, Biology of Silkworm (Nutrition, Genetics, Endocrinology, Reproduction, Pest and Diseases).

UNIT III: **(18 hrs)**

Insects as crop pests: Types of injuries and loss caused to plants in general factors governing the outbreak of pests. Pests of rice, sugarcane, coconut, vegetables, stored products.

UNIT IV: **(18 hrs)**

Methods of pest control- Natural control-Applied or Artificial control- Prophylatic methods-Curative or Direct method- Cultural methods- Mechanical method, Physical method- Biological methods-Chemical methods- Attractants, Repellents, Antifeedants.

UNIT V: **(18 hrs)**

Pesticide – Classification of Insecticides- Inorganic compounds- Organic compounds, Synthetic organic compounds. Plant protection appliances- Dusters and Sprayers, Aircraft and Other equipments. Integrated Pest Management.

REFERENCES:

1. The Science of Entomology. William S. Romoser and John G. Stoffolano. Wm. C. Brown Publishers, England. 1994.
2. The Silkwonn. An important laboratory tool. By Yataro Tazima, Kodarsha, Scientific Book Ltd., Japan. 1978.
3. Sericulture Manual: FAD, Agril, Service Bulletin, Rome.
4. Applied Entomology: P. G. Fenemore, Allaprkash, Wiley Eastern Ltd., Delhi. 1992.
5. Park, J. E and K. Park. Textbook of social and preventive medicine. Publ. Mis. Banarasides Bharol. Jabalpur.
6. Nayar, K. K, Ananthakrishnan, T. Nand B. V. David. General and Applied Entomology. Tata McGraw Hill Publ., New Delhi. 1989.
7. Entomology and Pest Management. Larry, P. Pedigo Prentice Hall, New Jersey. 1989.

Question paper pattern:

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	Total Marks			100

Distribution of Questions:

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	Unit – 3	2	
	Unit – 4	3	
	Unit – 5	2	
Section B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	1	
	Unit – 5	2	
Section C	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	-	
	Unit - 5	1	

SEMESTER - IV

TITLE OF THE PAPER: ANIMAL PHYSIOLOGY

Subject Code: 16PZOOC14	**Core Paper** 10: **Theory**	**Marks: 100**
Semester: IV	**Credits: 4**	**Total Hours: 60**

Course Objective: To enlighten the functional aspects of organ system in the body of animal and man towards internal equilibrium homeostasis.

UNIT I **(15 hrs)**

Enzyme action-Factors influencing enzyme action and its reversibility. Digestive enzymes - Mechanics of adsorption-Gastrointestinal hormones.

Exchange of gases-Transport of oxygen- Properties and Functions of Haemoglobin, Oxygen equilibrium curves. Carbon-di-oxide transport and Acid-base regulation-regulation of respiration. Life at high altitudes. Man as a deep sea diver.

UNIT II **(10 hrs)**

Haemodynamics in open and closed circulatory system: Electrical activity of heart muscle. Neurosecretion- Mechanisms of Hormonal Action. Physiology of Endocrine System. Sex hormones.

UNIT III **(10 hrs)**

Patterns of excretion in relation to environment. Renal regulation of acid-base balance. Osmo - ionic regulation in invertebrates and vertebrates. Physiology of hypertonic urine formation.

UNIT IV **(15 hrs)**

Muscle physiology-contractile proteins - Theories of muscle contraction. Isotonic and isometric contractions. Tetanus – Myoneural junction - Transducer mechanism in vertebrate chemoreceptors- Chemical sense and animal orientation. Theories of hearing - Echo-orientation-Photoreceptor pigments - Human eye retina-Phototropic, Scotopic and Arythmic eyes.

UNIT V **(10 hrs)**

Animal behaviour-Instincts-Learning –Physiological basis of learning-Circardian and Circannual rhythm-Photoperiodism. Role of pheromones – Communication.

TEXT BOOK:

1. Hoar, W.S. General and Comparative Physiology.

REFERENCE BOOKS:

1. David Saunders: An Introduction to Biological Rhythms.
2. K.Nagabushanam,M.S.Kodarkar and R.Sarojini: An Introduction to Animal Physiology
3. Prosser C.L.Comparative animal physiology.
4. Schmidt-Nielson: Animal physiology.

