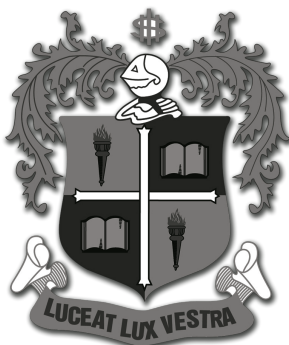


DEPARTMENT OF ZOOLOGY

M.Sc. - Zoology **SYLLABUS**

Effective from the Academic Year 2016-2017



LOYOLA COLLEGE (Autonomous)

Ranked 2 in INDIA RANKING 2017 - NIRF

'College of Excellence' Status Conferred by UGC in 2014

Re-accredited with 'A' Grade (3.70 CGPA) by NAAC in 2013

Chennai - 600 034

RESTRUCTURING-2016 (2016-17 batch ONWARDS) PG - Arts / Science / Commerce / Social Work

Part	Semester 1	Semester 2	Summer Vacation	Summer 3	Summer 4	Total Hours
Major Core (MC)	30(20 C)	24(20 C)	--	20(15 C)	30(24 C)	104(79 C)
Elective Subject (ES)	--	4(3 C)	--	4(3 C)	--	8(6 C)
Inter - Disciplinary (ID)	--	--	--	6(5 C)	--	6(5 C)
Self study Paper (SSP)				Outside class hours(2C)		(2 C)
Summer Training Program (STP)	--	--	3 to 4 weeks (1 C)	--	--	(1 C)
Life Skills Training (LST)	--	2h + 2h# (2 C)	--	--	--	2+2# (2 C)
Extension Activities	LEAP	LEAP(3 C)	--	--	--	(3 C)
Total Hours (Total Credits)	30 (20 C)	30+2# (23+5 C)	-(1 C)	30 (23+2 C)	30 (24 C)	120+2# (90+6+2*)C

Note: A theory paper shall have 5 to 6 contact hours and a practical session shall have 3 to 5 contact hours.

New format of the subject codes from the 2016 regulation

Subject codes are 10 characters long:

1 st	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th	9 th	10 th
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- 1st & 2nd digits – last two digits of regulation year in YY format (If 2016, it will be 16).
- 3rd alphabet: U – UG / P – PG / M – M.Phil. / D – Ph.D.
- 4th & 5th alphabets: department wise program code (example – MT / CO / HT.....)
- 6th digit: Semester for UG/ PG / M.Phil. and year for Ph.D.
- 7th & 8th alphabet: Category of paper or group of category of papers (GE/RL/OL/HE/OR/AL /ES/SK/MS/CM/CC/)
- 8th & 9th digits: subject number range (01 to 99).

For example,

Example 1: 16UCH1MC01

16 – Admitted in 2016
U – UG student
CH – Chemistry Student
1 – 1st Semester subject
MC01 – Major paper

Example 2: 16PCO2ID01

16 – Admitted in 2016
P – PG student
CO – Commerce Student
2 – 2nd Semester subject
ID01 – Inter disciplinary paper

- For subjects which are carried forward from one regulation to the next, the first two digits representing the regulation alone will change.
- Subjects which are not carried forward from one regulation to the next, will not appear in the new regulation.
- For new subjects which need to be added to a regulation, a new subject code must be created in continuation of the last created code under that type/category.
- Subject codes which are identical (except for the first two digits which represent the regulation year) are treated as equivalent for the purpose of syllabus / question paper setting / conducting examination / etc.

M.Sc Zoology

Restructured CBCS curriculum with
effective from June, 2016

S. No	Subject Code	Subject Title
1	16PZO1MC01	PHYLOGENY OF INVERTEBRATA AND CHORDATA
2	16PZO1MC02	BIOSYSTEMATICS
3	16PZO1MC03	ADVANCED DEVELOPMENTAL BIOLOGY
4	16PZO1MC04	APPLIED ENTOMOLOGY
5	16PZO1MC05	ANIMAL BEHAVIORAL BIOLOGY
6	16PZO1MC06	INVERTEBRATA, CHORDATA DEVELOPMENTAL
7	16PZO2MC01	MOLECULAR CELL BIOLOGY
8	16PZO2MC02	RADIATION BIOLOGY
9	16PZO2MC03	BIOCHEMISTRY
10	16PZO2MC04	ADVANCED EVOLUTIONARY BIOLOGY
11	16PZO2MC05	MOLECULAR CELL BIOLOGY LAB COURSE
12	16PZO2ES01	HISTOCHEMICAL TECHNOLOGY
13	16PZO2ES02	CLINICAL LAB TECHNOLOGY
14	16PHE2FC01	LIFE SKILLS TRAINING
15	16PZO3MC01	ENVIRONMENTAL BIOLOGY AND MANAGEMENT
16	16PZO3MC02	RESEARCH METHODOLOGY AND

		BIOSTATISTICS
17	16PZO3MC03	ANIMAL PHYSIOLOGY
18	16PZO3MC04	ECO - PHYSIOLOGY LAB COURSE
19	16PZO3ES01	BIOINFORMATICS
20	16PZO3ES02	AQUACULTURE
21	16PZO3TP01	SUMMER TRAINING PROGRAMME
22	16PZO3ID01	BIO-PRODUCTS AND MARKETING
23	16PZO4MC01	MICROBIOLOGY AND IMMUNOLOGY
24	16PZO4MC02	BIOTECHNOLOGY
25	16PZO4MC03	MICROBIOLOGY AND BIOTECHNOLOGY LAB
26	16PZO4PJ01	PROJECT AND VIVA VOICE

16PZO1MC01- PHYLOGENY OF INVERTEBRATA AND CHORDATA

SEMESTER	I	CREDITS	4
CATEGORY	MC	NO.OF HOURS/ WEEK	5

OBJECTIVE :

To learn the general characteristics and classification of different classes of invertebrates and vertebrates and to get an understanding of their evolutionary tree.

UNIT I : Diversity of Animal Kingdom

Levels of organization – Unicellularity vs multicellularity, Colonization and organization of germ layers (diploblastic and triploblastic condition) - Division of labour and organization of tissues (Brief fate of ectoderm, mesoderm and endoderm) - Development of coelome- Acoelomate, pseudocoelomate and coelomate organization - Radial and bilateral symmetry - Segmentation and cephalization.

