



Avinashilingam Institute for Home Science and Higher Education for Women
(Deemed to be University under Category A by MHRD, Estd. u/s 3 of UGC Act 1956)
Re - accredited with A++ Grade by NAAC. Recognised by UGC Under Section 12B
Coimbatore – 641043, Tamil Nadu, India

Department of Zoology
M.Sc., Zoology

Programme Outcome:

1. Acquire in-depth knowledge in science, gain technical and experimental skills in Zoology
2. Ability to express complex ideas in projects and research by enhancing the communicative skills
3. Enhance critical thinking by utilizing existing infrastructure to identify the problem and to discover solutions.
4. Building inquisitive skills to combat problems faced in the field of zoology by potential solutions
5. Impart team work skills to achieve shared goals in an effective manner
6. Capacity to identify resources required for a project and execute the project to completion by appropriate rules and regulations
7. Successful cope up with modern scientific trends through digital literacy to handle biological data.
8. Strengthen the ethical values to develop personal, professional and research ethics.
9. Imbibe a self-paced and self-directed learning ability to carry out independent research.
10. Identify the individual's entrepreneurial skills in life sciences.

Programme Specific Outcome:

1. Understand the fundamentals and application oriented knowledge in zoology.
2. Create graduates in the fields of zoological sciences to develop innovative products for societal approaches.
3. Expand entrepreneurial opportunities in zoological sciences.
4. To develop research aptitude in graduate to solve emerging disease epidemics.
5. To instigate and train students to clear competitive exams at national level.

Scheme of instruction and examinations
(For students admitted from 2021-2022 onwards)

Part	Subject Code	Name of paper/component	Hours of instruction/week		Scheme of examination				
			Theory	Practical	Duration of exam	CIA	CE	Total	Credit
First Semester									
I	21MZOC01	Functional Morphology of Invertebrates	5	-	3	40	60	100	5
I	21MZOC02	Functional Morphology of Vertebrates	5	-	3	40	60	100	4
I	21MZOC03	Cell and Molecular Biology	5	-	3	40	60	100	5
I	21MZOC04	Genetics	5	-	3	40	60	100	4
I	21MZOC05	Practicals I – Invertebrates and Vertebrates	-	3	3	40	60	100	3
I	21MZOC06	Practicals II – Cell and Molecular Biology and Genetics	-	5	3	40	60	100	3
II		CSS	-	2	-	-	-	-	-
Second Semester									
I	21MZOC07	Biochemistry	4	-	3	40	60	100	5
I	21MZOC08	Animal Physiology and Endocrinology	5	-	3	40	60	100	5
I	21MZOC09	Developmental Zoology	5	-	3	40	60	100	4
I	21MZOC10	Bioinformatics	4	-	3	40	60	100	4
I	21MZOC11	Practicals III –Biochemistry, Animal Physiology, Endocrinology, Developmental Biology and Bioinformatics	-	5	5	40	60	100	3
I	21MZOC12	Mini Project	-	1	-	100	-	100	2
I		Interdisciplinary Course	4	-	3	40	60	100	4
II	21MSXCS1	CSS	-	2	3	-	-	100	1
II		Professional Certification course	-	-	-	-	-	-	2
Internship during summer vacation for one month									
Third Semester									
I	21MZOC13	Environmental Biology and Toxicology (Open Book)	4	-	3	100	-	100	4
I	21MZOC14	Microbiology	4	-	3	40	60	100	4
I	21MZOC15	Immunology	4	-	3	40	60	100	4

I	21MZOC16	Biotechnology	4	-	3	40	60	100	4
I	21MZOC17	Evolution	4	-	3	40	60	100	4
I	21MZOC18	Practicals IV –Microbiology, Immunology and Biotechnology	-	3	5	40	60	100	3
I	21MZOC19	Economic Zoology (Self Study)	1	-	3	40	60	100	4
I		Multidisciplinary Course	2	-	-	100	-	100	2
II	21MZOC20	Internship	-	-	-	100	-	100	2
I	21MZOC21	Biostatistics and Thesis Writing	4	-	3	40	60	100	4
Fourth Semester									
I	21MZOC22	Research Project	-	30	-	100	100	200	8

Total credits –97

Other course to be undergone by the students

MOOC course - 2 to 4 credits

Minimum 97 to 2 credits to earn the degree

Other courses offered by the department

IDC - 21MZOI01 – Entrepreneurial Avenues in Zoology

MDC -21MZOM01 – Conservation of Fauna

Professional Certification Course

(i) 21MZOPC1 – Radioecology

(ii) 21MZOPC2 - Cytogenetic and Molecular Biology Techniques

Functional Morphology of Invertebrates

Semester I
21MZOC01

Hours of Instruction / week: 5
No. of credits: 5

Course Objectives:

1. To make students to understand
2. The systems of classification and morphology of invertebrates
3. The symmetry and coelom of the invertebrates and their significance

Unit 1.	General principles of Animal Taxonomy	20hrs
	Definition of taxonomy, Biological classification (artificial, natural and phylogenetic)–Nomenclature–Rules of Binomial nomenclature– Hierarchy of categories–Systematics–Numerical taxonomy– New trends in taxonomy–Species concept–Typological, Nominalistic and Biological species concept–Ecospecies, Coenospecies and super species–Grade of organization - *Symmetry–Coelom–Metamerism.	
Unit 2.	Locomotion and feeding	15 hrs
	Locomotion by Pseudopodia, Flagella and Cilia - Hydrostatic movement in hydra and star fish. * Feeding: Filter feeding in Polychaetes, Molluscs and Echinoderms	
Unit 3.	Respiration and circulation	10 hrs
	Organs of respiration: Gills (Crustacea), lungs (Pila), and trachea (Insecta)– respiratory pigments - Mechanism of respiration;Circulation – Cyclosis (Paramecium), Diffusion (Sponge) *Open circulatory system (Cockroach) and closed circulatory system (Neries).	
Unit 4.	Nervous system and sense organs	15 hrs
	Primitive nervous system in Coelenterata and Echinodermata; Advanced nervous system in Annelida, Arthropoda (Crustacea and Insecta) and Molluca (Cephalopoda). *Sense organs: Simple and Compound eye, statocyst and osphradium, nuchal organs, tactile and olfactory receptors	
Unit 5.	Excretion and Reproduction	15 hrs
	Organs of excretion - coelom, coelomoducts, nephridia, green glands and Malphigian tubules - Mechanisms of excretion. Reproduction: Asexual (Paramecium), Alternation of generation (Obelia), sexual (Fasciola and Nereis). *Larval forms of Crustacea and Echinodermata and their evolutionary significance.	

***Self study**

Total Hours: 75

Text Books:

1. Kotpal RL. Modern Text Book of Zoology, Invertebrates (9th Edition) Rastogi Publications, Meerut, 2014.
2. Jordan E L. Text book of Invertrabrate Zoology. S Chand and Company Ltd, New Delhi, 2010.
3. Kotpal RL. Modern Text book of Zoology- Invertebrates, Rastogi Publications, Meerut, 2005.
4. EkambaranathaAyyar. Manual of Zoology, Vol (I). Invertebrates, S. Viswanathan Printers and Publishers Pvt. Ltd., Chennai, 2002.

Reference Books:

1. Ruppert, Fox and Barnes. Invertebrate Zoology: A Functional Evolutionary Approach, 7th Edition, Cengage India, 2015.
2. Barnes RSK, Calow P, Olive PJW, Golding DW, Spicer JI. The Invertebrates: A New Synthesis. 3rd Edition. Blackwell Science, USA, 2002.

Course Outcomes:

1. Able to understand the fundamental principles of systematics.
2. Compare and understand the specific characteristics within each phyla..
3. Understand and communicate the major evolutionary significance in invertebrates
4. Elucidate the functional significance of associated morphologies and behaviour
5. Explicate economic importance of invertebrates.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	H	H	H	L	H	H	L	H	L
CO 2	H	H	H	H	L	H	H	H	L	M
CO 3	H	H	H	H	H	M	H	L	H	H
CO 4	H	H	H	H	M	H	H	L	L	L
CO 5	H	H	H	H	L	L	H	M	L	H

Functional Morphology of Vertebrates

Semester I
21MZOC02

Hours of instruction / week: 5
No of credits: 4

Course Objectives:

1. To know the principles of vertebrate classification
2. To understand the evolution of organ systems
3. To understand the distinctive characteristics of major vertebrate groups,

Unit 1.	Outline classification of Vertebrates upto orders with examples *Super class Pisces and super class Tetrapoda -Comparative anatomy of Vertebrates	10hrs
Unit 2.	Vertebrate integument and its derivatives General structure and functions of skin and *its derivatives - Glands, Scales, Horns, Claws, nails, hoofs, feathers and hairs	15 hrs
Unit 3.	Circulatory and Respiratory systems in Vertebrates General plan of circulation in various groups – Evolution of heart and aortic arches and portal systems – lymphatic systems. *Respiration – Internal and external respiration, Respiratory organs and Types of respiration – Gill, Cutaneous, Buccal, Pulmonary and Diaphragmatic.	20 hrs
Unit 4.	Nervous system Comparative anatomy of the brain in relation to its functions; Nerves– cranial and peripheral nerves - *Autonomous nervous system	15 hrs
Unit 5.	Urinogenital system in Vertebrate Types and Functions of Kidneys- Pro, Meso and Meta nephric kidneys Reproductive system, *Male and Female Gonads and Gono ducts - accessory reproductive glands. *Self Study	15hrs

