DEPARTMENT OF ZOOLOGY

M.Sc. Zoology

P.G. PROGRAMME

SYLLABUS

Effective from the Academic Year 2012-2013

Loyola College (Autonomous)

Chennai- 600 034

LOYOLA COLLEGE (AUTONOMOUS)
CHENNAI - 600 034.

P.G. & RESEARCH DEPARTMENT OF ADVANCED ZOOLOGY AND BIOTECHNOLOGY, LOYOLA COLLEGE

M.Sc Zoology

Restructured CBCS curriculum Phase IV effective from 2012-'13

Sub. Code	Title of the paper	Category	Hr	Credits	Total hours (Total credits)
SEMESTER - I					
ZO 1819	Phylogeny of Invertebrata and Chordata		5	4	
ZO 1820	Systematics and Biodiversity		4	3	
ZO 1821	Advanced evolutionary biology		5	3	
ZO 1822	Advanced developmental biology		5	4	**30 H**
ZO 1823	Histochemistry and Microtechnique		5	4	**(20C)**
ZO 1824	Invertebrata, Chordata & Developmental biology lab course		6	2	
	LEAP Outside class hours				
SEMESTER - II					
ZO 2817	Molecular cell biology	5		5	
ZO 2818	Applied Entomology	4		4	
ZO 2819	Immunology	5		4	**30+2 H**
ZO 2820	Cell and molecular biology lab course	6		4	**(23+5 C)**
ZO 2821	Immunology and Biophysics lab course	4		3	
	Elective subject (ES) paper				
ZO 2957	Chronobiology and Animal behavior (OR)	4		3	
ZO 2958	Biophysics and Radiation biology				
	LIFE SKILLS TRAINING (LST)	2 +2		2	
	LEAP			3	
Summer training programme (STP) 3 to 4 weeks		Summer vocation		1	**1C**
SEMESTER - III					
ZO 3813	Principles of Ecology and Environmental Management	MC	5	4	
ZO 3814	Research Methodology	MC	4	3	
ZO 3815	Biochemistry and Animal Physiology	MC	6	5	
ZO 3816	Environmental Biology, Biochemistry and Physiology Lab course	MC (P)	5	3	30 Hr (23+2Cr)
ZO 3950	Genomics, Metagenomics and Epigenetics (Or)	ES	4	3	
ZO 3951	Fishery biology	ES	4	3	
ZO 3876	Bio-products and Marketing	ID	6	5	
	Self study (SSP) Outside class hours			2	
SEMESTER - IV					

ZO 4810	Project and Dissertation	P	14	10	
ZO 4811	Microbiology	MC	4	4	
ZO 4812	Biotechnology	MC	4	4	30 Hr
ZO 4813	Molecular Endocrinology and Reproduction	MC	4	3	(24Cr)
ZO 4814	Microbiology, Biotechnology and Endocrinology Lab course	MC (P)	4	3	

ZO 1819 - PHYLOGENY OF INVERTEBRATA AND CHORDATA

SEMESTER	**: I**	**CREDITS**	**: 04**
CATEGORY	**: MC**	**NO. OF HOURS / WEEK**	**: 05**

Objective : To enlighten the origin, evolution,adaptive radiation and phylogenetic relationships of invertebrates and chordates.

UNIT I: EVOLUTION OF INVERTEBRATES AND CHORDATES

Origin, ancestry and evolution of invertebrates and chordates-Geological time scale-living fossils-coelom-grades of symmetry-polymorphism- metamerism- cephalization- fossil records-ostracoderms and placoderms.

UNIT II: COMPARATIVE STUDY

Comparative anatomy of digestive, respiratory, exoskeletal, skeletal, circulatory, nervous and urinogenital systems of invertebrates and chordates-Locomotory organs and movements in invertebrates -Flight adaptations of birds-Placentation in mammals.

UNIT III: ADAPTIVE RADIATION

Adaptive radiation in Annelids and Molluscs – colonial and social life of Invertebrates- Adaptive radiation in Fishes, Amphibians, Reptiles, Aves and Mammals.

UNIT IV: PARASITES AND VECTORS

Parasitic adaptations and pathogenecity of *Entamoeba* , *Plasmodium* , *Fasciola*, *Taenia solium* , *Trypanosoma* , *Echinococcus* and *Ascaris*.

UNIT V: AFFINITIES AND SYSTEMATIC POSITION OF MINOR PHYLA

Nemertinea, Rotifera, Bryozoa, Brachiopoda, Chaetognatha and Pogonophora.

TEXT BOOKS

1. Bhamrah, H.S and Junoja, K. 1999. A Text Book of Invertebrates. Anmol, New Delhi, 775pp.
2. Marshall, A.J and Williams, D.1974. Text Book of Zoology, Invertebrates. ELBS and MacMillan, 874pp.
3. Barrington, E.JW. 1974. Invertebrate Structure and Function, English Language Book Society and Nelson, 549p.
4. Pough F.H., C.M. Janis and J.B. Heiser, 2002. Vertebrate Life, Peasrson Education, Singapore, 699pp.
5. Young, J.Z.1969. The Life of Vertebrates, English Language Book Society and Oxford University,786pp.
6. Colbert, E.H., 1969. Evolution of the Vertebrates, Wiley Eastern, New Delhi, 504pp.
7. Hyman, L.H.1953. Comparative Vertebrate Life. The University of Chicago, Illinois, 536 pp.

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ZO 1820 - SYSTEMATICS AND BIODIVERSITY

SEMESTER : I		CREDITS	: 03
CATEGORY : MC		NO. OF HOURS / WEEK	: 04

Objective: To realize the biodiversity potential of our country and to understand the principle and methods of nomenclature and systematics.

UNIT I: ECOSYSTEM DIVERSITY

Concepts on Biodiversity, Ecosystem of India, Species and genetic diversity, Biodiversity hotspots, Conservation plans and treaties, Wild Life Protection Act, 1972, Zoos, Sanctuaries, National Parks, Biosphere reserves and protected areas in India. Extinct, critical, endangered and vulnerable fauna of India, Biotechnological tools for conservation of biodiversity.

UNIT II: DIVERSITY OF TERRESTRIAL AND FRESH WATER ECOSYSTEMS

Wetlands, reserve forests, rain forests and desert plains in India and their faunal resources, animals of lotic and lentic ecosystems, Threats to wetlands and conservation. Rivers of India and their faunal diversity.

UNIT III: DIVERSITY OF MARINE AND MANGROVE ECOSYSTEMS

Coastal, coral reef, mangrove, sea grass and sea weed ecosystems and their faunal resources. Threats to marine biodiversity. Animals of lagoons and estuaries. Pelagic and benthic animal of the sea. Marine productivity.

UNIT IV: INTRODUCTION TO ANIMAL TAXONOMY

Importance of taxonomy, stages in taxonomy, problems of taxonomists. Morphological, embryological. ecological, behavioural, cytological, biochemical and numerical approaches in taxonomy. Differential systematics.

UNIT V: NOMENCLATURE AND TAXONOMIC TOOLS

Kinds of classification, phyletic lineages, components of classification, Linnaean hierarchy. Species concepts, Kinds of species, Origin of code, ICZN, zoological records. Collection methods, preservation of data, curating, storing and cataloging, methods of identification, description of taxonomic characters, taxonomic keys, taxonomic publication.

TEXT BOOKS

1. Agarwal, and U.Gupta, 2004. Animal Taxonomy, S. Chand, New Delhi. 86pp.
2. John Milton M C, 2008. (Ed) Training Manual on GIS and Marine Biodiversity, 320pp.
3. Kapoor V.C.1998. Theory and practice of animal taxonomy, Oxford and IBH, New Delhi, 247pp.
4. Negi, S.S. 1996 Biosphere Reserves in India: Land use, Biodiversity and Conservation. Indus, New Delhi.
5. Singh B. K, 2004. Biodiversity : Conservation and Management, Mangal Deep Publication, 586pp.
6. Sivramiah Shantharam and Jane F. Montgomery, 1999. Biotechnology, Biosafety and Biodiversity, Oxford IBH, 237pp.
7. Swaminathan, M.S and S. Jana. 1992., Biodiversity, Mac Millian, Chennai, 326pp.
8. Traffic India, 1990. The Wild Life protection Act, 1972, 154pp.

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ZO 1821 - ADVANCED EVOLUTIONARY BIOLOGY

SEMESTER	**: I**	**CREDITS**	**: 03**
CATEGORY	**: MC**	**NO. OF HOURS / WEEK**	**: 05**

Objective: *To explore the process and product of evolution since nothing in biology makes sense except in the light of evolution.*

UNIT I: EVOLUTIONARY THOUGHT AND CAUSAL FECTORS

A historical overview - Neo-Lamarckism - Neo-Darwinism; Sexual selection; Modern concepts of Recapitulation theory. Mutation theory-Evolutionary significance of mutation.

UNIT II: COSMIC EVOLUTION AND ORIGIN OF LIFE

Origin of life- Pre-biotic organic compounds- Nature of proto-cells- Evolution of prokaryotes- Origin of eukaryotes- Origin of mitosis and sex.