UNIT II : Unicellular And Multicellular Organization

Salient features with examples of phyla, subphyla and classes mentioned below - Unicellular organization: Phylum Protozoa - Multicellular organization: Colonization level - Phylum Porifera - Multicellular organization: Division of labour (Cell differentiation) - Phylum Coelenterata.

UNIT III : Triploblastic; Acoelomate And Pseudocoelomate Organization

Acoelomate organization - Phylum Platyhelminthes - Pseudocoelomate organization – Phylum Nematelminthes. Triploblastic coelomate organization - Animals with metameric segmentation- Phylum Annelida - Animals with jointed appendages- Phylum Arthropoda

UNIT IV : Life Processes

Movement and locomotion -Amoeboid movement - Ultra-structure of cilia and ciliary movements - Action of muscles (Role of muscles in movement) .Nutrition - Types of nutrition: Autotrophic and heterotrophic. Apparatus for nutrition: Food vacuole Animals without alimentary canal, ex. Amoeba Animals with incomplete alimentary canal, ex. Hydra Animals with complete alimentary canal, ex. Bird - Brief account of physiology of digestion in vertebrates and symbiotic 4 digestion in Ruminants.

UNIT V : respiration and circulation

Types of respiratory surfaces: General body surface: Cell membrane - ex. Amoeba Skin - ex. Earthworm and Frog Specialized respiratory structures: Trachea and spiracles, Gills of fish, Lungs of Frog and Human, Air sacs of Birds. External respiration and cellular respiration with reference to human. Circulation - Types of circulating fluids: Water, coelomic fluid, lymph and blood - Types of circulation: Protoplasmic streaming, open and closed circulation, single and double circulation - Hearts: Types, heart in Daphnia, cockroach and chordates (1, 2, 3 and 4 chambered heart) - Structure of cardiac muscles.

Text Books

1. Ekambaranatha Iye. 2000. A Manuel of Zoology. Vol. IIS. Viswanathanand Co.
2. JordanE. L and P.S. Verma. 2002. Chordate Zoology. S. Chandand Co. New Delhi
3. Kotpal, R.L. 2000. Modern Textbook of Zoology: Vertebrates. Rastogi Publications, Meerut.
4. Verma, P.S. 2002. A Manual of Practical Zoology - Chordates. S. Chandand Co. Ltd.

Reference Books

1. Barnes, R.D. 1987. Invertebrate Zoology. W.B. Saunders. New Delhi.
2. Barrington E.J.W. 1967. Invertebrate Structure and Function. ELB Sand Nelson, London.
3. Brusca, R.C. and G.J. Brusca. 1940. Invertebrates. Sinauer Associates, Sunderland, M.A.

16PZO1MC02 - BIOSYSTEMATICS

SEMESTER I	CREDITS	3
CATEGORY MC	NO.OF HOURS/ WEEK	4

OBJECTIVE :To study the history, system and practice of classifying animal diversity.

UNIT I: Introduction To Animal taxonomy

Importance of taxonomy, stages in taxonomy, problems of taxonomists, Aims and tasks of taxonomists, taxonomy as profession, taxonomy and biodiversity, Rise of taxonomy.

UNIT II : Newer Trends in Taxonomy

Morphological approach, Immature stages and embryological approach, Ecological Approach, Behavioural Approach, Cytological and Biochemical Approaches, Numerical taxonomy and Differential systematics.

UNIT III : Zoological Classification

Kinds of classification, phyletic lineages, components of classification, Linnaean hierarchy. Species concepts : Typological species concept, Nominalistic species concept, Biological species concept, Evolutionary species concept, Recognition species concept, Kinds of species.

UNIT IV : Taxonomic Collection, Identification And Description

Species registry, collecting ways, Data collection, preservation, curating, storing and cataloging, maintaining quality of collection, methods of identification, description of

taxonomic characters. Zoological Nomenclature, origin of code, ICZN.

UNIT V : Taxonomic Records And Publications

Taxonomic keys, Taxonomic characters description, Taxonomic paper, Zoological Records, Directories, Abstracts, Review

Text Books

1. Kapoor V.C. 2010. Theory and practice of animal taxonomy, Oxford and IBH, New Delhi, 259pp.
2. Ashok Verma, 2015. Principles of Animal Taxonomy, Narosa Publishing house, 404pp.

Reference Books

1. George Gaylord Simpson, 1990. Principles of animal taxonomy, Columbia University Press, New York, 247pp.
2. Quicke, D. L. J, 2008. Principles and Techniques of contemporary Taxonomy, Blackie Academic Professional, 310pp.
3. The New Taxonomy, The Systematics Association Special Volume Series, 76. (ed.) Quentin. T. Wheeler, CPR Press, 2008.
4. Theodore Horace Savory, 1970. Animal Taxonomy, University of Michigan, 101pp.

16PZO1MC03 - ADVANCED DEVELOPMENTAL BIOLOGY

SEMESTER I	CREDITS	4
CATEGORY MC	NO.OF HOURS/ WEEK	5

Objective: 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 commitment – mechanism of developmental commitment-mosaic 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 transgenic 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 Indevelopmental 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. Majumdar 1985 Text Book of Vertebrate Embryology. Tata McGrawhill, New Delhi.
4. Scott F. Gilbert. 2006. Developmental biology, 8th edition. Sinauer associate inc., Sunderland, USA.

Reference Books

1. Twyman, R. M. 2003. Developmental biology, Viva Books publisher, 1st edition, New Delhi.
2. Berril N.J. 1974 Developmental Biology. Tata McGrawhill, New Delhi.

16PZO1MC04 - APPLIED ENTOMOLOGY

SEMESTER	I	CREDITS	4
CATEGORY	MC	NO.OF HOURS/ WEEK	5

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

UNIT I: Introduction To Entomology

Classification of Class Insecta – Insect collection, mounting and preservation, Receptor system in phytophagous insects, Types of damage caused by insects, Causes for insect assuming pest status.

UNIT II: Agricultural Entomology

Biology, nature, extent of damage and control measures of insect pests of some important crops – paddy, sugarcane, cotton, groundnut, coconut, mango and beverages. Pests of stored products and their control, locusts and their control measures.