Total Hours: 75

Text Books:

1. Kotpal RL. Modern text book of Zoology- Vertebrates, Rastogi publications, Meerut.2005
2. Jordan EL and Varma, PS. Chordate Zoology, S.Chand and Company, New Delhi 2005.
3. EkambaranathaAyyar. Manual of Zoology, Vol. II, Vertebrates, S.Viswanathan (Printers and Publishers) Pvt. Ltd., Chennai 2005

Reference books:

1. Kingsley JS Text book of vertebrate Zoology, New York, H.Holt 2010.
2. Asha Sharma .Vertebrates (Structure and Functions), Ramesh Book Depot,New Delhi 2008
3. Gurudharsan sikh and Bhaskar H. Advanced Chordate Zoology , Campus books, New Delhi 2008

Course Outcomes:

1. Understand the unique features, taxonomy and functional morphology of different classes of vertebrates.
2. Explore the role of integument and its derivatives in major vertebrates groups.
3. Knowledge of evolution of heart and lungs of vertebrates.
4. Compare the anatomy of vertebrate nervous system in perception to phylogenetic evolution.
5. Explore the structure and function of specific organization of vertebrates.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	H	H	M	H	H	H	M	H	H
CO 2	H	M	H	M	H	H	H	M	H	H
CO 3	H	M	H	M	H	H	H	M	H	L
CO 4	H	L	L	L	H	H	H	M	H	L
CO 5	H	M	H	M	H	H	H	M	H	H

Cell and Molecular Biology

Semester I
21MZOC03

Hours of Instruction/week : 5
No. of credits : 5

Course Objectives:

1. To understand structural and functional components of the cell
2. To elucidate molecular mechanism of cell functioning
3. To Illustrate process of proteins synthesis and regulation of gene expression

Unit 1.	Membrane structure and cell signalling Structure of model membrane- lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes. Cell surface receptors- signaling through G-protein coupled receptors, signal transduction pathways, second messengers and regulation of signaling pathways.	15 hrs
Unit 2.	Cell division and structural organization Strategies of cell division- Mitosis and meiosis, central cell cycle control system- cell cycle check points- cyclin and cyclin dependent kinases –control of cell cycle. Structural organization and function of intracellular organelles-Nucleus, mitochondria, Golgi bodies, endoplasmic reticulum, cytoskeleton and its role in motility.	15 hrs
Unit 3.	Cancer cells and DNA replication, repair and recombination Cancer and the cell cycle- interaction of cancer cells with normal cells, apoptosis and therapeutic interventions of uncontrolled cell growth. Replication- enzymes involved, replication origin and replication fork, fidelity of replication, extra chromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination.	15 hrs
Unit 4.	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, poly adenylation, structure and function of different types of RNA, RNA transport.	15 hrs
Unit 5.	Regulation of gene expression Regulation of gene expression in prokaryotes – Operon model in prokaryotes – Lac operon hypothesis – types of control of Operons, *Regulation of gene expression in Eukaryotes-Genomic level-Transcription level-Processing of RNA transcript-Transport of RNA out of nucleus-Translation of mRNA. * Self study	15 hrs

Total Hours: 75

Text Books:

1. Petter JR. Genetics- A Molecular Approach, Third edition, Pearson Education, New Delhi,2016.
2. Channarayappa, Cell biology, First edition, Orient Black Swan/ University Press, New Delhi,2010
3. Janet I,WallaceM.Karp's Cell and Molecular Biology-Concepts and Experiments,8thEdn. John Wiley&sons Inc., USA,2018

Reference Books:

1. David C,NanetteP,Michelle M. Molecular Biology,3rdEdn, Academic cell,Elsevier,2019
2. Veer BalaRastogi. Molecular Biology, Kedarnath Ram Nath publishers, Meerut(UP),2007
3. Ajoy Paul. Text book of Cell and Molecular Biology, 2ndEdn, Books and Allied (P) Ltd,Kolkata, 2009.
4. VeerBalaRastogi. Introduction to cytology, revised edition, Kedarnath Ram Nathpublishers,Meerut(UP),2010.
5. Verma PS, Agarwal VK. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S.Chand and Company Ltd., New Delhi. 2006.
6. Cooper GM. The cell – A molecular approach. 2ndEdn, ASM press, The American Society for Microbiology, USA.2007

Course Outcomes:

1. Able to describe transport across cell, cell-cell communication and mechanisms of signal transduction.
2. Outline the processes that control eukaryotic cell cycle.
3. Conceptualize and describe vesicular trafficking of secretory proteins and cell secretions.
4. Represent and illustrate the structural organization of genes and the control of gene expression.
5. Understand and apply general concepts of cell and molecular biology to relevant, specific problems.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	M	H	M	L	M	H	H	H	M
CO 2	H	M	H	M	L	M	H	H	H	M
CO 3	H	M	H	H	M	M	H	H	H	H
CO 4	M	M	H	M	M	M	H	H	H	M
CO 5	M	M	H	M	L	M	H	H	H	H

Genetics

Semester I
21MZOC04

Hours of Instruction/week : 5
No. of credits : 4

Course Objectives:

To facilitate the students

1. To understand the basic principles of Genetics
2. To know about the applied aspects of Genetics
3. To learn and apply concepts of modern transmission and molecular genetics

Unit 1.	Mendelian principles : Dominance, segregation, independent assortment* Extensions of Mendelian principles : Codominance, incomplete dominance, gene interactions, pleiotropy, Complementary, Supplementary, Epistatic, Lethal and cumulative genes- genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.	20 hrs
Unit 2.	Concept of gene : Allele, multiple alleles, ABO blood group and Rh factor, isoallele and pseudoallele, Gene mapping methods : Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants. Classical Genetics : Sex determination - Extra nuclear inheritance – Shell coiling in snails, inheritance of kappa particles in Paramecium, Sigma particles in Drosophila. Extra chromosomal inheritance : Inheritance of Mitochondrial and chloroplast genes, maternal inheritance*	20 hrs
Unit 3.	Human Genetics Human chromosomes- Classification and Identification – Lyons hypothesis – Barr body and heterochromatin- Autosomal and sex chromosomal abnormalities in man – Amniocentesis- Chromosomal aberrations - Pedigree charts – lod score for linkage testing, Eugenics and genetic counseling - Human genome project*	15 hrs
Unit 4.	Population and Applied Genetics Gene pool and gene frequencies – equilibrium of gene frequencies – Hardy-Weinberg equilibrium – Rate of changes in gene frequencies through natural selection Animal Breeding – History, Aims, Methods – Inbreeding, Outbreeding and hybrid vigour*	10 hrs
Unit 5.	Microbial Genetics Methods of genetic transfers - Transformation - Transduction and sexduction, - Specialized and generalized- Conjugation –F ⁺ X F ⁻ mating, HFr conjugation, F ¹ conjugation, Transposons-Discovery, Characteristics, types of transposable elements - Ac and Dc elements, Retrotransposons, IS Elements*. *Self Study	10 hrs

Total Hours: 75

Practicals I-Invertebrates and Vertebrates

Semester I
21MZOC05

Hours of instruction / week: 3
No of credits: 3

Course Objectives:

1. To learn computer aided Simulated animal dissection
2. To study the representative organisms of each phylum of both invertebrates and vertebrates
3. To observe the birds and other animals from their natural habitats through field visits

Invertebrate Simulated animal dissections available on invertebrates 3 Hrs

Five representative organisms for each phylum 8 Hrs

I. Amoeba, Paramecium, Plasmodium, Euglena and Balantidium

II. Leucosolenia, Hyalonema, Euplectela, Spicules and Gemmule of Sponge

III. Hydra, Obelia colony and medusa, Sea anemone, Madrepora and Tubipora

IV. Fasciola, Planaria, *Taeniasolium* Bipalium and Ascaris,

V. Neries, Chaetopterus, Megascolex, Arenicola and Polygordius

VI. Daphnia, Cyclops, Naupilus, Centipede and Peripatus

VII. Fresh water mussel, Mytilus, Octopus, Sepia and Pila

VIII. Starfish, Sea urchin, Cucumaria, Thyone and Ophiotrix

T.S. of sponge – T.S. of Hydra 3 Hrs

T.S. of liver fluke – T.S. of Nereis larval forms 3 Hrs

Vertebrates Simulated animal dissections of shark and frog 6 Hrs

Five representative organisms for each Phylum 8 hrs

I. Amphioxus, Suckerfish, Mullet, Mugil and Arius

II. Cacapus, Rana hexadactyla, Ichthyophis, Alytes and Rhacophorus

III. Calotes, Chameleon, Draco, Viper and Cobra

IV. Pigeon, Woodpecker, Crane, Partridge and King fisher

V. Bat, Loris, Pig embryo, Rabbit embryo and Sheep embryo

Field Visit Visit to Gass Museum 14 Hrs

Visit to Nilgiri Biosphere

Visit to Salim Ali centre for ornithology

Visit to Silent valley

The candidate should submit a certified bonafide record of practical work done during the semester at the time of practical examination

Total Hours: 45

References Books:

1. Ruppert, Fox and Barnes. Invertebrate Zoology: A Functional Evolutionary Approach, 7th Edition, Cengage India, 2015.
2. Kotpal RL. Modern Text Book of Zoology, Invertebrates (9th Edition) Rastogi Publications, Meerut, 2014.
3. Jordan EL. Text book of Invertebrate Zoology. S Chand and Company Ltd, New Delhi, 2010.