UNIT III: PALAENTOLOGY

Geological time scale- Fossil records (nature; conditions and dating)- Mosaic evolution-Man in the fossil records- Phyletic gradualism and punctuated equilibrium- mass extinction.

UNIT IV: SCELECTION IN ACTION

Natural Selection (Normalising; Diversifying; Disruptive) and Genetic Polymorphism - Gene Pool and Hardy- Weinberg equilibrium- Random genetic drift- Animal colouration and mimicry- Micro and Macro evolution- Pre-adaptation and Post-adaptation.

UNIT V: ADAPTATION AND SPECIATION

Adaptive radiation in reptiles and mammals- Convergence- Parallelism -Co-evolution- evolutionary constancy- speciation and Isolating mechanisms- Sibling and semi species- Hybridization as an evolutionary catalyst- Evolutionary genomics.

UNIT VI: MAN AND NATURAL SCELECTION

Eugenics, Euphenics and euthenics- Human races- Sociobiology (Scope, selfish gene, altruism, kin selection) -Man and Natural selection- Evolutionary future of mankind.

TEXT BOOKS

1. Darwin, C.R. 2000. On the Origin of species by means of natural selection (revised edition) Collier Books, New York.
2. Dobzhanunsky. T., Ayala. F.J., Stebbins, G.L and W. Valentine. 1976. Evolution, Surjeet, Delhi.
3. Dobzhanunsky.T. 1976. Genetics and the origin of species. Oxford and IBH,
4. Bajema J. 1971. Natural Selection in Human Population. John Wiley and Son, New York.
5. Dodson, E.O. 1990. A Text Book of Evolution, W.B. Saunders, Philadelphia.
6. Lull, R.S. 1984. Organic evolution, Seema publication New Delhi.

ZO 1822 - ADVANCED DEVELOPMENTAL BIOLOGY

SEMESTER : I		**CREDITS**	**: 04**
CATEGORY : MC		**NO. OF HOURS / WEEK**	**: 05**

Objectives: *To enhance an in-depth knowledge on animal and human embryonic development.*

Unit I: BASIC CONCEPTS OF DEVELOPMENT

Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients, Cell fate and commitement – mechanism of developmental commitment-mosic and regulative development – maintenance of differentiation pattern formation and compartments –morphogenesis –model organisms – developmental mutants- transgenic cells and organisms - cellular and microsurgical techniques.; cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.

Unit II: POST EMBRYONIC DEVELOPMENT

Metamorphosis- the hormonal reactivation of development-amphibian-insects, Regeneration –epimorphic regeneration of salamander limbs- compensatory regeneration in the mammalian liver. Aging –the biology of senescence

Unit III: GENES IN DEVELOPMENT

Gene expression and regulations – chromatin and DNA methylation –signal transduction- Nuclear transplantation – cellular differentiation- differential action- developmental genetic defects – role of cell death in development- Teratogenesis.

Unit IV: HUMAN EMBRYONIC DEVELOPMENT

Hormonal control of ovulation and pregnancy –development of germinal layers, foetal and maternal relationships- embryonic mutation – parturition – embryonic adaptation and the development of mammals. spermatozoa – Human embryo- Prenatal diagnosis-Medical implication of developmental biology.

Unit V: APPLICATION OF MODERN TECHNIQUES IN DEVELOPMENTAL BIOLOGY

Induced ovulation in humans- multiple ovulation and embryo transfer in cattle – embryo splitting – in vitro fertilization –IVF in cattle, IVF in Human cryopreservation, human cloning and its ethical implications, embryo transfer and developmental potential.

TEXT BOOKS

1. Subramanian, T. 2002. Developmental biology, Naraosa publishing house, New Delhi.
2. Balinsky, B. I. 1981. An introduction to embryology, Saunders College Publishing, 5th Edition, New York.
3. Twyman, R. M. 2003. Developmental biology, Viva Books publisher, 1st edition, New Delhi.
4. Berril N.J. 1974 Developmental Biology. Tata Mc Grawhill, New Delhi.
5. Majumdar 1985 Text Book of Vertebrate Embryology. Tata Mc Grawhill, New Delhi.
6. Scott F. Gilbert. 2006. Developmental biology, 8th edition. Sinauer associate inc., Sunderland, USA.

ZO 1823- HISTOCHEMISTRY AND MICROTECHNIQUE

SEMESTER : I		**CREDITS**	**: 04**
CATEGORY : MC		**NO. OF HOURS / WEEK**	**: 05**

Objectives: *To provide knowledge on cell and tissue architecture in normal and abnormal states, and application of diagnostic tool.*

UNIT I: CLASSIFICATION AND HISTOCHEMICAL TECHNIQUE FOR PROTEINS, CARBOHYDRATES AND LIPIDS

Proteins–Ninhydrin Schiff method (Amino groups), Sakaguchi method (Arginine). Carbohydrates –PAS reaction, Bauer-feulgen method (Glycogen); Lipids – Oll Red O method, Sudan black B method.

UNIT II: HISTOCHEMICAL TECHNIQUE FOR NUCLEIC ACIDS

DNA & RNA detection by Methyl Green-Pyronin method and Extraction by Brachet method.

UNIT III: MICROSCOPY, AUTORADIOGRAPHY AND ITS APPLICATIONS

Fluorescence microscopy, Electron microscopy, Scanning Electron Microscope, Transmission Electron Microscope, Autoradiography- working principle and preparation of sample.

UNIT IV: COLLECTION AND PREPARATION OF MATERIAL

Collection of soil micro arthropods - Whole mount - Dry mount of insects-Kill bottle-preparation of material-pinning, spreading and labelling.

UNIT V: TYPES OF MICROTOMES, IMPORTANCE OF MICROTECHNIQUE AND PREPARATION OF TISSUE

Paraffin Microtome, Cryostat, Ultra Microtome-Steps involved in tissue processing and Microphotography.

UNIT VI: A VISIT OF HISTOPATHOLOGICAL INSTITUTES AND MAINTENANCE OF RECORD

TEXT BOOKS

1. Patki, L.R. *et al.*, 1983. An Introduction to Microtechnique. S. Chand.
2. Pearse, A.G.E.,1970. Theoritical and applied Histological Techniques – Vol I Churchill livingstone, New York.
3. Bruce Casselman, W.G. 1962. Histochemical technique. Butler and Tanners, London.
4. John D. Bancroft and Marilyn Gamble, 2008. Theory and Practice of Histological Techniques. Churchill Livingstone Elsevier.

ZO 1824-INVERTEBRATA, CHORDATA AND DEVELOPMENTAL BIOLOGY LAB COURSE

SEMESTER : I		**CREDITS**	**: 02**
CATEGORY : MC (P)		**NO. OF HOURS / WEEK**	**: 06**

UNIT I: MAJOR DISSECTION

Crab--- nervous system , sepia--- nervous system , shark--- arterial and nervous system , frog- arterial system , venous system and cranial nerves .

UNIT II: MINOR DISSECTION

Vaginulus—digestive system , reproductive system and nervous system , Prawn—nervous system , Frog--- spinal and sympathetic nervous system

UNIT III: MOUNTING

Mouth parts of honeybee, cockroach, millipede, housefly and mosquito

Placoid scales of shark ---Brain of frog

UNIT IV: SPOTTERS

Systematic position : Centipede , holothuria , scorpion , amphioxus , narcine , ostracion , Anguilla , and syngnathus.

Mode of life : Porpita , nautilus , haliotis , mytilus , spirula , neries .poison apparatus of russels viper , uromastix , exocoetus , synapta , myxine , rhacophorus , and enhydrina .

Structural Modifications : Hippocampus , ambystoma , phrynosoma.

Ecological adaptations : Brain coral , brittle star , starfish , echinus , octopus , murex , chameleon , cobra , turtle , varanus , bat , draco .

Evolutionary importance : Balanoglossus , peripatus , limulus , chiton , axolotl larva

Parasitic adaptation : Ascaris , fasciola , taenia , cymathoa , sacculina .

Osteology: Frog—skull**,** pectoral and pelvic girdles and typical vertebra, Bird--- skull , palates in birds and synsacrum, Rat—skull, Calotes--- skull

Embryology: Chick embryo--24h, 48h, 72h , 98h , 11th day , 16th day and 21st day: Placenta of shark , sheep , goat and pig; Huma embryo

UNIT V: FIELD STUDY AND RECORD

TEXT BOOKS

1. Lal, S.S. 2005. A text Book of Practical Zoology: Invertebrate, Rastogi, Meerut.
2. Ekambaranatha Ayyar and T.N.Ananthakrishnan, 1995 A manual of Zoology Vol.I (Part 1,2) S.Viswanathan, Chennai.
3. Lal, S.S., 2005. A text Book of Practical Zoology: Vertebrate, Rastogi, Meerut.