UNIT III: Pests of Domestic Animals, Public Health And Household

Cattle (horse fly, stable fly, cattle fly), Fowl (shaft louse and chicken flea), Sheep and goat (head maggot and sheep ked). Mosquitoes, housefly, eye fly, sand fly, black fly, bed bug, assassin bug, flea, human body 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. Lac culture – lac cultivation – shellac.

UNIT V: Pest Control

Classification of insecticides on the basis of chemical nature, mode of entry and mode of action, biological control of insect pests, Integrated Pest Management and biopesticides, plant protection appliances, Field trips to agricultural institutes in and around Chennai.

Text Books

1. David, B and Ananthakrishnan, T. N. 2006. General and Applied Entomology, Second edition, Tata McGraw hill publishing company Ltd., New Delhi, India.
2. Vasanthraj David, B. and Ramamurthy, VV. 2012. Elements of Economic Entomology, Seventh edition, Namrutha publications, Chennai.

3. Pruthi, H.S. 1969. Text book on Agricultural Entomology, I.C.A.R. Publication, New Delhi.
4. Awasthi, V.B. 2012. Introduction to General and Applied Entomology, third edition, Scientific publishers, India.

Reference Books

1. Abishek Shukla, D. 2009. A Hand Book of Economic Entomology, Vedams e Books, New Delhi.
2. Ministry of Agriculture, Government of India, 1995. Manual on Integrated Pest Management in Rice & Cotton.
3. John William S. 1995. Management of Natural Wealth, Loyola College Publications, Chennai.

16PZO1MC05- ANIMAL BEHAVIOURAL BIOLOGY

SEMESTER I	CREDITS 3
CATEGORY MC	NO.OF HOURS/ WEEK 5

Objective : To learn the origin and development of animal behaviour and understand the influence of genetics, environment and evolutionary principles on instinct, innate and learned behaviours.

UNIT I : Genetics And Behaviour

Genetic material, Genes and chromosomes, Genetic variation, Single and Polygenic inheritance of behaviour, Heritability of behaviour, Natural selection and behaviour, Frequency distribution of phenotypes, Darwinian fitness, Evolution of adaptive strategies.

UNIT II : Evolution And Social Behaviour

Sexual selection, Altruism, Sexual strategy and social organisation, Animal perception, Neural control of

behaviour, Sensory processes and perception, Visual adaptations to unfavourable environments.

UNIT III : Animal And The Environment

Coordination and Orientation, Homeostasis and Behaviour, Physiology and Behaviour in changing environments, Animal Learning, Conditioning and Learning, Biological aspects of learning, Cognitive aspects of learning.

UNIT IV : Understanding Complex Behaviour

Instinct and learning, Displacement activities, Ritualization and Communication, Decision making behaviour in Animals, Complex behaviour of honey bees, Evolutionary optimality, Mechanism of Decision making. The mentality of Animals : Languages and mental representation, non verbal communication in human, mental images, Intelligence, tool use and culture, Animal awareness and Emotion.

UNIT V : Chronobiology

Organization of circadian system in multicellular animals; Concept of central and peripheral clock system; Circadian pacemaker system in invertebrates with particular reference to *Drosophila*; 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.

Text Books

David McFarland, 1985. Animal Behaviour, Longman Scientific & Technical, UK. 576pp.

Hatjindra Singh, 1990. A Text Book of Animal Behaviour, Anomol Publication, 293pp.

Hoshang S. Gundevia and Hare Govind Singh, 1996. Animal Behaviour, S. Chand & Co, 280pp.

1. Shukla, J. P 2010, Fundamentals of Animal Behaviour, Atlantic, 587pp.

2. Vinod Kumar, 2002. Biological Rhythms. Narosa Publishing House, Delhi.

Reference Books

1. Michael D. Breed and Janice Moore, 2012. Animal Behaviour, Academic Press, USA, 359pp.
2. Aubrey Manning and Martin Stamp Dawkins, 2012. An Introduction to Animal Behaviour, 6th Edition, Cambridge University Press, UK. 458pp.
3. Davis E.Davis, 1970. Integral Animal Behaviour, Mac Millan Company, London, 118pp.
4. Jay, C. Dunlap, Jennifer, J. Loros, Patricia J. De Coursey (ed). 2004. Chronobiology Biological time Keeping, Sinauer Associates Inc, Publishers, Sunderland, MA, USA.

16PZO1MC06- INVERTEBRATA, CHORDATA AND DEVELOPMENTAL BIOLOGY LAB COURSE

SEMESTER	I	CREDITS	2
CATEGORY	MC (P)	NO.OF HOURS/ WEEK	6

Objective : The principal objective is to introduce students to the developmental processes that lead to the establishment of the body plan of vertebrates and the corresponding cellular and genetic mechanisms.

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, neris .poison apparatus of russels viper, uromastix, exocoetus, synaptura, 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 21stday;Placenta of shark , sheep , goat and pig; Human embryo.

UNIT V: Field Study And Record

Text Books

- 1.Lal, S.S. 2005. A text Book of Practical Zoology: Invertebrate, Rastogi, Meerut.

2. EkambaranathaAyyar and T.N.Ananthakrishnan, 1995 A manual of Zoology Vol.I (Part 1,2) S.Viswanathan, Chennai.

16PZO2MC01- MOLECULAR CELL BIOLOGY

SEMESTER II	CREDITS 5
CATEGORY MC	NO.OF HOURS/ WEEK 5

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

UNIT I : Molecular Techniques

Microscopy (Conventional and confocal), Cytological techniques, Ultracentrifugation, 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, extrachromosomal replicons, DNA damage and repair mechanisms, repair and recombination. RNA synthesis and processing, 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. Lodish, H., Berk, A., Matsudaira, P., Kaiser, C.A. 2007. Molecular cell biology, what freeman, New York.
3. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter, 2002. Molecular biology, Garland science. New York.
4. Watson, J.D, 2004. Molecular Biology of the gene. Pearson Education, New Delhi.
5. De Robertis, E.D.F. & De Robertis, E.M.F., 1981. Cell and Molecular Biology, Saunders International, Philadelphia.

Reference Books

1. George M. Malacinski, 2010. Essential of molecular biology, 4th edition, Narosa publication.
2. John T. Hancock, 2006. Cell signaling, 2nd edition, oxford University press.
3. Stephns, D. 2006. Cell imaging, Scion publication

16PZO2MC02 - RADIATION BIOLOGY

SEMESTER	II	CREDITS	4
CATEGORY	MC	NO.OF HOURS/ WEEK	4

OBJECTIVE : To understand the radiobiological basis of radiation protection standards.