Question paper pattern:

Section	Question Component	Numbers	Marks	Total
Section A	Definition / Principles Answer any 10 out of 12 questions	1 – 12	2	20
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	Total Marks			100

Distribution of Questions:

Sections	Units	No. of Questions	
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	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	3	
	Unit – 5	2	
Section B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	1	
	Unit – 5	2	
Section C	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	-	
	Unit - 5	1	

TITLE OF THE PAPER: BIOCHEMISTRY

Subject Code: 16PZOOC15	**Core Paper** 11: **Theory**	**Marks: 100**
Semester: IV	**Credits: 4**	**Total Hours: 60**

Course Objective: To train the students to apply the principles for a better understanding of biological phenomena and to impart knowledge.

UNIT I **(12 hrs)**

Nature of living matter- Biomolecules, pH, Buffers. Enzymes –Mechanism of enzyme action, coenzymes, classification and functions. Isoenzymes, Apoenzymes, Holoenzymes –Enzyme kinetics.

UNIT II **(13 hrs)**

Clinical Biochemistry - Test for Liver function, Serum bilirubin, Classification of Jaundice, Bile acids and Bile salts, Tests based on the metabolic capacity of liver, Tests based on synthetic function of liver. Gastric function – Mechanism of HCl secretion.

UNIT III **(13 hrs)**

Proteins-Classification based on structure and solubility- Protein metabolism- Amino acid metabolism- Oxidative Deamination, Transamination, Decarboxylation, Demethylation Reaction, Structure of Haemoglobin, Haemoglobinopathies.

UNIT IV **(10 hrs)**

Lipids- Classification –Structure and Properties, Steroids-Cholesterol and Sex hormones. Lipid metabolism-Metabolism of fatty acids and glycerol, Coronary Artery Disease.

UNIT V **(12 hrs)**

Bioenergetics- Electron Transport Chain, Laws of Thermodynamics. Metabolism of Xenobiotics –Detoxification – Definition – Mechanism – Phase I Oxidation, Reduction, Hydrolysis –Phase II Conjugation Reaction - Glucuronic acid, Glutathione , Sulphate, Acetate and Methyl group.

TEXT BOOK:

1. Ambika Shanmugam: Fundamentals of Biochemistry for Medical Students.

REFERENCE BOOKS:

1. J.L.Jain:Fundamentals of biochemistry(1983).
2. Lehninger,A.L.(1970):Biochemistry, worth publishing co.,N.Y.
3. Lubert stryer: Biochemistry- (1975) Freeman and co.
4. D.W.Martin,P.A.Mayer and V.W.Redwell:Harper"s Review of biochemistry 19th edition(1983).Maruyen Asian Edition.

Question paper pattern:

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Section B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	2	
	Unit – 4	1	
	Unit – 5	2	
Section C	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	-	
	Unit - 5	1	

TITLE OF THE PAPER: BIOTECHNOLOGY

Subject Code: 16PZOOC16	Core Paper 12: Theory	Marks: 100
Semester: IV	Credits: 4	Total Hours: 60

Course Objective: To impart knowledge in understanding the principles of biotechnology and its applications.

UNIT I **(15 hrs)**

Introduction , origin and definition , scope and importance. Cloning strategies: Isolation of genomic DNA , Plasmid and Bacteriophage DNA . Introduction of r DNA into host cell. Identification of recombinants – Selection.

UNIT II **(10 hrs)**

Tools of Genetic Engineering: Enzymes in Gene cloning. E.coli vectors – Plasmid biology – PBR322 and its derivatives- Gene markers, Cloning Vectors and Phage Lambda, m13 Filamentous Phages – Cosmid – Phagemid. Expression vectors.

UNIT III **(10 hrs)**

Gene expression in Prokaryotes and Eukaryotes: cloning in yeast *Saccharomyces cerevisiae* genetics. Types of vectors - gene expression system. Eukaryotic vectors – SV 40 molecular genetics – markers system. Specialized cloning vectors for copy number – cloning promoters and terminators.

UNIT IV **(15 hrs)**

Gene cloning in health- care products: Insulin, Human growth hormone – Interferons, Tissue plasminogen activator, Recombinant vaccines – Types of recombinant vaccines - subunit vaccines, attenuated recombinant vaccines, vector recombinant vaccines, DNA vaccines.