ZO 2817 MOLECULAR CELL BIOLOGY

SEMESTER	**:**	**II**	**CREDITS**	**:**	**05**
CATEGORY	**:**	**MC**	**NO. OF HOURS / WEEK**	**:**	**05**

Objectives: *To understanding the cellular and molecular basis of life processes.*

UNIT I: MOLECULAR TECHNIQUES

Microscopy (Conventional and confocal), Cytological techniques, Ultracentifugation, X-ray diffraction, Chromatography, Autoradiography, Electrophoresis, Blotting techniques, fluorescent activated cells, Cell Sorter, microplate high through put readers, Fluorescent in situ Hybridization (FISH) and Animal Cell / tissue culture-cell imaging.

UNIT II: CELLULAR ORGANIZATION

Membrane structure and function: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps.

Structural organization and function of intracellular organelles: Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes.

Organization of genes and chromosomes: Operon, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons.

Cell division and cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle.

UNIT III: FUNDAMENTAL PROCESSES

DNA replication, repair and recombination: Unit of replication, enzymes involved replication origin and replication fork, extrachromosomal replicons, DNA damage and repair mechanisms.

RNA synthesis and processing: Transcription factors and machinery, formation of initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination, RNA processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA, RNA transport.

Protein synthesis and processing: Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, translational proof-reading, translational inhibitors, post- translational modification of proteins.

Control of gene expression at transcription and translation level: Regulation of phages, viruses, prokaryotic and eukaryotic gene expression, role of chromatin in regulating gene expression and gene silencing.

UNIT IV: CELL COMMUNICATION AND CELL SIGNALING

Host parasite interaction: Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells, alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals.

Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways

Cellular communication: General principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, neurotransmission and its regulation.

Cancer: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.

UNIT V: GENETIC ANALYSIS

Inherited genetic disorders in man, pedigree analysis, gene transfer for desired human behaviour, genetics of aging, human genome project, DNA finger printing, DNA from museum specimen, modern genetics and bioethics.

TEXT BOOKS

1. Ajoy Paul, 2011. Text books of cell & molecular biology, 3rd edition, Books & allied (P) Ltd., Kolkata, India.
2. George M. Malacinski, 2010. Essential of molecular biology, 4th edition, Narosa publication.
3. John t. Hancock, 2006. Cell signaling, 2nd edition, oxford University press.
4. Bruce, A *et al*. 2002 Molecular Biology of the Cell, IV edition, Garland, New York.
5. Watson, J.D, 2004. Molecular Biology of the gene. Pearson Education, New Delhi.
6. Stephns, D. 2006. Cell imaging, Scion publication.

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ZO 2818 - APPLIED ENTOMOLOGY

SEMESTER	**:**	**II**	**CREDITS**	**:**	**04**
CATEGORY	**:**	**MC**	**NO. OF HOURS / WEEK**	**:**	**04**

Objectives: *This core paper has been designed to understand the biology of insects, insect pest management, Integrated Pest Management and biological control.*

UNIT I: AGRICULTURAL ENTOMOLOGY

Outline Classification of the Class Insecta; Methods of collection, preservation and mounting of insects; Causes for insects assuming pest status; Biology, nature, extent of damage and control measures of insect pests of some important crops – paddy, sugarcane, cotton, groundnut, coconut, mango and tea; Locust and their control and insect pests of stored grains and their control measures.

UNIT II: VETERINARY ENTOMOLOGY

Cattle (horse fly, stable fly, cattle fly), Fowl (shaft louse and chicken flea), Sheep a nd Goat (head maggot and sheep ked).

UNIT III: MEDICAL ENTOMOLOGY

Mosquitoes, housefly, eye fly, sand fly, black fly, bed bug, assassin bug, flea, human body louse and head louse. Insects associated with household materials.

UNIT IV: PRODUCTIVE INSECTS

Apiculture - apiary, types of honey bees, selection of bees and location of apiary-sericulture - silkworm races, moriculture, rearing of silkworms and postcocoon processing.

UNIT V: PEST CONTROL

Classification of insecticides on the basis of their chemical nature, mode of entry and mode of action ; biological control of Insect pests, Integrated Pest Management; plant protection appliances and field trips to Agricultural Institutes in and around Chennai.

TEXT BOOKS

1. Vasantharaj David,B 2001. Elements of Economic Entomology, Popular Book Depot, Chennai
2. Ministry of Agriculture, Government of India, 1995. Manual on Integrated Pest Management in Rice and Cotton
3. John William S., 1995. Management of Natural Wealth, Loyola College Publications, Chennai.
4. John William,S., 2007. Defeating The Public Enemy The Mosquitoes: A real Challenge, Loyola College Publications, Chennai.
5. Abishek Shukla, D 2009. A Hand Book of Economic Entomology, Vedams e Books, (P) Ltd. New Delhi.

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ZO 2819 – IMMUNOLOGY

SEMESTER	**:**	**II**	**CREDITS**	**:**	**04**
CATEGORY	**:**	**MC**	**NO. OF HOURS / WEEK**	**:**	**05**

Objectives: *This core paper has been designed to understand the nature and components of defense mechanism of human body.*

UNIT I: BASICS OF IMMUNOLOGY

Introduction-historical perspective. Innate immunity (Non- specific), Adaptive immunity (Specific)- Humoral immunity, Cell mediated immunity.

UNIT II: CELL AND ORGANS OF IMMUNE SYSTEM

Cells of immune system- haemopoiesis, stem cells, lymphoid cells, mononuclear cells, granulocytes, mast cells, Dendritic cells. Organs of Immune system- primary lymphoid organs and secondary lymphoid organs.

UNIT III: ANTIGENS

Antigens immunogenicity vs. antigenicity, heptens. Factors influencing immunogenicity. Epitopes- B cells epitope and T cell epitope, immunity against protozoan, Fungi and bacteria.

UNIT IV: ANTIBODIES

Immunoglobulin- structure, isotypes and biological function. Immune response and theories. Antigenic determinant on immunoglobulin – isotype, allotype and idiotype. B-cell receptor. Immmunoglobulin superfamily, Monoclonal antibody, Organization and expression of immunoglobulin genes. Synthesis of immunoglobulin and disorder of immunoglobulin synthesis. Antigen – antibody interaction and immunodiagnostics. MHC- restriction. Organization and inheritance of MHC. Antigen processing and presentation.

UNIT V: MEDIATORS OF IMMUNE SYSTEM AND VACCINES

T cell receptors, cytokine, adhesion molecules, complement, hypersensitive reaction, Transplantation immunology. Vaccines schedule- principles and types of vaccines – DNA recombinant vaccines, serum therapy.

UNIT VI: IMMUNITY IN HEALTH AND DISEASE

Introduction to infectious disease, innate and adaptive immunity to infection, evasion of the immune response by pathogens; inherited immunodeficiency diseases, acquired immune deficiency syndrome; allergy and hypersensitivity- IgE and allergic reactions, hypersensitivity diseases; autoimmunity- responses to self antigens, transplant rejection- responses to alloantigens; manipulation of immune responses, vaccines; evolution of immune system- evolution of innate and adaptive immune system.

TEXT BOOKS

1. Immunology, David, Brostoff and Roitt, (7th Ed., 2006), Mosby & Elsevier Publishing, Canada, USA.
2. Roitt, I. M. 1994. Essential Immunology Blackwell Scientific, Oxford ISBN
3. Richard, A Golds Thomas J. Kindt and Barbara A. Osborn. 2000. Kuby- Immunology. Freeman and Co. New York.
4. Paul, W.E. 1989. Fundamentals of Immunology, Raver Press. New York.
5. Srivastava, R., Ram, B. P and Tyle,. P. 1991. Molecular mechanism of Immune regulation. VCH Publishers. New York.
6. Fatima, D and N.Arumugam2005, Immunology. Saras, Nagercoil.
7. Vaman Rao, 2006. Immunology, 2nd edition, Narosa Publishing House, New Delhi.

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ZO 2820 - CELL AND MOLECULAR BIOLOGY LAB COURSE

SEMESTER	**: II**	**CREDITS**	**:**	**04**
CATEGORY	**: MC(P)**	**NO. OF HOURS / WEEK**	**:**	**06**

Objective: *To provide hands-on training on techniques to explore cell and macromolecules of biological importance.*

UNIT I : Measurement of nucleocytoplasmic index, culturing suspension and monolayer cells, trypsination procedure, cellular measurement using micrometers, cell culture.

UNIT II: *Drosophila* culture and maintenance, morphology and sex identification, mutants, Monohybrid and dihybrid crosses and sex linked inheritance. Mounting of salivary glands of *Drosophila*/*Chironomous* larva for observing giant chromosomes with banding and balbiani rings. Comparing blood smear of an invertebrate and chordate – Insect, Frog and human.

UNIT III: Metaphase chromosome preparation form mouse bone marrow cells/ fish gill cells and Karyotyping – Squash preparation of cockroach/ grasshopper testis/ mouse and observation of meiotic stages usingplant/animal serum.

UNIT IV: Study of Mendelian traits in man and testing probability and chi square, using coin tossing and beads.