Course Outcomes:

1. Introducing the structure, function and behaviour of select invertebrate types through the observation of simulated animal dissections.
2. Reinforcing basic laboratory skills including microscopy, simulated animal dissection and careful observation
3. Providing with the ability to recognize the major groups of invertebrate
4. Record the fauna of different phylum and families through the visit to Gass Museum
5. Learn the keys for the identification of bird watching through the visits to Salim Ali centre for ornithology and Silent valley

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	H	M	H	H	M	H	M	H	H
CO 2	H	H	H	H	H	L	H	M	H	H
CO 3	H	H	M	H	H	L	H	M	H	H
CO 4	H	H	H	H	H	M	M	H	M	M
CO 5	H	H	H	H	H	M	M	H	M	M

Practicals II-Cell and Molecular Biology and Genetics

Semester I
21MZOC06

Hours of Instruction/week : 5
No. of credits : 3

Course Objectives:

1. To acquire skills in squash preparation, permanent slides and staining.
2. To develop practical skills in the advanced techniques of Molecular Biology
3. To enable the use of model organisms in understanding the genetic principles.

Cell Biology	Slides on tissues – Epithelial, connective, bone, muscular and germ cells	5 hrs
	Preparation of Squamous epithelial cells	3 hrs
	Cell size determination using micrometer	3 hrs
	Squash preparation of onion root tip and observation of mitotic stages	3 hrs
	Meiosis in cockroach testis	3 hrs
	Study of giant chromosomes in Chironomous larva and micrometric measurements of Puffs	3 hrs
	Separation of lymphocytes using histopaque	5 hrs
	Haemolysis	3 hrs
	Histology: Fixation, dehydration, embedding, sectioning, staining and permanent mounting of tissues - Submission of 5 best slides for Exam evaluation	16 hrs
	Molecular Biology	Isolation and estimation of DNA from onion
Isolation of plasmid DNA from bacteria		5 hrs
Restriction endonuclease digestion of DNA		5 hrs
PAGE - separation and molecular weight determination of proteins.		5 hrs
Genetics	Culture of Drosophila	5 hrs
	Identification of phenotypic traits in Drosophila	3 hrs
	Study of various genetic traits in man	3 hrs
	The candidate should submit a certified bonafide record of practical work done during the semester at the time of practical examination	

Total Hours: 75

Course Outcomes:

1. Understand transport across cell, cell-cell communication and mechanisms of signal transduction.
2. Outline the processes that control eukaryotic cell cycle.
3. Conceptualize and describe vesicular trafficking of secretory proteins and cell secretions.
4. Represent and illustrate the structural organization of genes and the control of gene expression
5. Understand and apply general concepts of cell and molecular biology to relevant, specific problems

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	M	H	M	M	H	L	H	M	M	L
CO 2	M	H	M	H	H	M	H	M	H	L
CO 3	M	H	H	M	H	L	H	M	H	L
CO 4	M	H	M	H	H	M	H	M	H	L
CO 5	M	H	H	M	H	H	H	M	M	L

Biochemistry

Semester II
21MZOC07

Hours of instruction / week: 4
No of credits: 5

Course Objectives:

1. To understand the chemical basis of life.
2. To study the structure, metabolism and biological significance of biomolecules
3. To enable students to understand the basic principles, working mechanism and applications of biochemical techniques

Unit 1.	Principles of biophysical chemistry	8 Hrs
	Bioenergetics – Concept of free energy, endergonic and exergonic reactions, Relationship between free energy, enthalpy and entropy, laws of thermodynamics, Redox potential, High energy compounds, biological significance of ATP and cyclic AMP*	
	Biological Oxidation – Enzymes involved in biological oxidation, Electron transport chain - Components and structural organisation of electron transport, Oxidative phosphorylation- Chemiosmotic hypothesis, Uncoupling of oxidative phosphorylation, mitochondrial transport systems - malate/glycerol phosphate shuttle.	
Unit 2.	Carbohydrates and Lipids	12Hrs
	Carbohydrates – Classification, structure and functions - Monosaccharides, Disaccharides, Polysaccharides - Homo and hetero polysaccharides. Metabolism – Glycolysis, TCA cycle, HMP shunt, glycogenesis, glycogenolysis, gluconeogenesis	
	Lipids - Classification, structure and functions of fatty acids, triacylglycerols, phospholipids, glycolipids, lipoproteins and steroids. Metabolism - Biosynthesis of fatty acids, β oxidation of fatty acids, ketogenesis, Biosynthesis and degradation of cholesterol*	
Unit 3.	Amino acids, Proteins and Enzymes	12Hrs
	Amino acids - Structure, classification and properties Metabolism - Transamination, deamination and decarboxylation, urea cycle, inborn errors of metabolism.	
	Proteins - Classification, levels of protein structure, bonds related to protein structure - Conformation of proteins by Ramachandran plot, domains, motif and folds*	
	Enzymes – Characteristics, Structure, Nomenclature, Classification, Active site, Mechanism of enzyme action, Factors affecting enzyme action, Enzyme inhibition.	
Unit 4.	Biochemical techniques I	15Hrs
	Electrochemical techniques – Determination of pH by hydrogen electrode and glass electrode, Buffer systems of body fluids and pH maintenance*	
	Centrifugation – Principle, types and applications of preparative and analytical ultracentrifuges	
	Chromatography – Principle, methodology and applications of thin layer and gas liquid chromatography	

Spectroscopy – Principle, types of spectra – absorbance, emission and fluorescence, Types of spectroscopy – Principle, instrumentation and applications of UV-visible spectroscopy, atomic absorption spectroscopy* Electrophoresis – Principles, methodology and applications of agarose gel electrophoresis and poly acrylamide gel electrophoresis

***Self-Study**

Total Hours: 60

Text Books:

1. Murray RK, Bender DA, Bootham KM, Kennlley PJ, Rodwell VW, Weil PA. Harpers Illustrated Biochemistry, Twenty ninth Edition, Tata McGraw Hill Companies' Publication, New Delhi, 2012.
2. Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, Fifth edition, CBS Publishers and Distributors, New Delhi, 2008.
3. Satyanarayana U, Chakrapani U. Biochemistry, Seventh Edition, Books and Allied Pvt. Ltd., New Delhi, 2013.
4. Wilson K, Walker J, Practical Biochemistry – Principles and Techniques, Eighth Edition, Cambridge University Press, India, 2018.

Reference Books:

1. Berg JM, Tymoczko JL, Stryer L, Biochemistry, Seventh Edition, W.H. Freeman & Company, New York, 2012.
2. Voet D, Voet JG, Pratt CW, Fundamentals of Biochemistry – Life at the Molecular Level, Fourth edition, John Wiley and Sons Inc., New York, 2013.
3. Boyer R, Concepts in Biochemistry, Third Edition, John Wiley and Sons Inc., United States, 2006.

Course Outcomes:

1. Impart knowledge on the biochemical concepts of bioenergetics
2. Gain perception on the basic structure and functions of biomolecules
3. Ability to grasp insight on metabolic pathway and able to relate with well being
4. Understand fundamental concepts on enzymes and their importance in biological reactions
5. Acquire information on the principles and practical experience of a wide range of biochemical techniques.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	L	L	L	L	L	H	L	L	L
CO 2	H	M	H	M	M	H	H	H	H	H
CO 3	H	M	H	M	M	H	H	H	H	H
CO 4	H	H	H	M	H	H	H	H	H	H
CO 5	H	H	H	M	H	H	H	H	H	H

Animal Physiology and Endocrinology

Semester II
21MZOC08

Hours of Instruction/week : 5
No. of credits : 5

Course Objectives:

1. To enable the students to understand the functions of various systems of animal body with special reference to mammals
2. Know about the role of various hormones in coordination of activities of biological systems in animals.
3. To understand and evaluate biological processes, behavioural states and animal response to different biological, social and environmental stimuli.