To define the radiation protection magnitudes and units, their values and their practical measurement

UNIT I : Radiation Quantities

Exposure, Absorbed Dose, Equivalent Dose, Effective Dose, Activity, Linear Energy Transfer

UNIT II : Cellular Response To Radiation

Indirect and direct action, Time scale of radiation effects, Cell kinetics, mitotic death and apoptosis, DNA damage and chromosomal aberrations, Cell cycle stage and radiation sensitivity, Sublethal damage, Cell survival curves, The oxygen effect, Relative biological effectiveness, Radioprotectors and Radiosensitizers.

UNIT III : Radiation Carcinogenesis

Irradiated populations from which quantitative data have been obtained for cancer incidence, The latent period, Sensitivity to radiation-induced cancer as a function of age, Risk estimates for radiation-induced cancer.

Radiation-induced injury to the gonads :Spermatogenesis, Oogenesis, Radiation doses to produce sterility, Hereditary effects of radiation.

UNIT IV : Whole-Body Radiation Effects

Acute radiation syndrome, Prodromal, Latent, Cerebrovascular (CNS), Gastrointestinal, Hematopoietic (bone marrow), Kinetics of depression and recovery of blood cell components, LD50/60, Treatment of radiation accident victims.

UNIT V: Radiation Protection

Objectives of radiation protection, Committees and regulatory bodies concerned with risk estimates and radiation protection, Occupational exposure, As low as reasonably achievable (ALARA), Protection of the embryo/fetus, Medical and Sentinel Events.

Text Books

1. Physics and Radiobiology of Nuclear Medicine - Gopal B. Saha. – Springer IIIrd edition 2006.
2. Radiation and Man - H. C. Jain - National Book trust, India. – 1994.

Reference Books

1. Essentials of Radiation Biology and Protection – Steve Forshier IInd edition
2. Life Sciences and Radiation – J. Kiefer - Springer 2004.

16PZO2MC03 -BIOCHEMISTRY

SEMESTER	II	CREDITS	4
CATEGORY	MC	NO.OF HOURS/ WEEK	5

Objective:To understand the basic principles of Biochemistry

UNIT I : Structure Of Atoms, Molecules And Chemical Bonds.

Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).

UNIT II : Stabilizing Interactions

Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc..Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).

UNIT III : Bioenergetics

Glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers. Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes.

UNIT IV : Conformation Of Proteins

Ramachandran plot, secondary, tertiary and quaternary structure; domains; motif and folds). Conformation of nucleic acids (A-, B-, Z-,DNA), t-RNA, micro-RNA).

UNIT V: Stability Of Protein And Nucleic Acid Structures

Metabolism of carbohydrates, lipids, amino acids, nucleotides and vitamins.

Text Books

1. Fundamentals of Biochemistry – AmbikaShanmugam. Wolters Kluwer Health (India), 2012.
Biochemistry – U. Satyanarayana, U. Chakrapani.– Elsevier – 4th edition 2013.

Reference Books

1. Principles of Biochemistry – Lehninger5th edition – W.H. Freeman & Company 2005.
Harper`s Illustrated Biochemistry - The McGraw-Hill Companies – 2012.

16PZO2MC04-ADVANCED EVOLUTIONARY BIOLOGY

SEMESTER II	CREDITS 4
CATEGORY MC	NO.OF HOURS/ WEEK 4

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 Factors

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 : Palaeontology

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 : Selection 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, Speciation, Man And Natural selection

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.Eugenics, Euphenics and eugenics-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. Dodson, E.O. 1990. A Text Book of Evolution, W.B. Saunders, Philadelphia.
3. Lull, R.S. 1984. Organic evolution, Seema publication New Delhi.

Reference Books

1. Dobzhanunsky. T., Ayala. F.J., Stebbins, G.L and W. Valentine. 1976. Evolution, Surjeet, Delhi.
2. Dobzhanunsky.T. 1976. Genetics and the origin of species. Oxford and IBH,
3. Bajema J. 1971. Natural Selection in Human Population. John Wiley and Son, New York.

16PZO2MC05 –

MOLECULAR CELL BIOLOGY LAB COURSE

SEMESTER I	CREDITS	3
CATEGORY MC (P)	NO.OF HOURS/ WEEK	6

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/Chironomouslarva for observing giant chromosomes with banding and balbiani rings.Comparing blood smear of an invertebrate and chordate – Insect, Frog and human.

UNIT III : Chromosome Preparation

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

UNIT IV : Mendelian Traits

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

UNIT V :SEPERTION TECHNIQUES

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.

16PZO2ES01-HISTOCHEMICAL TECHNOLOGY

SEMESTER	II	CREDITS	3
CATEGORY	ES	NO.OF HOURS/ WEEK	4

Objective: 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 – Oil 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 labeling.

UNITV: Types of Microtomes, Importance of Microtechnique And Preparation of Tissue

Paraffin Microtome, Cryostat, Ultra Microtome-Steps involved in tissue processing and Microphotography. A visit of histopathological institutes and maintenance of record.

Text Books

1. Patki, L.R. et al., 1983. An Introduction to Microtechnique, S. Chand publications.
2. Bruce Casselman, W.G. 1962. Histochemical technique. Butler and Tanners publications, London.

Reference Books

1. Pearse, A.G.E.,1970. Theoretical and applied Histological Techniques – Vol I Churchill livingstone, New York.

2. John D. Bancroft and Marilyn Gamble, 2008. Theory and Practice of Histological Techniques. Churchill Livingstone Elsevier.

16PZO2ES02 - CLINICAL LABORATORY TECHNOLOGY

SEMESTER I **CREDITS 3**

CATEGORY ES **NO.OF HOURS/ WEEK 4**

Objective: To learn the common pathogens and clinical diagnostic techniques for various diseases in man.

UNIT I : Human Anatomy And Safety Measure

Human body overview - Structural organization system, functions- common causes of accidents in lab – laboratory safety – biomedical waste. Classification wastes coding, Treatment wastes disposal medical Personal safety measure, - disposal of lab wastes and hazardous chemical reagents and glasswares- fire safety.