UNIT V: Permeability test using erythrocytes, Analysis of erythrocyte membrane lipids using Thin Layer Chromatography. Differential centrifugation of cell organelles and identification of mitochondrial fractions: Isolation and partial purification of DNA/ RNA/Plasmid. Demonstration of bacterial conjugation and mutation using mutagens. Chemical carcinogenesis in rat cell biopsy, normal and cancer cells, PCR (Visit to Cancer Institute/ Veterinary Research Center).

TEXT BOOKS

1. Gasque, E, 1992. A Manual of Laboratory experiments in Cell Biology. University of Wisconsin, Brown.
2. Hall, D and S. Kawkins, 1975. A Laboratory Manual of Molecular Cell Biology, English University, London.
3. Durairaj, G, 1998. A Laboratory Manual in Genetics. Emerald, Chennai.

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ZO 2958 – IMMUNOLOGY AND BIOPHYSICS LAB COURSE

SEMESTER	**:**	**II**	**CREDITS**	**:**	**03**
CATEGORY	**:**	**MC (P)**	**NO. OF HOURS / WEEK**	**:**	**04**

Objective: *To provide hands-on training on techniques to explore the immune system of biological importance.*

IMMUNOLOGY

Unit I

Dissection of primary and secondary immune organs from mice: Preparation of single cell suspension from bone marrow and spleen (spleenocytes) of mice - Cell counting and viability testing of the spleenocytes prepared.

Unit II

Preparation and study of phagocytosis by spleenic/peritoneal macrophages.

Raising polyclonal antibody in mice, serum collection and estimating antibody titre in serum by following methods: Ouchterlony (double diffusion) assay for Antigen -antibody specificity and titre -ELISA

Unit III

Antibody purification from the serum collected from immunized mice: affinity purification/ chromatography - Immunoelectrophoresis,.

Demonstration of Western blotting: a. Protein estimation by Lowry's method /Bradford's method - SDS-PAGE-Immunoblot analysis.

Precipitation an immunodiffusion (Ouchterlony).

BIOPHYSICS

UNIT IV: SEPARATION TECHNIQUES

Separation of amino acids using radiant and ascending chromatography –polymerisation of gel from using PAGE
Fractionation of serum proteins using SDS

UNIT V: MEASUREMENTS

Measurement of viscosity of different liquids using drop weight method
Measurement of surface tension on different liquids using burette method

TEXT BOOKS

1. Rajan, S. and Selvi Christy, R. 2001. Experimental procedure in Life sciences, Anjanaa book house, 1st edition, Chennai.
2. Sail bose, 1982. Elementary biophysics, Vijaya printers, Madurai.
3. Das, D, 1996. Biophysics and Biophysical Chemistry for Medical and Biology Students, Academic, Calcutta.
4. Bose, S, 2000. Elementary Biophysics, Jyothi. Maduari
5. Palanichamy, S and M. Shanmugavelu, 1991. Principles of Biophysics. Palani Paramount.
6. Lehninger, A. L. 2006. Biochemistry, Freeman, New York.

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ZO 2957-CHRONOBIOLOGY AND ANIMAL BEHAVIOUR

SEMESTER	**:**	**II**	**CREDITS**	**:**	**03**
CATEGORY	**:**	**ES**	**NO. OF HOURS / WEEK**	**:**	**04**

UNIT I : INTRODUCTION TO CHRONOBIOLOGY

Chronobiology in 21st century; Evolution of biological timing system; Clocks, genes and evolution; Adaptive functional significance of biological clocks. Studying biological clocks; Perception of natural zeitgeber signals; Geophysical environment - Seasons; proximate and ultimate factors.

UNIT II : DIVERSITY AND COMPLEXITY OF THE CLOCK SYSTEM

Organization of circadian system in multicellular animals; Concept of central and peripheral clock system; Circadian pacemaker system in invertebrates with particular reference to *Drosophila;* Molecular Biology of the circadian pacemaker system, Photoreception and photo- transduction; The physiological clock and measurement of day length; Molecular bases of seasonality; The relevance of biological clocks for human welfare - Clock function (dysfunction); Human health and diseases - Chronopharmacology, chronomedicine, chronotherapy.

UNIT III : EVOLUTION OF BEHAVIOUR

Genetics and behavior - Natural selection, Mendel's laws, genetic variation, heritability of behavior, environmental influences upon behavior, juvenile and innate behavior, survival value and fitness, evolutionary strategies, sexual selection, altruism, social organization.

UNIT IV : MECHANISM OF BEHAVIOUR

Animal perception - sensory receptor, nervous system, hormones, sensory process and perception. Animal and the environment - coordination, spatial orientation, homeostasis. Animal learning - conditioning and learning, biological aspects of learning, cognitive aspects of learning.

UNIT V : UNDERSTANDING COMPLEX BEHAVIOUR

Instincts and learning, displacement activities, ritualization and communication, decision making in animals - complex behavior of honey bees, evolutionary optimality, mechanisms of decision making, languages and mental representation, intelligence, tool use and culture, animal awareness and emotion.

TEXT BOOKS

1. David McFarland, Animal Behaviour, Pitman Publishing Limited, London, UK.
2. Davis E Davis, 1970. Integral Animal Behaviour, Mac Millan Company, London, 118pp.
3. Harjindra Singh, 1990. AText Book of Animal BEhaviour, Anomol Publications, 293pp.
4. Hoshang S. Gundevia and Hare Govind Singh, 1996. Animal Behaviour, S. Chand & Co, 280pp.
5. Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Chronobiology Biological Timekeeping: Sinauer Associates, Inc. Publishers, Sunderland, MA, USA.
6. Manning, A and M.S Dawkins, An Introduction to Animal Behaviour, Cambridge University Press, UK
7. Saunders, D.S ., C.G.H. Steel, X., Afopoulou *(ed.)* R.D. Lewis. (3rd Ed) 2002. Insect Clocks Barens and Noble Inc. New York, USA
8. Shukla, J. P 2010. Fundamentals of Animal Behaviour, Atlantic, 587pp.
9. Vinod Kumar, 2002. Biological Rhythms: Narosa Publishing House, Delhi/ Springer- Verlag, Germany.

LOYOLA COLLEGE (AUTONOMOUS)
CHENNAI - 600 034.

ZO 2958 – BIOPHYSICS AND RADIATION BIOLOGY

SEMESTER	**:**	**II**	**CREDIT**	**:**	**03**
CATEGORY	**:**	**ES**	**NO. OF HOURS / WEEK**	**:**	**04**

Objective : To impart knowledge on the basic principles of biophysics and radiation biology.

UNIT I: PHYSICAL LAWS IN LIVING SYSTEMS

Diffusion- fick's law-Diffusion constant- Plasmolysis- Haemolysis and Cyclosis Laws of osmosis- surface tension- viscocity.

UNIT II: RADIACTIVITY AND PHOTO ELECTRIC EFFECT

Principles of radioactivity- Isotopes- Geiger muller counter - X-ray diffraction Electron Spin Resonance-Medical and Biological uses of X-rays- NMR and Ultrasound- Photoelectric effect-Lasers and their applications- Microscopy.

UNIT III: SEPARATION TECHNIQUES

Chromatography -TLC and HPLC- Principles of Electrophoresis PAGE and Immunoelectrophoresis-Thermography and scanning .

UNIT IV: TYPES AND BIOLOGICAL EFFECTS OF RADIATION

Different types of radiation- Direct and Indirect Effects of Radiation -Measurement of radiation levels and limits-Possible implications in Radiotherapy .

UNIT V: HERITABLE EFFECTS AND CARCINOGENESIS

Chromosomal and Chromatid Aberrations - Point Mutations-Chromosomal and Multifractional diseases-Genetic risk assessment-Doubling Dose -Muataion component-Initiation, promotion, progression and dose response for Radiation Induced Cancers.

TEXT BOOKS

1. Das, D, 1996. Biophysics and Biophysical Chemistry for Medical and Biology students by, Presidency College, Calcutta, Academic, Calcutta.
2. Bose, S, 1982. Elementary Biophysiscs, Jyoth , Madurai.
3. Casey, E.J, 1962. Biophysics Concepts and Mechanism. Affiliated East-West Press, New Delhi.
4. Palanichamy, S and M. Shanmugavelu, 1991. Principles of Biophysics. Palani Paramount.
5. Prasad, K.N., CRC *Handbook of Radiobiology*, CRC Press, Florida
6. Eric J Hall, Amato J Giaccia *Radiobiology for the Radiologist* Lippincott
7. Williams & Wilkins (Sixth Edition)
8. A.H.W. Nias An Introduction to Radiobiology John Wiley and sons
9. Alison P Casarette *Radiation Biology* Prentice Hall Inc

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ZO 3813 - PRINCIPLES OF ECOLOGY AND ENVIRONMENTAL MANAGEMENT

SEMESTER	**:**	**III**	**CREDIT**	**:**	**04**
CATEGORY	**:**	**MC**	**NO. OF HOURS / WEEK**	**:**	**06**

Objectives: *This core paper has been designed to impart the existing natural resources of India, their preservation and conservation plans.*

UNIT I: ECOLOGICAL PRINCIPLES

Introduction to ecology, evolutionary ecology, environmental concepts – laws and limiting factors, ecological models. Characteristics of population, population size and exponential growth, population dynamics, fertility rate and age structure. Competition and coexistence, intra-specific and inter-specific interactions, scramble and contest competition model, mutualism and commensalism, prey-predator interactions. Nature of ecosystem, production, food webs, energy flow through ecosystem, biogeochemical cycles, resilience of ecosystem, ecosystem management. Biosphere, biomes and impact of climate on biomes.