Unit 1.	Digestive system, Circulatory and Excretory system Digestive glands in a mammal –Digestion*,BMR, Blood and Lymph composition, plasma proteins, coagulation and erythropoiesis, blood volume regulation - Heart – myogenic heart, origin and conduction of cardiac impulse- ECG – Ultra structure of Nephron – formation and concentration of urine, micturition, Electrolyte and acid base balance	15hrs
Unit 2.	Respiratory, Nervous and muscular system Respiratory pigments-Blood gas transport-Respiratory quotient – Regulation of respiration. Structure and functions of Nervous tissue-Reflex action- Conduction of nerve impulse- Autonomic nervous system, Morphology and physiology of sense organs –vision, hearing, gustation, olfaction and tactile*- Properties and mechanism of contraction of muscles -Biochemistry of muscles - Neuro muscular junction	20hrs
Unit 3.	Communication and Animal behaviour Bioluminescence-Pheromones -Biological rhythm-Circadian and Circannual rhythm-Orientation and navigation*	10hrs
Unit 4.	Endocrine glands Structure and functions of endocrine glands in Mammals – Pituitary – hypothalamus-Thyroid-Parathyroid–Pancreas-Adrenal and Prostaglandins* Thermo regulation – comfort zone, body temperature, physical, chemical and neural regulation, acclimatization	15hrs
Unit 5.	Hormonal Control Ovarian cycle, Menstrual cycle and Physiology of pregnancy, Hormonal regulation of male and female reproduction, Hormonal control of Gastric metabolism Neuroendocrine systems in Crustacea and Insecta - Hormone Analogue and its applications*- Genetic disorders due to hormonal imbalance *Self study	15hrs

Total Hours: 75

Text books

1. Rastogi SC. Essentials of Animal Physiology, New Age International, New Delhi, India 2007.
2. Verma PS. Agarwal VK and Tyagi BS. Animal Physiology. S. Chand Publishers India 2010.

Reference books:

1. Christopher D. and Moyes. Principles of Animal Physiology. 3rd Edition, Pearson Publishers, U.S. 2015.
2. Arora MP. Animal Physiology. 7th Edition. Himalaya Publishing House, India 2017.
3. Hadley. Endocrinology. George Bell Publishers, England 2009.
4. Dharmalingam Textbook of Endocrinology. Jaypee Medical PU, New Delhi, India 2010.
5. Sherwood L. Klandorf H. and Yancey PH. Text Book of Animal Physiology. Cengage Learning India Pvt., Ltd. 2008.
6. HillR W. Wyse GA. and Anderson M. Animal Physiology. 2nd Ed., Sinauer Associates, Inc Publisher, Massachusetts 2008.
7. Moyes CD. and Schulte PM. Principles of Animal Physiology. Pearson Education, Dorling Kindersley Publication. New Delhi 2007.
8. Guyton AC. Textbook of Medical Physiology. W.B. Saunders Company, Philadelphia, London, Toronto and IgakuShoin/Saunders (Tokyo).2007.

Course Outcomes:

- 1 Understand the physiological systems and their specific functions
- 2 Gain knowledge on the interactions and interdependence of physiological and biochemical processes
- 3 Be able to know the transfer of information from one group of animals to other using signals
- 4 Learn generously the life supporting properties and regulation of biological processes in the body from conception through adulthood by the endocrine glands.
- 5 Understanding of factors influencing the adaptations and responses of organisms to particular environment.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	H	M	H	H	H	H	H	H	H	H
CO 2	H	H	H	H	H	H	H	M	H	M
CO 3	H	H	H	H	H	H	H	H	H	M
CO 4	H	H	H	H	H	H	H	H	L	L
CO 5	H	M	M	M	M	M	H	H	H	M

Developmental Zoology

Semester II
21MZOC09

Hours of instruction / week : 5
No of credits: 4

Course Objectives:

Enable the students

1. To understand the basic principles of growth and development
2. To understand the general concept of ontogeny development
3. To understand the metamorphosis and assisted reproductive techniques

Unit 1	Spermatogenesis and Oogenesis Origin of primordial germ cells-spermatogenesis process-sertoli cells-spermatogenesis- hormonal regulations, gene expression and control-structure and biochemistry of spermatozoa.Process of Oogenesis – Development during Oogenesis*- Vitellogenesis- egg maturation – egg cortex organization of the egg	15 hrs
Unit 2	Fertilization, cleavage and Gastrulation Mechanism of fertilization – biochemical aspects of cleavage –molecular changes during cleavage – morphogenetic movements*- cell adhesion molecules and pattern formation.	15 hrs
Unit 3.	Nucleus and cytoplasm in development Nuclear control of development - enucleation experiments - nuclear transplantation* - cytoplasmic determinants – cytoplasmic control of nucleus during development.	15 hrs
Unit 4.	Induction competence and differentiation Concept of organizer –embryonic induction – types – properties, role and chemical nature of induction-concept of competence – differentiation of embryonic cells* – stem cells- concept of determination.	15 hrs
Unit 5.:	Metamorphosis, Regeneration and Human development Types and hormonal mechanism of metamorphosis in amphibians –regeneration process–histological changes– metaplasia–puberty –menstrual cycle – implantation – parturition –birth defects and test tube baby* * Self study	15 hrs

Total Hours: 75

Text Books:

1. Muneesh Kaint. Text Book of Chordate Embryology. Wisdom Press. 1st Edition, New Delhi, India 2013
2. Morgan. TH. Embryology and Genetics. Agro House Behind Nasrani Cinema. 4th edition, Jodhpur 2010.
3. Veer BalaRastogi. Chordate Embryology. KedarNathRamNath publication, New Delhi 2011.

Reference Books:

1. Scott F. Gilbert, Karen Knisely. Developmental Biology 9th Ed + a Student Handbook in Writing in Biology 3rd Ed. Sinauer Associates Incorporated 2010.
2. Lewis Wolpert. Developmental Biology: A Very Short Introduction. Oxford University Press; 1st edition 2011
3. Abhilash Jain. Advanced developmental Biology. Campus Books International. 1st edition , New Delhi, India. 2010.

Course Outcomes:

1. Compare and contrast the developmental stages amongst the variety of animal phyla.
2. Understand the mechanism of fertilization, cleavage and gastrulation.
3. Describe the cellular control in the development of the embryo
4. Knowledge on the potential role of stem cells and its research applications
5. Understand the human menstrual cycle, implantation, parturition, birth defects and test tube baby

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	H	H	H	H	L	H	H	L	L
CO 2	H	H	H	H	M	L	H	L	L	L
CO 3	H	H	M	L	L	L	H	L	M	L
CO 4	H	H	H	H	H	H	H	H	H	L
CO 5	H	H	M	H	H	H	H	H	H	L

Bioinformatics

Semester II
21MZOC10

Hours of Instruction/week : 4
No. of credits : 4

Course Objectives:

1. To outline fundamentals of bioinformatics principles
2. To use bioinformatics tools to compare and analyse nucleic acids and protein databases
3. To explain functional genomics and the features of model organisms

Unit 1.	Biological databases Introduction to Bioinformatics: Definition - goals – applications; Central Bioinformatics Resources and Access Information: NCBI - EMBL-EBI; Biological databases: Nucleotide sequence database (GenBank, EMBL-Bank, DDBJ) - Protein database (UniProtKB, PIR, PDB, InterPro, Pfam, PRINTS, SCOP and CATH) - Specialised database (OMIM, GEO, ENA, KEGG, and PubMed); Sequence format: GenBank format - FASTA format* .	12 hrs
Unit 2.	Sequence analysis Molecular sequence alignment: Importance – homology – similarity – identity – Gaps; Scoring matrices: PAM – BLOSUM* ; Pairwise sequence Alignment methods: DotPlot – Dynamic Programming method (Global and Local alignment) – Heuristic method (FASTA and BLAST); Multiple sequence alignment and Phylogeny: CLUSTALW – phylogenetic tree building.	12 hrs
Unit 3.	Genomics Gene and Genome analysis: differences between Eukaryotes, Bacteria, Archaea and viral genome - Human Genome project* - UCSC Genome Browser – ENCODE – Noncoding and repetitive DNA sequences - Finding genes in genome (GENCODE) – SNPs - Next Generation Sequencing: Overview of Techniques - Data analysis - Applications.	12 hrs
Unit 4.	Proteomics Protein sequencing: Gel electrophoresis – MALDI-TOF* ; Protein analysis: ExPASy tools – protein property prediction; Protein structure prediction: Ramachandran plot - homology modelling – Threading – <i>Ab Initio</i> prediction – structure validation – structure visualization tools; Application in Modern drug discovery process.	12 hrs
Unit 5.	Functional genomics Genome expression: SAGE - Microarray - RNA-seq; microarray data analysis: GOR2 – Descriptive statistics methods; Protein-Protein interaction – Yeast Two-Hybrid System – Protein Networks – Cytoscape; Model organisms: E. coli – <i>Arabidopsis thaliana</i> – Yeast – <i>Coenorhabditiselegans</i> – Drosophila – Zebra fish* – Mouse	12 hrs
		Total Hours: 60

*Self study

Text Books:

1. Xiong J. Essential Bioinformatics, Cambridge University Press, 2006
2. Attwood TK, Parry DJ. Introduction to Bioinformatics, Pearson Education Singapore Pvt. Ltd, 2005
3. Rastogi SC, Rastogi P, Mendiratta N. Bioinformatics Methods and Applications: Genomics Proteomics and Drug Discovery, 4thEdn, PHI Learning Pvt. Ltd.2013