UNIT II : Haematology

Composition and functions of blood - collection of blood - types of anaemia- blood coagulation - bleeding time- clotting time- determination of hemoglobin - erythrocyte sedimentations rate- packed cell volume- Total count of RBC- Differential count of WBC- bleeding disorders of man – blood grouping-Platelet count-Hemopoietic system – erythropoiesis, thrombopoiesis and leucopoiesis – Hemopoietic.

UNIT III : Bio Medical Techniques And Blood Parasites

Structure and function of cells - parasites - *Entamoeba- Plasmodium-Leishmania* and Trypanosome-blood Pressure monitor- Computer tomography (CT scan) - Magnetic Resonance imaging (MRI)- flowcytometry - treadmill test-PET.

UNIT IV : Medical Physiology

Cardiovascular system-Cardiac cycle - regulation of heart rate, cardiac shock. Heart sounds, Electrocardiogram-significance-ultra sonography -ultrasonic diagnostic methods-dialysis.

UNIT V : Diagnostic Pathology

Handling and labeling of histology specimens - tissue processing – fixation, dehydration embedding, block preparation. Microtomes –sectioning, staining – methods – mounting - problems encountered during section cutting and remedies.

Text Books

1. Godker, P.B. and Godker, P.D. 2011. Text book of medical Laboratory Technology, Bhalani Publishing house, Mumbai.
2. Hoffbrand,A.V. and P.Moses, 2011.Essential Haematology, John Wiley and Sons, Chicester.
3. Guyton and Hall, 2010. Text book of medical physiology, Elsevier, New Delhi.

Reference Books

1. Cella, J.H. and Watson, J. 2004. Manual of laboratory test, Aitbs, New Delhi.
2. GayatriPrakash, 2012. Lab manual on blood analysis and medical analysis, S. Chand, New Delhi.
3. Manoharan, A. and Sethuraman, 2003. Essential of Clinical Heamatology, Jeypee, New Delhi.

16PHE2FC01 - LIFE SKILLS TRAINING

SEMESTER	II	CREDITS	4
CATEGORY	FC(T)	NO.OF HOURS/ WEEK	2+2

Course Objectives:

To improve and sustain the primal level of competence and performance of PG students through an advanced training of holistic development of oneself.

To empower through various skills and strengthen them to face the future life issues and challenges.

To equip them with practical and value based learning of soft skills for a better life in future.

Competence building	Career Preparatory Training
Power talk	Interview Guidance
Emotional Intelligence	Group Dynamics
Stress management	Leadership skills
Decision Making	Negotiation Skills
Positive image building	Creative writing

INSIDE CLASS HOURS (2 hrs)

Unit – I: Constructing Identity

Self Image – Understanding self image – shadows down the lane – self acceptance - **Self Knowledge** – Knowing oneself - **Self confidence** – Guilt and grudges -Power of belief – positive thinking– optimizing confidence - **Self development** – perception, attitude and Behavioural change, developing a healthy and balance personality - **Self esteem** – signs - indicators

Unit – II: Capacity Building

Motivation – Definition, types (Intrinsic and Extrinsic), Theories (Maslow’s hierarchical needs, etc), Factors that affect motivation, Challenges to motivation, Strategies to keep motivated, motivational plan. **Time Management Skills**– steps to improve time management, overcoming procrastination, assessing and planning weekly schedule, challenges, goal settings, components of goal settings,

consequences of poor time management, control of interruption and distractions.

Communication, public speaking, talents, creativity, learning

Unit – III: Professional Skills – Leadership development skills – difference between leader and manager, different styles and their utilities, functions of leadership, application of knowledge, overcoming from obstacles, influential skills and Leadership qualities. **Application skills** – Managing Career and self-direction, Visionary thinking, formulating strategies, shaping strategies, building organizations relationships, change management. Project Management Skills, Independent working skills, Writing skills, Public Speaking, analytical Skills, Neo Research and Development. **Problem solving skills** – Process, approaches and its components, creative problem solving, Tools and techniques, application of SMART analysis and barriers to problem solving.

Unit – IV: Life Coping Skills

Life skills – Personal and reproductive Health, love, sex, marriage and family – family life education – Gender Equity - child bearing and Childrearing practices, Geriatric Care - adjustability **Human Relationship** – formal and informal - peer group – friends – same and other gender - family – Colleagues – community – emotional intelligence - **Stress Coping skills** – Definition of stress, strategies to alleviate stress, problem and emotion focused coping, techniques to reduce stress, stress reaction phases, crisis intervention steps, creating positive affirmations, Signs, Symptoms and Reactions of Stress.

Unit – V: Social Skills

Human Rights Education, Understanding Human Rights, International and national mechanisms, protection and preservation of HRs, Human Rights in the context of new,

technological and electronic society, **Peace Education**, Social Harmony in the context of religious fundamentalism and fanaticism, Understanding Peace and Justice, Conflict Resolution Strategies.

Reference books :

1. Healing Your Emotional Self: A Powerful Program to Help You Raise Your Self-Esteem, Quiet Your Inner Critic, and Overcome Your Shame by Beverly Engel
2. Self-knowledge and self-discipline by B. W. Maturin
3. Motivation: Biological, Psychological, and Environmental (3rd Edition) by Lambert Deckers
4. Getting Things Done: The Art of Stress-Free Productivity by David Allen
5. Managerial Skills in Organizations by Chad T. Lewis
6. Social Intelligence: The New Science of Human Relationships by Daniel Goleman

OUTSIDE THE CLASS HOURS (2 hrs)

- Each student will choose either of the above-mentioned modules and is expected to undergo a training/workshop in that module.
- She/he will have to accomplish ten hrs outside the class hours to fulfill the 2 credits.

Methodology:

Inputs, ABL model, Documentaries, group activities and Interaction, Special workshop by professionals.

Evaluation:

There will be end test and a Project for ‘inside the class hours’. Viva Voce will be conducted for the ‘Outside the class hours’.

16PZO3MC01 - ENVIRONMENTAL BIOLOGY AND MANAGEMENT

SEMESTER	III	CREDITS	4
CATEGORY	MC	NO.OF HOURS/ WEEK	5

Objective : 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

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 biology, Books and Allied, Kolkata.
3. Sanyal, K. Kundu, M. and Rana, s. 2009. Ecology and environment, Books and allied, Kolkata.