UNIT II: THE ENVIRONMENT

Physical environment; biotic environment; biotic and abiotic interactions. Habitat and niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche. Population ecology: Characteristics of a population; population growth curves; population regulation; concept of metapopulation, age structured populations. Species interactions, Community ecology, Ecological succession, Ecosystem.

Environmental pollution; global environmental change; biodiversity-status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches. Conservation Principles, major approaches and conservation management strategy.

UNIT III: ENVIRONMENTAL STRESSES AND THEIR MANAGEMENT

Global climatic pattern, global warming, atmospheric ozone, acid and nitrogen deposition, coping with climatic variations. Major classes of contaminants. Uptake, biotransformation, elimination and accumulation of toxicants. Factors influencing bioaccumulation from food and trophic transfer. Pesticides and other chemical in agriculture, industry and hygiene and their disposal. Impact of chemicals on biodiversity. Bioindicator and biomarkers of environmental health. Biodegradation and bioremediation of chemicals. Biodiversity – assessment, conservation and management, biodiversity act and related international conventions.

UNIT IV: MANAGEMENT OF ECOSYSTEMS

Remote sensing as a tool: physical basis - information extraction – role in ecological research, Environmental auditing, Environmental impact assessment, Biotechnological principles and environmental management.

UNIT V: AGENCIES OF ENVIRONMENTAL CONSERVATION

Green peace movement - Chipko Movement - nuclear disarmament, Role of government agencies: Central and State Pollution Control Boards - Ministry of Environment and Forests – National Biodiversity Authority - National Environment. Awareness Programme, NGOs, Natural Disaster Management,

Legislations for environmental Protection, Biovillages – sustainable utilization and development, Environmental ethics.

TEXT BOOKS

1. Asthana, D.K. and Meera, A. 2009. A text book of environmental studies, S. Chand , New Delhi.
2. Grant, W.E. and Swannack, T.M., 2008, Ecological Modelling, Blackwell.
3. Odum E.P.1983. Basic Ecology, Saunders, New York
4. Southwood, T.R.E. 2004. Ecological Methods, Chapman and Hall, London, 250pp
5. Wilkinson, D.M., 2007, Fundamental Processes in Ecology: An Earth system Approach, Oxford University Press, UK.

REFERENCE BOOKS

1. Rajagopalan, R. 2005, Environmental Studies: From Crisis to Cure, Oxford Univ. press, New Delhi
2. Saha, t.K. 2010. Ecology dan Environmental bilogy, Books and Allied, Kolkata.
3. Sanyal, K. Kundu, M. and Rana, s. 2009. Ecology and environment, Books and allied, Kolkata.
4. Satyanarayana, U., 2005, Biotechnology, Books and Allied, Kolkata.
5. Vesilind P.A. and Pierce, J. 1982. Environmental engineering Callingwood, Allarbor Science.

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ZO 3814 - RESEARCH METHODOLOGY

SEMESTER	**: III**	**CREDIT**	**: 03**
CATEGORY	**: MC**	**NO. OF HOURS / WEEK**	**: 04**

Objective: To introduce the basic facets of scientific research and understand the essential requirements of a research problem and latest tools available to achieve desired results.

UNIT I: INTRODUCTION TO SCIENTIFIC RESEARCH

Definition, basic and applied research, interdisciplinary research, Literature Review - Research reading, discriminative reading, consulting source material, reference cards, primary and secondary literature, Biological abstract, Current Content, Review, Monographs, peer reviewed journals, e-resources, digital library, electronic research tools, bibliography software.

UNIT II: LABORATORY SAFETY

Biohazards, risk groups, bio-safety levels, laboratory acquired infections, routes of exposure, safety measures, good laboratory practices, biohazardous wastes, types of hazards, bioethics, safety of lab animals.

UNIT III: EXPERIMENTAL DESIGNS AND ANALYSIS

Observation, hypothesis designing, experimental unit, field survey and questionnaire, sampling unit, experimental error, generalization, controls, randomization, statistical software and analysis: hypothesis testing, Chi square test, LC_{50} value, Probit analysis, ANOVA, Regression and Correlation coefficients.

UNIT IV: RESEARCH REPORT

Literature citation, components of a research report, use of tables and figures, preparation of photographs and microphotographs, formatting and requirements for manuscript preparation.

UNIT V: INTELLECTUAL PROPERTY RIGHTS

Patent, copy right, trademarks, designs, trade secrets, traditional knowledge, biopiracy, National Biodiversity Authority - acts and regulations, indigenous technology, Research project proposal preparation - funding agencies and thrust areas.

TEXT BOOKS

1. Gurumani, N 2009. Research Methodology for Biological sciences, MJP Publishers, 753pp.
2. John W. Creswell, 2011. Research Design, Sage, 260pp.
3. Kothari C. R. 2009. Research Methodology: Methods and techniques, New Age International, 401pp.

REFERENCE BOOKS

1. Dwiredi R. S. 1997. Research Methods in Behavioural Sciences, Mac Millan, 256pp.
2. Southwood, T.R.E. 2004. Ecological Methods, Chapman and Hall, London, 250pp.

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ZO 3815- BIOCHEMISTRY AND ANIMAL PHYSIOLOGY

SEMESTER	**:**	**III**	**CREDIT**	**:**	**05**
CATEGORY	**:**	**MC**	**NO. OF HOURS / WEEK**	**:**	**05**

Objective : To understand the biochemical processes in animal physiology.

UNIT I: ENZYMES

Definition of Enzymes, Classification of enzymes, mechanism of enzyme action, Michaelis-Menton reaction, enzyme inhibitors.

UNIT II: ANABOLISM

Anabolism – biosynthesis: Carbohydrates: central pathway, bypass reactions, gluconeogenesis, glycogenesis. Lipids – Mitochondrial synthesis of fatty acids, non-mitochondrial synthesis of fatty acids, synthesis of triglycerides, synthesis of phospholipids, synthesis of cholesterol, errors in lipid metabolism.

UNIT III: CATABOLISM AND INTEGRATION OF BIOMOLECULES

Catabolism: Carbohydrates – glycolysis, TCA cycle, HMP pathway, glycogenolysis, energetics of the cycles. Proteins – overview of protein catabolism – Transmination, deamination, fate of ammonia and carbon skeleton, urea cycle. Lipids – mobilization of fats from dietary intake. Break down of fatty acid and cholesterol.

Integration of biomolecules - intermediary metabolites – phosphorylation, types, biological oxidation, energy rich compounds – oxidative phosphorylation.

UNIT IV: BODY MECHANISM

Systems of circulation, Peripheral circulation, Regulation of heart beat and blood pressure, Transport and exchange of gases, Neural and chemical regulation of respiration, Gas transfer in air and water, Gas exchangers, Circulatory and respiratory responses to extreme conditions, Acid –base balance, Regulation of body pH.

Osmoregulation in aquatic and terrestrial environments, Kidney functions, Extra-renal osmoregulatory organs, Patterns of nitrogen excretion. Thermoregulation - Heat balance in animals, Adaptations to temperature extremes, Aestivation and hibernation, Counter current heat exchangers. Adaptations to Stress- Basic concept of environmental stress.

UNIT V: SENSING THE ENVIRONMENT

Photoreception, chemoreception, mechanoreception, echolocation, Endogenous and exogenous biological rhythms, Chromatophores and bioluminescence.

Feeding mechanisms and their control, effect of starvation. Muscle physiology – striated and smooth muscle, Adaptations of muscles for various activities, Neuronal control of muscle contraction, Electric organs.

TEXT BOOKS

1. Ambika Shanmugam 1974. Fundamentals of Biochemistry for Medical Studies. Second Edition (Revised), Aries Agencies, Chennai, pp.647.

2. Jain, L.L. Sunjay Jain & Nitin Jain. 2005. Fundamental of biochemistry, S. Chand and Company Ltd., New Delhi, pp.1230.
3. Lehninger, A. L. 2006. Biochemistry, Freeman, New York.
4. Satyanarayana, U and Chakrapani, 2008. Fundamentals of chemistry, Books and allied, Kolkata.
5. Shanmugam, A, 1990. Fundamentals of Biochemistry, Shanmugam, Chennai.

REFERENCE BOOKS

1. Dantzler, W.H. Comparative Physiology (Handbook of Physiology), Dantzler, W.H. (ed.) Oxford University Press, New York, USA.
2. Devesena, T. 2010. Enzymology, Oxford University press, New Delhi.
3. Nicholas, C.P. and lewis, S. 2010. Fundamentals of Enzymology, Oxford University press, New Delhi.
4. Stryer, L, 1988. Biochmistry. 3rd Edition. Freemen.
5. West, Edward Staunton, Todd Wilbert R. Mason Howard, S. and Bruggen John T. Van. 1974. Textbook of biochemistry Amerind Publishing Co. Pvt. Ltd, New Delhi, pp.1595.