Reference Books:

1. Richard S L, Tudor I O. Bioinformatics and Drug Discovery- Methods in Molecular Biology, 3rdEdn, Springer New York, 2019
2. Pevsner J. *Bioinformatics* and functional genomics, 3rdedn, Wiley India exclusive, 2019.
3. Rui R, Xuegong Z, Michael QZ. Basic bioinformatics, Springer, 2013
4. Chandarsekar M, Ratankumar C, Mirasif I. Basic applied bioinformatics, 1stEdn, John Wiley & sons, 2018
5. Baxevanis AD, Ouellette BF. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rdEdn., Wiley Interscience, Hoboken, NJ. 2005.
6. Mount DW. Bioinformatics: Sequence and Genome Analysis, 2nd Edn, Cold Spring Harbor Laboratory Press, New York, 2004
7. Campbell AM, Heyer LJ. Discovering Genomics, Proteomics & Bioinformatics. 2ndEdn. Pearson Education, New Delhi, 2004.
8. Pennington SR, Dunn MJ. Proteomics: from Protein Sequence to function. BIOS Scientific Publishers, Oxford 2002.
9. Sensen CW. Essentials of Genomics and Proteomics. Wiley-VCH, 2002
10. Kothekar V. Introduction to Bioinformatics – An ideal book for beginners in Bioinformatics, First edition, Dhruv Publications, New Delhi, 2004

Course Outcomes:

1. Locate and use the main databases at the NCBI and EBI resources and know the difference between databases, tools, repositories and be able to use each one to extract specific information
2. Extract data from specific databases using accessions numbers and gene names
3. Able to perform simple genome sequence analyses using existing tools
4. Interpret correctly the outputs from tools used to analyse biological data and make meaningful predictions from these outputs.
5. Able to describe and comprehend the fundamental concepts of molecular modelling and computational driven drug discovery

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	M	L	H	M	H	H	H	L	L	H
CO 2	H	M	M	H	L	H	M	L	M	L
CO 3	M	L	H	M	M	L	H	L	L	H
CO 4	H	H	M	M	L	M	M	L	H	M
CO 5	H	M	M	H	L	H	H	L	H	L

Practicals III - Biochemistry, Animal Physiology, Endocrinology, Developmental Biology and Bioinformatics

Semester II
21MZOC11

Hours of instruction / week: 5
No of credits: 3

Course Objectives:

1. Able to demonstrate an understanding of fundamental bio chemical principles
2. To understand the general concept of endocrine glands
3. To understand the application of Developmental Zoology.

I. Biological Chemistry	Estimation of protein in fish sample	3hrs
	Estimation of carbohydrates in fish sample	3hrs
	Estimation of fat in fish sample	3hrs
	Salivary amylase activity in relation to pH	3 hrs
II. Animal Physiology & Endocrinology	Hemoglobin estimation	2 hrs
	Preparation of haemin crystals	3 hrs
	Preparation of human blood smear	3hrs
	Enumeration of RBC and WBC using haemocytometer	3hrs
	Excretory products of animals	3hrs
	Effect of salinity on the metabolic rate of fish	3hrs
	Effect of thyroxine on the oxygen consumption fish	5 hrs
	Slides on histology of endocrine glands	5 hrs
	Adrenal gland	
	Pancreas T.S	
III. Developmental Biology	Pituitary gland	
	Thyroid gland	
	Thymus gland	
	Adrenal gland	
	Slides on Frog Embryology	10 hrs
	T.S. of ovary	
	Cleavage - 2 cell, 4 cell, 8 cell and 32 cell stages	
Blastula-Gastrula – olk plug stage, Neural plate,Neural fold, Neural tube		
Tadpole – 4mm, 7mm, 10mm		
Slides on chick embryology - Chick embryo - 18h, 24h, 36h, 48h, 72h and 96h	10 hrs	
IV. Bioinformatics	1.Search engines & important sites viz., NCBI, EBI, Swiss-Prot	2 hrs
	2.Format, distinguishing features, Uses and Applications of biological databases such viz., EMBL, DDBJ, GenBank,UniProt, PIR, TrEMBL, Prosite, PRINT, Pfam, BLOCK,PDB, KEGG,OMIM,PUBMED	2 hrs
	3.Use of BLAST and its variants (especially PSI-BLAST) for the identification of very similar and divergent sequences	2 hrs
	4.Multiple sequence alignment using Clustal W and preparation of simple phylogenetic trees using Tree View	2 hrs

5. Detection of general signals, regulatory regions and promoter prediction	2 hrs
6. Secondary structure prediction using various available tools	2 hrs
7. Tertiary structure and function prediction using homology modeling and ab initio method	2 hrs
8. Visualization of 3D protein structure –Rasmol-Swiss PDB viewer	2 hrs

The candidate should submit a certified bonafide record of practical work done during the semester at the time of practical examination

Total Hours: 75

Reference Books:

1. Christopher D, Moyes. Principles of Animal Physiology. 3rd Edition, Pearson Publishers, U.S,2015.
2. MuneeshKainth. Text Book of Chordate Embryology. Wisdom Press. 1st Edition, New Delhi, India, 2013.
3. Lewis Wolpert. Developmental Biology: A Very Short Introduction. Oxford University Press; 1st edition, 2011.
4. David Hames and Nigel Hopper. Biochemistry Taylor and Francis Publication Pvt. Ltd.2010.
5. Dharmalingam. Textbook of Endocrinology, Jaypee Medical PU, New Delhi, India, 2010.
6. Sathyanarayana U. Biochemistry Book & Allied (p) Ltd. Kolkata, 2005.

Course Outcomes:

1. Assess the estimation of protein, carbohydrate and fat using fundamental biochemical principles.
2. Estimation of different physiological systems and their specific functions.
3. Identify the factors influencing the responses of organisms.
4. Describe fundamental concept of molecular mechanisms of embryological stages

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	H	M	M	H	H	H	M	M	L
CO 2	H	H	M	M	H	H	H	M	M	L
CO 3	H	H	M	H	H	H	H	M	L	L
CO 4	H	H	M	M	H	M	H	M	L	L

Environmental Biology and Toxicology
(Open book)

Semester III
21MZOC13

Hours of Instruction / week: 4
No of credits: 4

Objectives:

1. To understand the various factors of environment
2. To know about the strategies for disaster management
3. To learn about the implications of environment on human health and social issues
4. To have knowledge about environmental toxicants and their hazards

Unit 1	Introduction to Environmental Studies and Biodiversity Definition – Types of environment – Natural resources- forest, water, mineral, food and energy. Biodiversity: Classification – Values of biodiversity – Biodiversity at global level, Hot spots, Biogeographical classification of India, India mega biodiversity Nation- endangered and endemic species of India-Threats of biodiversity& Conservation.	12hrs
Unit 2	Human Health and Environment - Population growth- Population explosion environment and public health- Value education, HIV/AIDS- Human rights. Disaster management – Definition, Flood, Earth quake, Tsunami, Cyclone and Land slide.	12hrs
Unit 3	Social Issues and Environment Sustainable development- Urban problem related to energy – Water management and conservation, Resettlement and rehabilitation of people, Environmental ethics, Climate change, Wasteland reclamation, Consumerism, Environmental Protection Acts.	12hrs
Unit 4	Environmental Toxicants and Health hazards Survey of environmental toxicants – pesticides, automobile emissions, heavy metals, fertilizers, food additives, radioactive substances, accumulation of toxic residues in organisms — routes of entry, absorption, distribution, excretion and biotransformation of toxicants, mode of action, dose response relationship, teratogens, carcinogens, mutagens, safety evaluation of toxicants, role of LC ₅₀	12hrs
Unit 5	Case studies: <i>In situ</i> and <i>Ex situ</i> conservation of Indian animals: Population management - Project Tiger and Elephant - Captive breeding programme- Public participation in conservation – Poaching of wild animals – Man animal conflict Cauvery Water dispute - Heavy metals in water and soil, Bioaccumulation of toxicants, Mining and quarrying in India - Survey of food additives – Pesticides in soft drinks - Fuel conservation.	12hrs

Total Hours: 60

Microbiology

Semester III
21MZOC14

Hours of instruction / week: 4
No of credits: 4

Objectives:

1. To recognize the similarities and differences between microbial groups
2. To enable the students to know the biology and pathogenesis of infectious diseases
3. To understand the role of microbes in various fields

Unit 1. **Microbial Taxonomy**

History – Contributors to Microbiology, Scope of Microbiology*, Classification of microbial kingdom, Structure and outline classification of bacteria, fungi and virus 12 hrs

Unit 2. **Methods in Microbiology**

Sterilization techniques - Physical and Chemical, Culture media – Types and Preparation, Methods of growing microbes, Cultivation of aerobes – Batch and continuous culture, Anaerobes- Gas Pack method, Methods of isolation and maintenance of pure culture, Identification of bacteria, Nutritional requirements for microbes, Growth curve of microbe, Factors affecting microbial growth, Measurements of microbial growth* 12 hrs