16PZO3MC02 - RESEARCH METHODOLOGY AND BIOSTATISTICS

SEMESTER	III	CREDITS	4
CATEGORY	MC	NO.OF HOURS/ WEEK	5

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 Research

Need for research, Literature collection, Research methods- Problem selection – Literature survey – Familiarity with ideas and concepts of investigation- Acquiring technical skills – Drawing inferences from data- Qualitative and Quantitative analysis – Assessing the problem – Results and Conclusions.

UNIT II : Research Design

Need for research design: Features of good design, Important concepts related to good design- Observation and Facts, Prediction and Explanation, Development of Models. Developing a research plan: Problem identification, Experimentation, Determining experimental and sample designs.

UNIT III : Data Collection, Analysis And Report Writing

Observation and Collection of Data-Methods of data collection- Sampling Methods, Data Processing and Analysis Strategies, Technical Reports and Thesis writing, Citation, Acknowledgement, Preparation of Tables and Bibliography. Data Presentation using digital technology.

UNIT IV : Ethical Issues

IPR – Introduction, Protection of IPR in India, terminologies associated with IPR – Patent, Copyright, Trademark, Design, Trade Secrets, other issues related to IPR, Plagiarism.

UNIT V : Biostatistics

Biometry, Collection, Classification & tabulation of data, Frequency distribution – Types, measures of central tendency – mean, median & mode, measure of dispersions – Standard deviation, Quartile deviation & mean deviation, Std errors & std curve, Probability – Hypothesis testing for significance, Chi square and Student ‘t’ Test, Regression and Correlation – ANOVA, Introduction to statistical softwares

Text Books

1. Research Methodology – C.R. Kothari. (2009), New Age International.
2. Research Methodology for Biological Sciences – N. Gurumani. MJP Publishers.

Reference Books

1. Research Methods: A Process of Inquiry – Anthony. M, Grazino. A. M

16PZO3MC03 - ANIMAL PHYSIOLOGY

SEMESTER	III	CREDITS	4
CATEGORY	MC	NO.OF HOURS/ WEEK	4

OBJECTIVE: To expose the students to the various physiological mechanisms functioning in animal kingdom.

UNIT-I: Nutrition And Excretion

Nutrition - nutrients - digestion and adsorption of proteins, carbohydrates and lipids. Role of gastrointestinal hormones in digestion. Excretion - excretion of metabolic waste products in relation to the environment - physiology of excretion in Man.

UNIT-II: Respiration and circulation And osmoregulation

Respiration in Invertebrates and Vertebrates - physiology of respiration in Man. Respiratory Pigments, nervous and chemical control of respiration, BMR. Circulation - types of hearts - physiology of cardiac muscle - heart beat and its regulation - blood coagulation and theories. Iono - osmoregulation in Invertebrates (crustaceans), fishes, birds and mammals -hormonal control.

UNIT-III:Coordination

Neuromuscular co-ordination - types of neurons, transmissions of nerve impulse and reflex action. Chemical composition of muscle fiber and physiology of muscle contraction. Myoneural Junction. Endocrine gland in mammals - Hormones and Functions. Physiology of mammalian reproduction-reproductive cycle-hormonal control of reproduction.

UNIT-V: Behavioural physiology

Bioluminescence - chemistry and functional significance. Behaviour (types - tropism, taxis, kinesis, reflex, learning).

Temperature regulation: Poikilotherms, and heterotherms - hibernation, aestivation - diapause.

UNIT V : Human Reproductive Physiology

Reproductive Process in Male : Development, descent and structure of the testis. Spermatogenesis: Molecular changes, hormonal regulation, and spermiogenesis. Sertoli cells, Leydig cells, Epididymis, Structure of Spermatozoon and anomalies. Sperm capacitation, Vas deferens, Seminal Vesicle, Accessory sex glands. Reproductive Process in Female : Onset of puberty and delayed puberty Oogenesis, Estrous cycle in mammals, Menstrual cycle and Menopause, Mechanism and hormonal control of ovulation, Corpus luteum: histogenesis, function, maintenance and luteolysis, Oviduct: structure, regional differentiation and function, Uterus: Types, abnormalities and Cervix - structure, functions.

Text Books

1. Verma P. S, B.S. Tyagi and U.V. Agarwal, 2005. Animal Physiology. S. Chand & Company Ltd, New Delhi.
2. Rastogi, S. T 1988. Essentials of Animal Physiology. Wiley, Eastern Limited, Madras.
3. Williams S. Hoar, 1966. General and Comparative Physiology. Prentice Hall of India, New Delhi.
4. Hoar, W.S. 1991. General and Comparative Physiology. Prentice Hall of India, New Delhi.
5. Herkat, P.C. and Mathur, P.N. 1976. Text Book of Animal Physiology. S. Chand Co. Pvt. Ltd., New Delhi.

Reference Books

1. Wilson. A, 1979. Principles of Animal Physiology. Macmillan Publishing Co., Inc. New York.
2. Leon Goldstein, 1977. Introduction to Comparative Physiology. Holt, Rinehart and Winston, New York.
3. Prosser, C.L. 1973.

4. Comparative Animal Physiology, 3rd edn. W.B. Saunders & Co., Philadelphia.
5. Barrington, E.J.W. 1975. An Introduction to General and Comparative Endocrinology. Clarendon Press, Oxford
6. Bentley, P.J. 1971. Endocrine and osmoregulation, Springer Verlag, New York.
7. Welson, A. 1979. Principles of Animal Physiology. McMillan Publishing Co. Inc. New York.
8. The Physiology of Reproduction, Vol 1 and 2, Ernst Knobil and Jimmy D. Neil, (ed), Raven Press. Male Reproductive Function, Christina Wang, (ed), Kluwer Academic Publishers.

16PZO3MC04 - ECO-PHYSIOLOGY LAB COURSE

SEMESTER	I	CREDITS	3
CATEGORY	MC (P)	NO.OF HOURS/ WEEK	6

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 Alkalinity in water samples. Analysis 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 and spectrophotometry or Colorimetry, Electrophoresis, centrifuge, and 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. AmbikaShanmugam. 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.

16PZO3ES01 - BIOINFORMATICS

SEMESTER	III	CREDITS	3
CATEGORY	ES	NO.OF HOURS/ WEEK	4

Objective: To understand various computational techniques employed to analyze biological data with the use of sequence information.