ZO 3816 – ENVIRONMENTAL BIOLOGY, BIOCHEMISTRY AND PHYSIOLOGY LAB COURSE

SEMESTER	**:**	**III**	**CREDIT**	**:**	**03**
CATEGORY	**:**	**MC (P)**	**NO. OF HOURS / WEEK**	**:**	**05**

Objective: *To provide hands on training in designing and experimenting problems in environmental biology, biochemistry and physiology.*

UNIT I: ENVIRONMENTAL BIOLOGY

Estimation of Dissolved oxygen, Salinity, Nitrites, Phosphates, Calcium and Alkalinty in water samples.

Anaylsis of Industrial effluent - TDS, TSS, BOD, (COD - Demonstration).

Collection, isolation and identification of marine and fresh water plankton.

Study of sandy, muddy and rocky shore fauna with special reference to their adaptation.

Animal Association - parasitism, mutualism and commensalism.

UNIT II : BIOCHEMISTRY

Buffer preparation and determination of pH.

Enzyme kinetics: Salivary amylase and Maltose standards: influence of enzyme concentration, time course, pH, temperature, substrate concentration (Lineweaver Burk Plot) on enzyme activity.

Quantitative estimation of glucose, protein, cholestoerol, urea and creatinine in the serum of goat.

UNIT III: PHYSIOLOGY OF ANIMALS

Oxygen Consumption in a aquatic animal

Salt loss and salt gain in fish

Estimation of Proteins, Carbohydrates and Lipids in the tissues of Fish

UNIT IV: BLOOD ANALYSIS

Effect of Insulin and Adrenalin on Blood Glucose level

Blood Clotting Time, Bleeding Time

Estimation of Haemoglobin and ESR.

UNIT V: SPOTTERS

Principles and application of spectrophotometry or colorimetry, electrophoresis, centrifuge, Chromatography.

Principle and Application of Sphygmomanometer, Kymograph.

Haemoglobinometer, ESR

TEXT BOOKS

1. Asthana, D.K. and Asthana, M.2001. Environmental Problems and Solutions. S. Chand , New Delhi.
2. Alpha Soli, I. Arceivala.1998. Wastewater treatment for pollution control, Tata McGraw Hill, New Delhi

REFERENCE BOOKS

1. Ambika Shanmugam. 1974. Fundamentals of Biochemistry for Medical Studies. Second Edition, Aries Agencies, Chennai, pp.647.
2. Odum. E.P. 1996 Fundamentals of Ecology. Nataraj Publishers, Dehra Dun.
3. West, Edward Staunton, Todd Wilbert R. Mason Howard, S. and Bruggen John T. Van. 1974. Textbook of biochemistry Amerind Publishing Co. Pvt. Ltd, New Delhi, pp.1595.

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ZO 3950 - GENOMICS, METAGENOMICS AND EPIGENETICS

SEMESTER	**:**	**III**	**CREDIT**	**:**	**03**
CATEGORY	**:**	**ES**	**NO. OF HOURS / WEEK**	**:**	**04**

Objective: *This paper gives a current knowledge about gene, genomics, metagenomics and epigenetics.*

UNIT I: GENOMICS

Organization and structure of genomes - size, gene-complexity, architecture of mitochondrial genome, organization and nature of DNA in eukaryotes; transposable elements, pseudogenes, segmental duplications.

Mapping genomes - physical maps, EST, SNPs as physical markers, radiation hybrids, FISH, gene maps, integration of physical and genetic maps; sequencing genomes: recognition of coding and non-coding regions, quality of genome-sequence data.

UNIT II: BIOINFORMATICS

Bioinformatics - datasets, sequence analysis based on alignment, *de novo* identification of genes, *in silico* methods. Comparative genomics - orthologs and paralogs, protein evolution by exon shuffling; human genome project.

Large scale mutagenesis and interference - genome wide gene targeting; systematic approach, random mutagenesis, insertional mutagenesis, libraries of knock-down phenocopies created by RNA interference; transcriptome analysis, DNA micro-array profiling, data processing and presentation, expression profiling, proteomics - expression analysis, protein structure analysis, protein-protein interaction.

UNIT III: METAGENOMICS

Introduction - from genomics to metagenomics, history of the culture divide, 16S rRNA analysis and culturing, culture independent insight, global impact of metagenomics; next generation of DNA sequencing technologies and potential challenges, the developments and impact of 454 and Solexa sequencing. Pioneering projects in metagenomics - acid mine drainage project.

UNIT IV: METAGENOMICS AND ENVIRONMENT

Ecological inference from metagenomics - symbiosis, competition and communication; metagenomics of soil and soil health; microbial community - genomics in ocean; application of metagenomics - technical advancement in the field, application and expected benefits from large scale metagenomics data, application in human health, agriculture, industry and environment remediation.

UNIT V: EPIGENETICS

Brief history of epigenetics - overview and concepts; chromatin modifications and their mechanism of action, concept of 'histone-code' hypothesis, epigenetics in *saccharomyces cerevisiae*, position effect variegation, heterochromatin formation, and gene silencing in *Drosophila*, fungal models for epigenetic research: *Schizosaccharomyces pombe* and *Neurospora crassa*; epigenetics of ciliates; RNAi and heterochromatin assembly, role of noncoding RNAs.

DNA methylation in mammals, germ line and pluripotent stemcells , epigenetic control of lymphopoiesis, nuclear transplantation and the reprogramming of the genome. epigenetics and human disease, epigenetic determinants of cancer.

TEXT BOOKS

1. David C. Allis and Thomas Jenuwein. 2007. Epigenetics. Cold Spring Harbor Laboratory Press, New York, USA.
2. Nature Publishing Group, 2010. Next generation DNA sequencing. Cold Spring Harbor Laboratory Press, New York, USA.
3. Primrose, S. B. and Twyman R. M. 2006. Principle of Genome Analysis and Genomics, Blackwell Publishing Company, Malden, USA.

REFERENCE BOOKS

1. Brown, T. A., 2005. Genomes 3, Garland Science Publishing, London, UK.
2. Metagenomics: Sequence from the Environment, NCBI.
3. Mount, D. W., Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press, New York, USA.
4. The New Science of Metagenomics: Revealing the secrets of our microbial planet, Academic press, Washington DC, USA.
5. Watson, JD. 2004. Molecular Biology of Gene, Pearson Education, Delhi, India.

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ZO 3951- FISHERY BIOLOGY

SEMESTER	**:**	**III**	**CREDIT**	**:**	**03**
CATEGORY	**:**	**ES**	**NO. OF HOURS / WEEK**	**:**	**04**

Objective: This subject gives the indepth knowledge about fishes and fish farming

UNIT I: INTRODUCTION OF FISH

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: advantages of fish migration – Factor influencing fish migration – types of migration

UNIT II: DIGESTION, GILL RESPIRATION, RESPIRATORY ORGANS

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 – function of weberian apparatus.

UNIT III: SPECIALIZED ORGANS IN FISHES

Light producing organs: nature of light producing organs location – categories of light producing organs - regulation of light emission in fishes - mechanism of light production from luminous organs – Biological significance of luminescence in fishes.

Electric organs in fishes: Nature, source and origin of electric organs in fishes – location and general structures of electric organs – functioning mechanism of electric organs - function of electric organs. Sound producing organs: sonic mechanism in various fishes – significance of sound production in fishes. Poison glands in fishes: poisonous and venomous fishes – division of poisonous fishes – chemical nature of fish toxins.

UNIT IV: LARVIVOROUS FISHES, PATHOLOGY AND ECONOMIC IMPORTANCE

Essential characters of larvicidal fish – larvicidal fishes in India – sign of sickness in fishes – nutritional diseases, intrinsic diseases, and diseases caused by pathogens and parasites – food value – fish by products.

UNIT V: PRAWN FISHERY, FISH FARMING AND CAGE CULTURE

Food and feeding of prawn - types of prawn fishery - prawn culture - freshwater and marine prawn culture - export of prawn - pollutional impacts of prawn fishery - advantages of fish culture in cages – limitation of fish culture in cages – principle and scope of integrated fish farming.

TEXT 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. Kamaleshwar Pandey and Shukla, J.P. 2010. Rastogi Publications, Meerut.
4. Pandey and Shukla. 2010. Fish and Fisheries, Rastogi Publications, Meerut.
5. Parihar, R.P. 1996. A text book of fish biology and Indian fisheries, central publishing house, Allahabad, India

REFERENCE BOOKS

2. Jhingran , V. G. 1982. Fish and fisheries of India, Hindustan publications, India.
3. Shailendra Ghosh, 2009. Fisheries and aquaculture management, Adhyayan, New Delhi.
4. Wikolsky, G.V. 1963. The ecology of fishes, academic press, London.