Unit 3. **Industrial Microbiology**

Bioprocessing, Fermentors- Types, Functions, Design and Operation, Microbial selection, Types of Fermentation-Submerged, Solid and Surface type, Stages in fermentation - Upstream and Downstream Processing, Strain Improvement, Fermented products- Single Cell Protein, Wine, Citric acid * 12 hrs

Unit 4. **Environmental Microbiology**

Bioremediation - Criteria for bioremediation, Bioremediation techniques, Methods for removal of pollutants (heavy metals), Biosorption – Mechanism of biosorption, Types of biosorbents, Factors affecting biosorption, Desorption and recovery, Advantages and disadvantages, Large scale industrial effluent treatment, Bioindicators* 12 hrs

Unit 5. **Medical Microbiology**

Microbial Infection – Routes of infection, types of infection, types of infectious diseases, microbe – host interaction, Approaches in diagnosis
Bacteria – *Staphylococcus aureus*, *Salmonella typhi*, *Mycobacterium tuberculosis*, *Treponema palladium*
Fungus - Mycoses – Superficial –Dermatophytoses, Subcutaneous – Mycetoma, Systemic– Histoplasmosis, Opportunistic –Candidiasis
Virus – Herpes virus, Hepatitis virus, Rabies virus, Human Immuno Virus* 12 hrs

* Self study

Total Hours: 60

Text Books:

1. Talaro KP, Chess B, Foundations in Microbiology, 10th Edition, Mc-Graw – Hill Publishing Company Ltd., New Delhi , 2017.
2. Willey J, Sherwood L, WoolvertonCJ, Prescott’s Microbiology, 10th Edition, Mc-Graw – Hill Publishing Company Ltd., New Delhi, 2016.
3. Ananthanarayan R, Paniker CKJ, Ananthanarayan and Paniker’s Textbook of Microbiology, 9th Edition, University Press, Hyderabad, 2013.

Reference Books:

1. Micheal J, Pelzar JR, Chan ECS, Krieg NR, Microbiology, 10th Edition, Tata Mc-Graw – Hill Publishing Company Ltd., New Delhi, 2009.
2. Dubey R and Maheshwari DK, A text book of Microbiology, S. Chand and Company Ltd., New Delhi, 2000.
3. Rajan R, Medical Microbiology, First Edition, MJP Publishers, Chennai, 2007.
4. Casida, J.R. Industrial Microbiology, Fifth Edition, New Age International Publishers, New York, 2009.

Course Outcomes:

1. Gain knowledge on microbial diversity and its significance
2. Apply culture techniques in clinical and research problems
3. Describe the importance of microbes in industrial sector
4. Acquaint the interaction between microbes and environment for sustainable development
5. Identify the integral role of microbes in pathogenesis and its control measures

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	M	H	H	M	M	M	M	M	H	M
CO 2	H	H	H	H	M	H	M	H	H	H
CO 3	M	H	H	M	H	H	M	H	H	H
CO 4	H	H	H	H	H	H	M	H	H	H
CO 5	H	H	H	H	H	H	M	H	H	H

Immunology

Semester III
21MZOC15

Hours of Instruction / week: 4
No. of credits : 4

Objectives:

1. To outline the key components of the innate and adaptive immune responses
2. Define the cellular/molecular pathways of humoral /cell-mediated immune response
3. Be able to acquaint with immune system of our body

Unit 1.	Introduction to Immunology Types of immunity -Innate and Acquired immunity, Ultra structure and functions of primary and secondary lymphoid organs, Cell types - origin and differentiation of B and T cells-specific functions.	12 hrs
Unit 2.	Antigens and Immunogens Antigens - essential features, epitopes, classes of antigens, Immunoglobulins - 3D structure-classes- antigenic determinants- class switching-generation of antibody diversity, antigen-antibody interaction - affinity, avidity, cross reactivity, precipitation and agglutination reaction, radio immuno assay, ELISA, immuno fluorescence.	12 hrs
Unit 3.	Immune response Immune response - antigen recognition- processing and presentation-interaction of T and B cells – cell mediated and humoral immunity - cytokines and immune response –immunological memory, hypersensitivity reaction - type 1, type 2, type 3 and type 4 reactions, immuno deficiency diseases,Immunological tolerance	12 hrs
Unit 4.	MHC and Complements Major Histocompatibility Complex : structure of MHC molecules –types - MHC and antigen presentation, Complements - classical and alternative pathways and immunological significance	12 hrs
Unit 5.	Transplantation and tumour immunology Transplantation immunology : HLA typing-immunology of graft rejection-immuno suppressive therapy, Tumour immunology - tumour antigen, immunity against cancer, cancer immuno therapy, Auto immunity - organ specific and systemic auto immune diseases, Immuno prophylaxis - active immunization-recent approaches to vaccine production- passive immunization.	12 hrs

Total Hours : 60

Text Books:

1. Kuby J. Immunology, 7th edition, W. H. Freeman and Co, New York.2007
2. Benjamini E, Coico R, Geoffrey S. Immunology- A short course, 4th Edition, John Willey Inc., New York.2000
3. Roitt I, Brostoff J, Male D. Immunology,7 th edition, Mosby Publishers, London,2002

Reference Books:

1. Tizard IR. Immunology- an introduction, 4th Edn., Saunders College Publishing, Philadelphia, 1995.
2. Chakravarty AK. Immunology and Immunotechnology. Oxford University Press. New Delhi, 2006.
3. Banarjee A, Nirmala B. Fundamentals of Microbiology and Immunology, 2nd Edition, New central Book Agency, Kolkata, 2008
5. Murphy K, Travers P, Walport M. Immunology, 7th edition, Garland Science, UK, 2007
6. David M, Jonathan B, David BR, Roitt IM (2013) Immunology, 8th Edition, Elsevier-Saunders publications, UK, 2013
7. Subash CP. Text Book of Microbiology and Immunology, 2nd Edn, Elsevier India, 2012

Course Outcomes:

1. Describe the cell types and organs that are involved in immune response
2. Apply immunological techniques to solve certain clinical and research problems
3. Able to differentiate between various types of hypersensitivity reactions
4. Identify the main mechanisms of immune tolerance and autoimmunity
5. Explain adverse functions of these cellular and molecular components during abnormal circumstances

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	M	H	H	L	L	H	H	H	H
CO 2	M	M	H	H	H	M	H	M	H	M
CO 3	M	M	M	H	H	L	M	H	H	L
CO 4	H	H	H	M	M	L	H	M	M	L
CO 5	M	H	M	H	M	M	H	M	H	M

Biotechnology

Semester III
21MZOC16

Hours of instruction/week: 4
No of credits: 4

Objectives:

1. To enable the student to learn the recent advances in Biotechnology
2. To learn the application of r-DNA technology
3. To develop practical knowledge and acquire analytical skills.

Unit 1	Introduction –Scope and importance of biotechnology	12 hrs
	Enzymes in genetic engineering- Basic principles and Enzymology, Genetic engineering. Basic steps of gene cloning, DNA manipulative enzymes. Exonucleases, Endonucleases, Restriction Endonuclease and it's types*, S1 Nuclease, DNA ligase, Alkaline phosphatase, Reverse transcriptase, DNA Polymerase, Methyl transferase, Polynucleotide kinase, Terminal transferase	
Unit 2	Vectors in gene cloning – Cloning vehicles, Plasmids, Bacteriophages, Cosmids, Phagemids, Yeast artificial chromosomes, Bacterial artificial chromosomes, expression vectors, shuttle vectors, Transposons. Gene cloning strategies, Preparation of rDNA and its introduction into host cells - Transformation, conjugation, electroporation, microinjection, transduction, direct gene transfer, agroinfection, liposome fusion, biolistics*.	12 hrs
Unit 3	Identification of recombinants: Restriction enzyme analysis, Southern blotting, Northern blotting, In-situ hybridisation, DNA Sequencing, PCR, DNA Probes, RFLP, RAPD*.Construction and analysis of gene libraries, site directed mutagenesis.	12 hrs
Unit 4	Animal Biotechnology- Facilities for animal cell culture - Sterilization- Media Preparation- Physico- chemical properties of culture media – Types of media – Balanced salt solutions – complete culture media - Serum free medium- Characterization of cultured cells – Primary cell culture – Techniques for primary cell culture – Cell lines and its types – Subculture and its types- stem cells and its types*.	12 hrs
Unit 5	Applications of biotechnology in human welfare – Tissue plasminogen activator, Erythropoietin, interferon's – recombinant vaccines- Monoclonal antibodies –Transgenic animals - Genetically Modified Microorganisms (GEMOs) – Gene Therapy Biotechnology and Bio-safety operation guidelines and regulations. Intellectual property right and protection* –Forms of protection, General Agreement of Tariffs and Trade (GATT) and Trade Related IPR's (TRIPs), Patenting of biological Materials - significance.	12 hrs

Text Books:

1. Nita Verma. Biotechnology, PACIFIC publication, 1st edition, New Delhi 2013
2. Prakash S Lohar. Text book of Biotechnology, MJP publishers, 1st edition, Chennai 2012.
3. Sobti RC, Suparna S. Pachauri. Essentials of Biotechnology, Ane Books Pvt. Ltd, 1st edition. Chennai, New Delhi, Mumbai 2009
4. Dubey RC. A textbook of Biotechnology, S.Chand and Company Ltd., New Delhi 2006.