UNIT I : Biological Data Bases

Introduction to data types and Source, Classification and Presentation of Data. Quality of data, private and public data sources. General Introduction of Biological Databases; Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary). Specialized Genome databases: (SGD, TIGR, and ACeDB). Structure databases (CATH, SCOP, and PDBsum), database management System.

UNIT II : Data Storage And Retrieval

Flat files, relational, object oriented databases and controlled vocabularies. File Format (Genbank, DDBJ, FASTA, PDB, SwissProt). Introduction to Metadata and search; Indices, Boolean, Fuzzy, Neighboring search. The challenges of data exchange and integration. Ontologies, interchange languages and standardization efforts. General Introduction to XML, UMLS, CORBA, PYTHON and OMG/LIFESCIENCE.

UNIT III : Sequence Alignments Evolutionary Analysis

Introduction to Sequences, alignments and Dynamic Programming; Local alignment and Global alignment (algorithm and example), Pairwise alignment (BLAST and FASTA Algorithm) and multiple sequence alignment (Clustal W algorithm), Phylogenetic Analysis, Tree evaluation, Hidden Markov Model. Distances, Cladistic and Phenetic methods. Clustering Methods. Rooted and unrooted

tree representation. Bootstrapping strategies, Use of Clustal and PHYLIP.

UNIT IV : Gene Identification, Prediction, Expression And Microarrays

Basis of gene prediction, pattern recognition, Gene prediction methods, Gene prediction tools, DNA Microarrays, Gene Expression profiles, Tools for microarray Analysis, Applications of Microarray Technology.

UNIT V : Protein Structure Visualization And Drug Discovery

Protein Structure Databases, Visualization, Pharmacogenetics, Pharmacogenomics, Analysis of Single Nucleotide Polymorphism, Drug Discovery Technologies and Strategies, Drug Design Approaches, Computer aided Drug Designing Methods.

Text Books

1. Harshawardhan, P.B. 2007. Bioinformatics - Principles and Applications - Tata McGraw Hill, New Delhi.
2. Mount, D. W., 2001. Bioinformatics - Sequence and genome analysis. Cold Spring Harbor.
3. Rastogi, S. C. 2003, Bioinformatics (Concepts, Skills and Applications) CBS, New Delhi.
4. Stephen A. K. and Womble, D.D., 2003, Introduction to Bioinformatics: A Theoretical and Practical Approach, Humana Press, New Jersey.
5. Zhumur, G and Bibekanand, M. 2008. Bioinformatics (principles and applications) Oxford University press, New Delhi.

Reference Books

1. Cynthia, G. and Jambeck, P. 2001. Developing Bioinformatics Computer Skills, Shroff, Mumbai.
2. James D. Tisdall, J.D. 2001. Beginning Perl for Bioinformatics, Shroff, Mumbai
3. David, M. 2001, Bioinformatics: Sequence and Genome Analysis Cold spring harbor laboratory Press.
4. Gibas C and P. Jambeck, 2000, Developing Bioinformatics Skills, O' Reilly and Associates, California.
5. Rashidi, H. and Lukas K. Buehler, 1999, Bioinformatics Basics Applications in Biological Science and Medicine, CRC press.

16PZO3ES02 - AQUACULTURE

SEMESTER	III	CREDITS	3
CATEGORY	ES	NO.OF HOURS/ WEEK	4

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

UNIT I : Fish Reproduction Development And Growth

Hormonal actions for fish breeding, Developmental traits and pattern of fish eggs and larvae. Ageing and growth of fish, Selection of site and species for aquaculture, Qualities of culturable indigenous and exotic species, Site selection and construction of farms for carp and prawn culture

UNIT II : Fish Pathology And Diseases

General principles of diseases in aquaculture, Major diseases in aquaculture, control and management. Immune protection in fish systems and Stress response, Transformation of infection into diseases

UNIT III : Aquaculture Of Carps

Concepts and economic principles of farm management, Culture system, preparation and management of ponds for culture, Spawning and fry production, grow out, Transportation and polyculture, Aquaculture of freshwater prawns, Major cultivated species of prawns, Reproduction and larval rearing of prawns.

UNIT IV : Integration Of Aquaculture

Rationale of integrated farming of fish and livestock, Rice field aquaculture, Non-conventional aquaculture system, Raceways, Cages and Pen enclosures, Waste water recycling through aquaculture

UNIT V : Techniques Of Stock Improvement

Induced breeding and bundh breeding, Cryopreservation, hybridization, polyploidy and transgenesis, Modern hatcheries and management.

Text Books

1. Gupta, S.M., 2010. Text book of fishery, Ann Backer, Mumbai.
2. Hanifa, M.A. 2011. Aquatic resources and aquaculture, Dominant, New Delhi.
3. Kamaleshwar Pandey and Shukla, J.P. 2010. Rastogi Publications, Meerut.

Reference Books

1. Govindan, T.K. 1985. Fish processing, technology, Oxford University, Delhi.
2. Jhingran, V. G. 1982. Fish and fisheries of India, Hindustan publications, India.
3. Shailendra Ghosh, 2009. Fisheries and aquaculture management, Adhyayan, New Delhi.

16PZO3TP01 SUMMER TRAINING PROGRAMME
SEMESTER III CREDITS 1
CATEGORY TP(P) No.of hours/ week 3 – 4 wk

1. A staff member of a department (GUIDE) will be monitoring the performance of the candidate.
2. The summer training program falls between Semester II and III. Students are expected to undergo this training soon after the second semester examinations.
3. The training will commence not later than one week after the completion of the semester examination
4. Organizations for the summer placement must be confirmed before the commencement of the second continuous internal tests.
5. Students must submit letter of induction to the respective guide within the first week of the internship.
6. The student has to spend a total of 20 working days in the respective field.
7. Students are expected to submit weekly reports along with daily time sheets to the respective supervisors.
8. The reports will be used to evaluate the student's performance.
9. Students should submit a letter of completion from the organization duly signed by the authorities.
10. If the staff is satisfied with the performance of student, he/she will be marked **“COMPLETED”** at the end of the semester and the details will be submitted to COE office through the HOD

16PZO3ID01 - BIOPRODUCTS AND MARKETING
SEMESTER III CREDITS 5
CATEGORY ID NO.OF HOURS/ WEEK 6

OBJECTIVE: To enable students to appreciate the science behind aquaculture farming and poultry farming and to help 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 – milk products – Indian dairy products

UNIT II : Bioproducts Of Terrestrial Animals

Apiculture and honey production – sericulture and silk production – poultry production – egg and meat.