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ZO 3876 – ENTREPRENEURSHIP AND FARM MANAGEMENT

SEMESTER	**: III**	**CATEGORY**	**: ID**
HOURS	**: 6**	**CREDITS**	**: 5**

Objective: *This paper enhance the knowledge of management of animal farms and entrepreneurship*

UNIT I: ENTREPRENEURSHIP

Entrepreneur: Meaning of entrepreneur – evolution of the concept, function of an entrepreneur, traits of entrepreneur. Types of entrepreneur, interapreneur – and emerging class – factors promoting entrepreneurship, barriers to entrepreneurship.

UNIT II: OPPORTUNITY ANALYSIS

Opportunity analysis – project identification – selection – analysis – sources of finance and supporting institution.

UNIT III: BUSINESS PLAN PROCESS

Meaning of business plan, business plan process, guidelines for writing a business plan – structure and content of business plan – style and format of the business plan – outline of a business plan and exploration of each section of the plan – model business plan for business venture and social venture though case studies.

UNIT IV: FISH, PRAWN, PEARL AND HONEY BEE CULTURE

Aquaculture – fish culture – maintenance of nursery ponds – construction of fish farm – culturing ponds – composite fish farming – prawn culture – breeding methods and spawning of prawn – pearl culture – apiculture – Hive maintenance and management - Sericulture – silk production in India.

UNIT V: POULTRY AND DAIRY FARMING

Poultry breeding and management – breeds of Fowls – breeding for meat production – care of new borns – poultry production in India – poultry diseases – Dairy farming – breeds of cattle – artificial insemination - milk production in India.

TEXT BOOKS

1. Gupta, S.M., 2010. Text book of fishery, An Backer, Mumbai.
2. Khankha, S.S. 2011. Entrepreneurial development, S. Chand, Delhi.
3. Sukumar, D.E. 2002. Outline of Dairy Technology, Oxford University, New Delhi.

REFERENCE BOOKS

1. Govindan, T.K. 1985. Fish processing, technology, Oxford University, Delhi.
2. Kamaleshwar Pandey and Shukla, J.P. 2010. Rastogi publications, Meerut.
3 Shailendra Ghosh, 2009. Fisheries and aquaculture management, Adhyayan, New Delhi.
4. Tomas, B.S and Neera Singh. 2003. Applied Zoology, Emkay, Delhi.

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ZO 4811 - MICROBIOLOGY

SEMESTER	**:**	**IV**	**CREDIT**	**:**	**04**
CATEGORY	**:**	**MC**	**NO. OF HOURS / WEEK**	**:**	**04**

Objectives: *To study the microorganism in various types, molecular and applied oriented microorganism.*

UNIT I: INTRODUCTION

Fundamentals of microbiology-History and scope of microbiology, The origin of Microbial life - Theory of spontaneous generation. Pasteurs's Tyndall experiments fermentation studies. Whittackers five kingdom classification- prokaryotic cellular organization- methods for studying microorganisms.

UNIT II: MICROBIAL STRUCTURE AND ORGANISATION

Anatomy of prokaryotes - cell wall, cytoplasmic membrane, cilia flagella capsule, cytoplasmic inclusions, sporulation. Organization and structure of microorganism, microbial nutrition and growth-cellular metabolism- generation of cellular energy and biosynthesis of macromolecules – energy release.

UNIT III: MICROBIAL AND MOLECULAR GENETICS

Gene structure & organization- DNA and RNA as genetic material - replication and expression – mechanism of genetic variation- bacterial conjugation –DNA transmission – transduction – Organization & functioning of prokaryotic genome plasmids -DNA repair and recombination.

UNIT IV: MICROORGANISM AND HUMAN DISEASES

Pathogenicity of microorganism – epidemiology of infectious disease – human disease caused by virus, prions, bacteria, fungi and protists-prevention. Sterilization - methods of sterilization and Disinfection. Antimicrobial chemotherapy - tests for sensitivity to antimicrobial agents- Non specific (innate) resistance at the immune response.

UNIT V: MICROBIAL APPLICATIONS

Microbial ecology – microorganism in marine, freshwater, terrestrial environment – microbial interactions – microbiology of food – applied and industrial microbiology

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TEXT BOOKS

1. Crueger and Crueger, 2004. A text book of industrial Biotechnology, Panima publishers (Singapore) corporation, New Delhi.

2. Dubey R.C. & Maheshwari, D.K. 2009. A text book of Microbiology, S. Chand & company Pvt. Ltd, New Delhi.
3. Prescott, Harley and Klein's, 2008. Microbiology, 7th edition, Tata McGraw Hill international edition, Page 1-1086.

REFERENCE BOOKS

1. Jeffrey C. Pommerville, 2006. Alcamo's fundamental of microbiology, Jones and Barlett, Boston.
2. Pelzar, M.J. and Chan ECS, King, N.R. 2002. Microbiology-concepts and applications, McGraw Hill, Jnc. New York.
3. Ronald M Atlas, 1997, Principles of microbiology, 2nd edition, Tata McGraw Hill international edition, Page 1-1098.

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ZO 4812 - BIOTECHNOLOGY

SEMESTER	**:**	**IV**	**CREDIT**	**:**	**04**
CATEGORY	**:**	**MC**	**NO. OF HOURS / WEEK**	**:**	**04**

Objective: This paper gives the update knowledge and applied values of biotechnology

UNIT I: MOLECULAR BIOLOGY AND GENETICS

Molecular structure of genes and chromosomes; DNA replication and control; Transcription and its control; Translational processes; Regulatory controls in prokaryotes and eukaryotes; Mendelian inheritance; Gene interaction; Complementation; Linkage, recombination and chromosome mapping; Extrachromosomal inheritance; Chromosomal variation; Population genetics; Transposable elements, Molecular basis of genetic diseases and applications.

UNIT II: BIOPROCESS BIOTECHNOLOGY

Bioprocess technology for the production of cell biomass and primary/secondary metabolites, such as baker's yeast, ethanol, citric acid, amino acids, exopolysacharides, antibiotics and pigments etc.; Microbial production, purification and bioprocess application(s) of industrial enzymes; Production and purification of recombinant proteins on a large scale; Chromatographic and membrane based bioseparation methods; Immobilization of enzymes and cells and their application for bioconversion processes. Aerobic and anaerobic biological processes for stabilization of solid / liquid wastes; Bioremediation.

UNIT III: BIOPROCESS ENGINEERING

Kinetics of microbial growth, substrate utilization and product formation; Simple structured models; Sterilization of air and media; Batch, fed-batch and continuous processes; Aeration and agitation; Mass transfer in bioreactors; Rheology of fermentation fluids; Scale-up concepts; Design of fermentation media; Various types of microbial and enzyme reactors; Instrumentation in bioreactors.

UNIT IV: ANIMAL BIOTECHNOLOGY

Special features and organization of plant cells; Totipotency; Regeneration of plants; Plant products of industrial importance; Biochemistry of major metabolic pathways and products; Autotrophic and heterotrophic growth; Plant growth regulators and elicitors; Cell suspension culture development: methodology, kinetics of growth and production formation, nutrient optimization; Production of secondary metabolites by plant suspension cultures; Hairy root cultures and their cultivation. Techniques in raising transgencies.

UNIT IV: CHARACTERISTICS OF ANIMAL CELLS

Metabolism, regulation and nutritional requirements for mass cultivation of animal cell cultures; Kinetics of cell growth and product formation and effect of shear force; Product and substrate transport; Micro & macro-carrier culture; Hybridoma technology; Live stock improvement; Cloning in animals; Genetic engineering in animal cell culture; Animal cell preservation.

UNIT V: RECOMBINANT DNA TECHNOLOGY & BIOINFORMATICS

Restriction and modification enzymes; Vectors: plasmid, bacteriophage and other viral vectors, cosmids, Ti plasmid, yeast artificial chromosome; cDNA and genomic DNA library; Gene isolation; Gene cloning; Expression of cloned gene; Transposons and gene targeting; DNA labeling; DNA sequencing; Polymerase chain reactions; DNA fingerprinting; Southern and northern blotting; In-situ hybridization; RAPD; RFLP; Site directed mutagenesis; Gene transfer technologies; Gene therapy.

Bioinformatics: Major bioinformatics resources (NCBI, EBI, ExPASy); Sequence and structure

databases; Sequence analysis (biomolecular sequence file formats, scoring matrices, sequence alignment, phylogeny); Genomics and Proteomics (Large scale genome sequencing strategies; Comparative genomics; Understanding DNA microarrays and protein arrays); Molecular modeling and simulations (basic concepts including concept of force fields).

TEXT BOOKS

1. Ignacimuthu, S. 2008. Basic biotechnology, Tata McGraw hill, New Delhi.
2. Ruby, R.C. 2012. A text book of biotechnology, S. Chand company, New Delhi.
3. Sasidhara, R. 2011. Animal biotechnology, MJP publishers.

REFERENCE BOOKS

1. Davis, J.M. 2007. Basic cell culture, Oxford University press, New Delhi.
2. Peters, p. 2009. Biotechnology – A guide to genetic engineering, WMC brown publisher, UK.
3. Ramawat, K.G et al. 2009. Comprehensive biotechnology, S. Chand company, New Delhi.
4. Ranga, M.M. 2003. Animal biotechnology, Agrobios, New Dehi.