Reference Books:

1. Glick BR, Pasternak JJ, Patten CL. Molecular Biotechnology: Principles and Applications of Recombinant DNA, Fourth edition, ASM Press, Canada 2010.
2. Ponmurugan P, GangatharaPrabhu B. "Biotechniques". MJP publishers, 1st edition. Chennai, New Delhi 2012.

Course Outcomes:

1. Understand the tools and techniques in rDNA technology and its applications
2. To understand the theoretical and experimental implications of vectors in research and gene cloning
3. Provide the ability to decipher, evaluate and understand data generated from biotechnology-based assays
4. Comprehend fundamental concepts and principles of establishing animal cell culture
5. Understand the importance of patent laws and intellectual property rights

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	M	M	M	L	M	H	L	M	L
CO 2	H	M	H	H	H	M	H	M	H	M
CO 3	H	M	H	H	H	H	H	L	H	M
CO 4	H	H	H	M	M	M	M	L	H	M
CO 5	H	H	M	M	L	H	M	M	H	M

Evolution

Semester III
21MZOC17

Hours of instruction / week: 4
No of credits : 4

Objectives

1. To facilitate the students
2. To understand the basic principles of Evolution
3. To know about the origin of life and theories of Evolution

Unit 1.	Origin of life and evolutionary concept	12hrs
	Origin of life-Theories of evolution- Lamarkism, Darwinism, Devries mutation theory and Modern theory of origin of life-Oparintheory,Prebiotic synthesis and Biological evolution-origin of coacervates, Protocells,*Biochemical origin of life-Evidences of Evolution .	
Unit 2.	Mechanism of Evolution	12hrs
	Variation- Types of variation-Isolation- Premating and Post mating mechanism - Hardy Weinberg's law of equilibrium and significance-Natural selection-Types- Polymorphism–Types and significance -Molecular evolution - Evolution of Protein	
Unit 3.	Consequences of Evolution	12hrs
	Adaptation – Types of adaptation, Divergent and Convergent of Evolution, Structural adaptations- Classification of adaptations, Mimicry- protection, aggressive and conscious mimicry,Protective coloration- *Biological significance of colours.	
Unit 4.	Paleontology and Behavioral evolution	12hrs
	Paleontology -Classification of rocks-Fossils- Types, Formation, dating and significance-Geological time scale- Behavioral evolution- *Group selection, Altruism, Kin selection and Sexual selection	
Unit 5.	Human evolution and Philosophical issues	12hrs
	Uniqueness of man –Fossil history and Phylogeny of man, Place and time of origin of man, * Cultural evolution and Evolutionary future of mankind *Self study	

Total Hours: 60

Text Books:

1. Brian K, Hall, BenediktHallgrímsson. Stirickberger's Evolution, 5th Edition, Jones and Bartlett India Pvt. Ltd. Publishers, 2014.
2. Veer BalaRastogi. Organic Evolution, 12th Revised Edition, Kedarnath Ram Nath Publishers, Meerut, 2014.
3. Rao CV. Human evolution and its uniqueness, Atlantic Publishers and distributors, New Delhi, 2005
4. Verma PS, Agarwal VK. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, Second Edition, S. Chand Company Ltd, New Delhi, 2004.

Reference Books:

1. Franklin Shull A. Evolution, Second Edition, J.V. Publishing House, Jodhpur, 2008.
2. Mark Ridley Evolution, Third edition, Blackwell Science Ltd, USA, 2004.
3. Gould SJ. The structure of evolutionary theory. Harvard University Press, Cambridge, 2002.

Course Outcomes:

1. Understand the contemporary observations of biological evolution
2. Knowledge and skills in Phylogenetic analysis and related to *molecular evolution*
3. Analyze the role of pattern, adaptive features of consequences of evolution.
4. Acquire evolutionary information of the fossil record
5. Investigate the evolutionary basis of behavior in primates and man.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	H	M	H	M	H	H	M	H	H
CO 2	H	H	L	M	M	H	H	H	H	M
CO 3	H	H	L	H	L	H	H	H	H	M
CO 4	H	H	L	M	M	H	H	M	H	H
CO 5	H	H	M	M	L	H	H	M	H	M

Practicals IV- Microbiology, Immunology and Biotechnology

Semester III

21MZOC18

Hours of instruction / week: 3

No of credits: 3

Objectives:

1. To understand the biochemical aspects of microorganisms
2. To enable the students to know the molecular based techniques
3. To describe the biotechnological techniques in research problems

Microbiology

1	Methods of growing microbes –Agar, Broth, Slant, Stab culture	2 Hrs
2	Techniques for pure culture of microbes – Spread, pour and streak plate methods	3 Hrs
3	Isolation and enumeration of microbes from soil, water and air.	3Hrs
4	Identification of bacteria by Gram and Negative staining	3Hrs
5	Biochemical tests – Indole, Methyl red, VogesProskauer, Citrate Utilization, Catalase and Starch Hydrolysis Tests	3Hrs
6	Identification of fungi by lacto phenol cotton blue staining	2Hrs
7	Determination of Microbial growth – Turbidity method	3Hrs
8	Production of Wine	2Hrs
9	Bioremediation of industrial effluent/ sewage water using biosorbents	2Hrs
10	Antibiotic sensitivity test	3Hrs

Immunology

11	Haemagglutination	2Hrs
12	Single radial Immunodiffusion technique	3Hrs
13	Enzyme Linked Immunosorbent Assay	2Hrs

Biotechnology

14	Isolation and estimation of DNA from goat liver	3Hrs
15	Agarose Gel Electrophoresis of DNA	3Hrs
16	Polymerase Chain Reaction for amplification of DNA (Demonstration)	3Hrs
17	Restriction digestion of DNA	3Hrs

Total Hours: 45

Course Outcomes:

1. Able to isolate and identify microbes
2. Analyze the pathogenicity of disease causing microorganisms
3. Execute immunological techniques to solve clinical problems
4. Assess the bio sorbents that clean environment
5. Apply biotechnological methods in research sectors

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	M	H	H	H	H	M	M	L	L
CO 2	H	M	H	H	H	H	M	M	M	L
CO 3	M	M	H	H	H	H	M	M	H	M
CO 4	H	M	H	H	H	H	H	M	H	H
CO 5	H	M	H	H	H	H	M	M	H	L

**Economic Zoology
(Self-study)**

Semester – III

Hours of instruction/week: 1

21MZOC19

No of credits: 4

Objectives:

1. To disseminate information on economic aspects of Zoology
2. To inculcate knowledge on useful animals to man kind
3. To understand the modern techniques of animal culture

Unit 1	Apiculture Life history of honey bee, kinds of honey bees- natural hives- Artificial hive –Newton’s hive and other appliances, enemies and diseases of honey bees- Economics and marketing values	3 hrs
Unit 2	Sericulture Life cycle and rearing of silkworm moth (<i>Bombyxmori</i>), – Diseases- Protozoan, bacterial, fungal & viral- setting up of a sericulture unit.	3 hrs
Unit 3	Pisciculture Cultivable species of fishes in India –construction of a pond – polyculture- Sewage fed fish culture – induced breeding	3 hrs
Unit 4	Vermiculture Cultivable species of earthworm – vermi composting methods – conditions required for vermicomposting – vermicast – vermiwash	3 hrs
Unit 5	Poultry Science Breeds of fowls – the deep litter system – practical aspects of chick rearing – management of growers and layers – feed formulations – vaccines	3 hrs

Total Hours: 15

Text Books:

1. Upadhyay VB. Economic Zoology. Rastogi Publications, Meerut 2006
2. Yadav, Manju. Economic Zoology. Discovery Publishing House, New Delhi 2003
3. RavindranathanKR. Economic Zoology. Dominant Publishers & Distributors 2003

Reference Books:

1. Nigam HC. Modern Trends in Biology & Economic Zoology. Vishal Publ. Co., Jalandhar, Punjab 2006
2. JawaidAhsan, Sinha, SP.A Handbook of Economic Zoology. S. Chand Group Publ., New Delhi 2008.