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

16PZO4MC01 - MICROBIOLOGY AND IMMUNOLOGY

SEMESTER	IV	CREDITS	4
CATEGORY	MC	NO.OF HOURS/ WEEK	4

OBJECTIVE: 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. Whittacker's five kingdom classification- Methods for studying microorganisms.

UNIT II : Microbial Structure And Organisation

Anatomy of prokaryotes - cell wall, cytoplasmic membrane, cilia, flagella, capsule, cytoplasmic inclusions, sporulation. 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 : Immunology - Immunodeficiencies

Congenital Immunodeficiencies, Acquired Immunode

iciencies, Vaccination, Principles and Significance, Types of Vaccines (subunit, killed, attenuated etc.), Future trend and target of vaccination

UNIT V : Developmental And Regenerative Immunology

Molecular mechanisms of B lymphocyte development and leukemogenesis, Thymic and T cell development - lineage commitment of hematopoietic stem cells, Plasticity of hematopoietic stem cell and application, Evolution of this primary lymphoid organ (model sea Urchin, Drosophila, Xenopus, zebrafish and mice)

Text Books

1. Dubey R.C. & Maheshwari, D.K. 2009. A text book of Microbiology, S. Chand & company Pvt. Ltd, New Delhi.
2. Prescott, Harley and Klein's, 2008. Microbiology, 7th edition, Tata McGraw Hill international edition, Page 1-1086.
3. David, Brostoff and Roitt, 2006. Immunology, 7th Ed., Mosby & Elsevier Publishing, Canada, USA.
4. C.VRao, 2005. Immunology, 2nd edition, Narosa Publishing House, New Delhi.

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, Inc. New York.
3. Ronald M Atlas, 1997, Principles of microbiology, 2nd edition, Tata McGraw Hill international edition, Page 1-1098.

16PZO4MC02 - BIOTECHNOLOGY

SEMESTER	IV	CREDITS	4
CATEGORY	MC	NO.OF HOURS/ WEEK	4

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

UNIT-I: Recombinant DNA Technology

Gene cloning - the basic steps - various types of restriction enzymes - ligase linkers and adaptors - c DNA - transformation - Selection of recombinants. Hybridization techniques chemical synthesis of oligonucleotides.

Gene probe - Molecular finger printing (DNA finger printing) - RFLP - the PCR techniques - Genomic library - Blotting techniques - Southern blotting - Northern blotting - Western blotting

UNIT-II: Cloning Vectors

Plasmid biology - cloning vector based on E. coli PBR 322 and bacteriophage. Cloning vector for yeast. Cloning vector for Agro bacterium tumefaciens. Cloning vector for mammalian cells - Simian virus 40 - Gene transfer technologies.

UNIT-III: Animal Biotechnology

Cell culture - Organ culture - whole embryo culture - Embryo transfer - In vitro fertilization (IVF) technology - Dolly - embryo transfer in human. Transgenic animal. Human gene therapy. Cryobiology.

UNIT-IV: Microbial Biotechnology

Fermentation - bioreactor - Microbial products - Primary & Secondary Metabolites - enzymes technology - single cell protein (SCP). Biopolymers, Biopesticides and Biofertilizers.

UNTI-V: environmental biotechnology and applications of biotechnology

Bioremediation - bioremediation of hydrocarbons - Industrial wastes - Heavy metals - Xenobiotics - bioleaching - biomining - biofuels. Applications of biotechnology in agriculture, medicine and food science. Genetically modified organism (GMO'S) - GM foods. Biotechnology & biosafety - IPR.

Text Books

1. R. Ian Freshney, 2010. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, John Wiley & Sons, USA.
2. Portner R. 2007. Animal Cell Biotechnology, Humana Press, USA.
3. Gupta, P.K. 2004. Biotechnology and Genomics. Rastogi Publications, Meerut.
4. Das, H.K. 2004. Text Book of Biotechnology. Wiley Dreamtech India Pvt. Ltd., New Delhi.

Reference Books

1. Purohit, S.S. and S.K.Mathur. 1999. Biotechnology Fundamentals and Application. Agro Botanica, New Delhi.
2. R.C.Dubey 2001 A text book of biotechnology. RajendraRavindra Printer. New Delhi.
3. T.A. Brown 2004 Gene cloning and DNA analysis. Blackwell Science, Osney Mead, Oxford.
4. Glyn N. Stacey, John Davis ,2007. Medicines from Animal Cell Culture, John Wiley & Sons, USA.

16PZO4MC03 - MICROBIOLOGY AND BIOTECHNOLOGY LAB COURSE

SEMESTER	IV	CREDITS	4
CATEGORY	MC	NO.OF HOURS/ WEEK	4

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

UNIT I : Staining Methods

Staining Techniques: Simple staining technique, Gram staining technique, Negative staining.

UNIT II : Culture Techniques

Pure culture techniques – preparation of slants, sub culturing, streaking, pouring and spread plate method, Study of cultural characteristics of bacteria/Fungi on selective –differential media

UNIT III : 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 and enumeration of microorganism from air, soil and water

UNIT IV : Biotechnology

Isolation of genomic DNA from bacteria and purification by column spin. Isolation of plasmid DNA by Poly ethylene glycol method. Quantification of DNA and RNA spectrophotometric method. DNA amplification by PCR. DNA elution from Agarose gel.

UNIT V : Microtechniques

Agrose Gel Electrophoresis system, Southern blotting technique, PCR technique, MABs production, Dolly the

mammalian clone, Vaccine production, DNA sequencing system, DNA finger printing. Field visit.

Text Books

1. Ader R, Felten D.L. 2007. Psychoneuroimmunology, Nicholas C., Academic Press, UK.
2. Cappuccino, J. G. and N. Sherman. 2007. Microbiology – A Laboratory Manual, Pearson Education India, New Delhi.
3. Mudili, J. 2007. Introductory Practical Microbiology, Alpha Science International, New Delhi.

Reference Books

1. Ignacimuthu, S. 2002. Methods in biotechnology, Phoenix, New Delhi.
2. Schmauder, H.P. and Scjweezer, M. 2002. Methods in biotechnology, Taylor and Francis, UK.