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ZO 4813 - MOLECULAR ENDOCRINOLOGY AND REPRODUCTION

SEMESTER	**:**	**IV**	**CREDIT**	**:**	**03**
CATEGORY	**:**	**MC**	**NO. OF HOURS / WEEK**	**:**	**04**

Objective: This paper highlights the knowledge of reproductive biology and molecular endocrinology

UNIT I: INTRODUCTION OF AND HORMONES

Hormones as chemical signals for control and regulation of physiological processes. Nature of hormonal actions - biology of hormones.

Structure of peptide and protein hormones - Purification and characterization of hormones – Structure, Function relationships in different hormones - Biosynthesis of protein hormones - Storage and secretion of hormones: molecular mechanisms of regulation - Transcriptional and post-transcriptional mechanisms of hormone biosynthesis and secretion - Regulation of biosynthesis and secretion - Inhibitors of hormone biosynthesis and their use.

UNIT II: HORMONE SIGNALING

Nature of hormonal effects and actions - Mechanisms of hormone action and signal attenuation- Signal discrimination - signal transduction and signal amplification in hormone regulated physiological processes - Structural requirements for successful hormone-receptor interactions - Receptor antagonists and their applications - Metabolism of hormones by target and non-target tissues - Pharmacokinetics of hormones - Hormones and behaviour- cellular and molecular actions of semiochemicals.

UNIT III: THERAPEUTIC AGENTS OF HORMONE

Hormones as therapeutic agents - Current developments in design and production of hormonal contraceptives - Recombinant protein hormones-production and application in regulation of fertility in farm animals and humans - Evolution of chemical communication in animal systems - Unsolved problems in hormonal biology.

UNIT IV: MALE REPRODUCTIVE MECHANISM

Sex determination and differentiation: Mechanism of sex determination, differentiation of gonad and the genital tract.

Spermatogenesis: structural and molecular events - experimental approaches to study spermatogenesis - Seminiferous epithelial cycle - Sertoli cell: structure and function - Leydig cell - Leydig and Sertoli cell proliferation during foetal and postnatal development- Regulation of testicular functions - Epididymal maturation of spermatozoa - Signal transduction pathway in acrosome reaction - Male sterility: azoospermia, oligozoospermia, asthenozoospermia, varicocele - Genetic basis for male infertility, Mutational analysis in genes for hormones, receptor and gamete development.

Unit V: FEMALE REPRODUCTIVE MECHANISM

Follicular development and selection - Role of extra and intra gonadal factors in folliculogenesis - Oocyte maturation and its regulation - Ovulation: factors involved in follicular rupture - Luteinization and luteolysis - Follicular atresia - Regulation of reproductive cycle in female: menstrual cycle in human, estrous cycle in rat, estrous behaviour in cycling animals - Female reproductive disorder: amenorrhea,

polycystic ovary.

Fertilization: Activation of egg - Contraception leading to prevention of polyspermy: surgical, hormonal and immunocontraception.

REFERENCES

TEXT BOOKS

1. Ernst Knobil and Jimmy D. Neil, 2002. The Physiology of Reproduction, Raven Press.
2. Peter C.K. Leung and Eli Y. Adashi, 2004. The ovary, Elsevier (Academic Press), New York.
3. Samuel S. C. Yen, Robert B. Jaffe, Robert L. Barbieri, 2009. Reproductive Endocrinology: Physiology, Pathophysiology, and Clinical Management, Saunders publisher. USA.

REFERENCE BOOKS

1. Christina Wang, 1999. Male Reproductive Function, Kluwer Academic Publishers, New York.
2. Freedman L. P., 1998. Molecular Biology of Steroid and Nuclear Hormone receptors, Birkhauser, Boston, USA.
3. Jayanta, K.P. and Saroj, S.G. 2009. Oxford University press, New Delhi.
4. Litwack, G. 1985. Biochemical actions of hormones, ed. Academic press, New York, USA.
5. Solly Zuckerman Zuckerman, Barbara J. Weir, T. G. Baker. 1977. The ovary, Academic Press.
6. Veer Bala Rastogi, 2007. Molecular biology, Kedar Nath Ram Nath, Delhi.

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ZO 4814 – MICROBIOLOGY, BIOTECHNOLOGY AND ENDOCRINOLOGY LAB COURSE

SEMESTER	**:**	**IV**	**CREDIT**	**:**	**03**
CATEGORY	**:**	**MC (P)**	**NO. OF HOURS / WEEK**	**:**	**04**

Objective: This lab study helps to understand about microbes, microbial techniques, biotechnology and hormone function in human being.

UNIT I: MICROBIOLOGY

Staining Techniques: Simple staining technique. Gram staining technique, Negative staining
Pure culture techniques – preparation of slants, sub culturing, types of streaking.
Study of cultural characteristics of bacteria/Fungi on selective –differential media

UNIT II: DETERMINATION OF MICROBES

Determination of Thermal Death Point (TDP) and Thermal Death Time (TDT) of Microorganisms.
Determination of growth curve of a given microorganism
Isolation of antibiotic resistant mutants by chemical mutagenesis.
Isolation and enumeration of microorganism for air, soil and water.

UNIT III: BIOTECHNOLOGY

Isolation of genomic DNA from bacteria and purification by column spin.
Isolation of plasmid DNA by Poly ethylene glycol method.
Restriction digestion of isolated DNA (single and double digestion).
Quantification of DNA and RNA specrophotmetric method.
DNA amplification by PCR.
DNA elution from Agarose gel.

UNIT IV: ENDOCRINOLOGY

Identification of hypothalamic nuclei following histological, histochemical and immunocytochemical methods.
Isolation and characterization of pituitary cells.
In vitro effect of glucocorticoid and catecholamines on phagocyte functions.

In vivo bio- assay for estrogen and testosterone

UNIT V: ESTIMATION OF ENZYME ACTION

Estimation of cAMP in a rat tissue (e.g. adipose) with and without hormone stimulation.
Streptozotocin administered rat model for diabetes.
Demonstration of phospholipase C action.

TEXT BOOKS

1. Ader R, Felten D.L. 2007. Psychoneuroimmunology, Nicholas C., Academic Press, UK.
2. DeGroot L. J. and Jameson J.L., 2006. Endocrinology, Saunders Elsevier Press, USA.
3. Kalaichelvan, D.T. 2005. Microbiology and biotechnology a laboratory manual, MJP, Chennai.
4. Murugesan, A.G. and Rajakumari, C. 2005. Environmental science and biotechnology (theory and techniques) , MJP, chennai.
5. Rajan, S. and Balakumar, S. 2003. Medical Microbiology (theory and practicals), rock city publications, Trichy.

REFERENCE BOOKS

1. Brown R., 1994. An Introduction to Neuroendocrinology, Cambridge University Press, Cambridge, UK.
2. Ignacimuthu, S. 2002. Methods in biotechnology, Phoenix, New Delhi.
3. Schmauder, H.P. and Scjweozer, M. 2002. Methods in biotechnology, Taylor and Francis, UK.

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CO 3876 - BIOPRODUCTS AND MARKETING

SEMESTER : III		CREDIT :	05
CATEGORY : ID		NO. OF HOURS / WEEK :	06

Objective: *To enable students to appreciate the science behind aquaculture farming and poultry farming and to helps students to the production and marketing practices for bio-products.*

UNIT I: DAIRY PRODUCTS

Dairy products – special milks – cream – butter – ice cream – cheese – condensed milks – dried milks – dried milk products – Indian dairy products

UNIT II: BIOPRODUCTS OF TERRESTRIAL ANIMALS

Apiculture and honey production – sericulture and silk production – poultry production – eggs and meats.

UNIT III: BIOPRODUCTS OF AQUATIC ANIMALS

Production of prawn – Fish and Fish products – Food of culturable fishes – fishing methods – fish preservation - Pearl production – Harvesting of pearls

UNIT IV: MARKETING AND MARKETING PROCESS OF BIOPRODUCTS

Definition of marketing and marketing management –marketing process –evolution – marketing plan – marketing mix- relationship building – branding – customer retention strategies.

UNIT V: BIO-PRODUCTS MARKETING

Environment – market size – segmentation – using modern techniques – pricing – budgeting – market research – media- market maths – institutional support – promotion boards – events management – social responsibility.

TEXT BOOKS

1. Kotler, P., Armstrong, G., Agnihotri, Y.P., Ehsan, U.H., 2009. Principles of marketing – A south Asian perspective, Pearson.
2. Sukumar, D.E. 2002 Outline of Dairy Technology, Oxford Uni, New Delhi.

REFERENCE BOOKS

1. Henricksons, R.L. Meat, Poultry & Sea Food Technology
2. Lawrie, R.A. Meat Science by Pergamon Press.
3. Mountney, G.J. Poultry Products Technology
4. Parkhurst & Mountney. Poultry Meat and Egg Production
5. Toman, B. S. and Nerra Singh, 2003. Applied biology.