UNIT V **(10 hrs)**

Mining and metal biotechnology: Microbial enhancement of oil recovery –Biopolymers-surfactant and non-surfactant polymers. Biodegradation –Removal of metals from water. Xenobiotics and biomining

TEXT BOOK:

1. T.A. Brown – Gene cloning an Introduction (1995), Third edition Stanley Thornes Publishers.

REFERENCE BOOKS:

1. Benjamin Lewin Gene VII (2000) Oxford university press.
2. Desmond S.T.Nicholl- An introduction to Genetic Engineering (1996) – Cambridge University press.
3. Purohit- Biotechnology.
4. Schlegel- Genetic Engineering
5. R.W.Old and S.B.Primrose Principles of Gene Manipulation .(1994).V Edition . Blackwell Science.

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	Unit – 3	2	
	Unit – 4	1	
	Unit – 5	2	
Section C	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	-	
	Unit - 5	1	

IV - SEMESTER

TITLE OF THE PAPER: PRACTICAL III: ANIMAL PHYSIOLOGY, ENVIRONMENTAL BIOLOGY AND BIOCHEMISTRY

Subject Code: 16PZOOC12P	**CORE PRACTICAL III**	**Marks: 100**
Semester: III & IV	**Credits: 4**	**Total Hours: 60**

ANIMAL PHYSIOLOGY

1. Estimation of RQ in fish with reference to temperature.
2. O_2 consumption in a terrestrial animal (cockroach).
3. Salt loss and salt gain in fish.
4. Estimation of carbohydrates in the tissues of meat.
5. Determination of aminoacids in the tissues (Liver/muscle) of fish / egg albumin (paper chromatography).
6. Principles and applications of the following instruments: - Kymograph, spectrophotometer, Sphygomanometer, Electrophoretic unit.

ENVIRONMENTAL BIOLOGY

1. Identification of freshwater and marine planktons.
2. Study of rocky, sandy, muddy shore fauna, Marine, Fresh water fauna and their adaptations.
3. Determination of hydrobiological features of different samples – (freshwater, brackishwater, seawater and polluted water)-pH, salinity, free- carbon dioxide dissolved oxygen and calcium.
4. Analysis of macro and microorganisms in soil, soil litter of the GNC college campus.
5. Animal associations- parasitism , mutualism and commensalism
6. Study of termitarium (demonstration).
7. Earthworm population estimation.
8. Analysis of industrial effluent for TDS,TSS,BOD and COD.(demonstration)
9. Study of fauna in their natural habitats by visiting places of zoological interest.

BIOCHEMISTRY

1. Blood: Clotting time, bleeding time.
2. Estimation of hemoglobin.
3. Erythrocyte Sedimentation Rate (ESR) - Chick.

TITLE OF THE PAPER: PRACTICAL IV: DEVELOPMENTAL BIOLOGY, BIOINFORMATICS, COMPUTER APPLICATIONS, AND ENTOMOLOGY

Subject Code: 16PZOOC13P	**CORE PRACTICAL IV**	**Marks: 100**
Semester: III & IV	**Credits: 4**	**Total Hours: 60**

DEVELOPMENTAL BIOLOGY

1. Oogenesis and spermatogenesis – Histological studies in a mammal.
2. Demonstration. Induced ovulation and fertilization in frog or fish.
3. Egg density in frog / fish.
4. Mounting of chick embryo.

BIOINFORMATICS

1. Displaying any one web- page from Human Genome Project (Demonstration).

COMPUTER APPLICATIONS

1. Ms Word, Ms Excel
2. Preparing a Power point presentation.
3. Graphic presentation: Bar diagram and Histogram.

ENTOMOLOGY

1. **Taxonomy:** Identification of insects of orders Odonata, Orthoptera, Blattodea, Mantodea, Isoptera, Hemiptera, Thysanoptera, Neuroptera, Coleoptera, Diptera, Lepidoptera and Hymenoptera.
2. **Control**: Insecticide formulations and mixtures, common natural enemies of crop pests (parasitoids, predators, microbes)
3. **Storage entomology**: Collection, identification and familiarization with the stored grains/seed insect pests and nature of damage caused by them
4. **Plant protection appliances**: Dusters and sprayers.