Course outcomes:

1. Apply the knowledge of managing beehives for honey production and marketing
2. Acquire knowledge about the rearing of silkworms and causative agents of silkworm diseases.
3. Understand various methods of aquaculture practices.
4. Role of Vermiculture in protecting the environment and managing the waste
5. Describe poultry breeds and basic concepts related to vaccines.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	H	H	H	H	H	M	M	H	H
CO 2	H	H	H	H	H	H	M	M	H	H
CO 3	H	H	H	H	H	M	M	L	H	H
CO 4	H	H	H	H	H	H	M	L	H	H
CO 5	H	H	H	H	H	M	M	M	H	H

Biostatistics and Thesis Writing

Semester III
21MZOC21

Hours of instruction / week:4
No of credits: 4

Objectives:

1. To learn the methods of data collection and the application of statistical methods in solving biological problems
2. To know the principles of research design and thesis writing

Unit 1:	Introduction to Statistics Statistics – definition, scope, functions and limitations, development of biostatistics and its applications - sources of statistical data - primary and secondary sources, *statistical organizations presentation of data - classification and tabulation of data, frequency distribution, Diagrammatic and *Graphical representation of statistical data – bar diagrams, pie chart, line graph , histogram, frequency polygon, frequency curve and Ogive curve	12 hrs
Unit 2:	Descriptive statistics Measures of central tendency – *objectives, mean, median and mode, uses, merits and demerits Measures of dispersion – *objectives, range, quartile deviation, mean deviation, standard deviation, absolute and relative measures of dispersion, uses, merits and demerits Correlation and regression analysis - definition, uses, types of correlation, methods of studying correlation – scatter diagram, graphic method, Karl Pearson’s coefficient of correlation, rank correlation, concurrent deviation, *least squares method, regression lines, regression equations, regression coefficients	12 hrs
Unit 3:	Sampling and Theoretical Distribution Sampling – meaning, advantages, concept of parameter and statistics, sample size, sampling error--*Introduction of probability and its applications-Types of samples – probability samples – simple random sample, stratified random sample, systematic sample, cluster sample, multistage. Non-probability samples– purposive sampling, quota sampling, accidental sampling- Theoretical distributions – Binomial, Poisson and Normal distributions- properties, uses and applications	12 hrs
Unit 4:	Testing of Hypothesis Procedure of Proposing and testing hypothesis, student’s t- test, analysis of variance - one way and two way classification, non-parametric and distribution free tests – chi-square test.	12 hrs

Unit 5: Research Design and Report Writing

12hrs

Research – knowledge and sciences, types and application, research definition – research design – identifying the problem, reviewing the literature, designing the study – *chapter outline

Documentation - report writing, presentation, test layout, use of tables and figures, their placement, numbering, foot notes to tables and figures, spacing and alignment, referencing – reference systems, essential information – special capitalization and alphabetical and chronological order, editing and evaluating the final report, *components of a research thesis. Plagiarism, Plagiarism tool,

Research Ethics,

***Self study**

Total Hours: 60**Textbooks:**

1. Kothari CR. Research methodology– Methods and Techniques, New Age Publications Pvt. Ltd, New Delhi,2009.
2. Agarwal SC. A handbook of fish farming. Narendra pub. House, Delhi, 2007
3. Annadurai B . A text book of Biostatistics, New age International Pvt. Ltd Publishers, Chennai, 2007.
4. Gurumani N. Research Methodology, MJP publishers, Chennai,2006.
5. Gupta SP. Statistical methods, Sultan Chand and Sons Publishers, New Delhi ,2004.

References Books:

1. Chakrabaty NM, Chakrabaty PP, and S.C.Mondal SC. Biology, breeding and farming of important food fishes. Narendra pub. House, Delhi, 2010.
2. Ronald, N. Forthofer, EunSul Lee. Introduction to Biostatistics, Elsevier Publications India Pvt. Ltd, New Delhi,2010.
3. Klaynekl Daniel. Biostatistics, Wiley India Pvt. Ltd., New Delhi, 2009.

Course Outcomes:

1. Understand the basic concept and applications of biostatistics.
2. Ability to calculate the descriptive statistics and its significance
3. Knowledge on implementation of hypothesis in validating a model.
4. Identify the appropriate hypothesis testing procedure related to variables and samples
5. Interpret current knowledge and skills to new methods in research design and report writing.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	H	H	H	H	H	H	M	H	L
CO 2	H	H	H	H	H	H	H	L	M	L
CO 3	H	H	H	H	H	H	H	L	M	L
CO 4	H	H	H	H	H	H	H	L	L	L
CO 5	H	H	H	H	H	H	H	M	L	L

DEPARTMENT OF ZOOLOGY
Multidisciplinary Course
Conservation of Fauna

Semester III
21MZOM01

Hours of instruction / week: 2
No of credits: 2

Objectives:

1. To enable the students to know about the faunal diversity and its importance
2. To enable the students to understand the importance of the conservation of fauna

Unit 1	Introduction to biodiversity	6 hrs
	Types of biodiversity- Genetic, species and ecosystem diversity	
	Biodiversity measurement– Alpha, beta and gamma diversity	
	IUCN Red list Categories – Threatened, vulnerable, endangered, rare and indeterminate, global distribution of fauna, hot spots of fauna	
Unit 2	Faunal distribution and faunal wealth of India	6 hrs
	Asiatic lion, tiger, Indian rhinoceros, Indian elephant, lion tailed macaque, nilgirthar, panther, flying squirrel	
Unit 3	Human impact on faunal diversity	6 hrs
	Habitat destruction, over exploitation, introduction of exotic species, deforestation, environmental pollution, global climate change, desertification, commercial trade of animal species	
Unit 4	Strategy for faunal conservation	6 hrs
	In situ Conservation- Sanctuary, national parks, biosphere reserve	
	Ex situ Conservation- Zoological parks, aquaria, gene bank, cryopreservation	
	Project to conserve Wild life- Project tiger, crocodile breeding project, operation rhino, Gir lion project, Project elephant	
Unit 5	Biodiversity awareness	6hrs
	Role of education and research institution and organizations for wild life conservation. Wild life (protection) Act	

Total Hours: 30

Textbooks:

1. Singh BK. Biodiversity Conservation and Management. Mangal deep publications. Jaipur 2004.
2. Mallapureddi V, Reddy K. Wildlife Biodiversity Conservation. Daya publishing House Delhi 2008.
3. Deswal S, and Deswal A. Basic course in Environmental studies. Dhanpat Rai & Co (P) Ltd Educational & Technical publishers Delhi 2009.
4. Raman Sivakumar. Environmental Science & Engineering. Tata McGraw Hill Education Private Ltd 2010.

Reference Books:

1. Hosetti BB. Concepts in Wildlife Management. Daya publishing House Delhi 2008.
2. Hosetti BB, and Ramakrishna S. Biodiversity : Concepts and Conservation. First edn Aavishkar Publishers Jaipur 2016.

Course outcomes:

1. Gain knowledge on theories in the field of systematic and biodiversity.
2. Able to understand the distribution and wealth of fauna
3. Identify various human activities on forest ecosystem
4. Acquire knowledge and skill conserve fauna
5. Understand the problems related to wildlife conservation and management.

DEPARTMENT OF ZOOLOGY

Interdisciplinary Course Entrepreneurial Avenues In Zoology

Semester – II
21MZOI01

Hours of instruction / week : 4
No of credits: 4

Objectives:

1. To disseminate information on economic aspects of Zoology
2. To inculcate knowledge on useful animals to man kind
3. To understand the marketing values animal culture

Unit 1.	Aquaculture Sustainable Aquaculture: Extensive, semi-intensive and intensive culture of fish; Pen and cage culture; Poly culture; Composite fish culture; Brood stock management; Induced breeding of fish; Preparation of compound diets for fish; Role of water quality in aquaculture; Fish diseases: Bacterial, viral and parasitic. Entrepreneurship in Aquaculture: Preservation and processing of harvested fish, Fishery by-products Practicals <ul style="list-style-type: none">• Identification of common edible fishes• Identification of ectoparasites• Field visit to a fish farm	12 hrs
Unit 2.	Apiculture Biology of Bees: Classification and biology of honey bees, social organization of bee colony Rearing of Bees: Selection of bee species for apiculture, artificial bee rearing (apiary), beehives – newton bee pasturage, bee keeping equipment methods of extraction of honey (indigenous and modern) Diseases and Enemies: Diseases and enemies, control and preventive measures Bee Economy: Products of apiculture industry and its uses (honey, bees wax, propolis, pollen) Entrepreneurship in Apiculture: Bee keeping industry –modern methods in apiculture. Practicals <ul style="list-style-type: none">• Identification of honey bee• Field visit to an Apiary	12 hrs
Unit 3.	Sericulture Biology of Silkworm: Life cycle of <i>Bombyxmori</i> , Structure of silk gland and secretion of silk Rearing of Silkworms: Selection of mulberry variety and establishment of mulberry garden Rearing house and appliances, Disinfectants-Formalin, bleaching powder, RKO Silkworm rearing technology: Early age and Late age rearing, Types of mountages Spinning, harvesting and storage of cocoons Pests and Diseases: Uzi fly, dermestid beetles and vertebrates. Protozoan, viral, fungal and bacterial diseases, Control and prevention of pests and diseases Entrepreneurship in Sericulture: Sericulture industry in different states, employment. *Visit to sericulture centre.	12 hrs 12 hrs

Unit 4.	Vermiculture Introduction to Vermiculture: definition, species selection, earthworm biology and rearing Vermicompost Technology: Small Scale Earthworm farming for home gardens, Conventional commercial composting, Earthworm Farming (Vermiculture), vermicomposting harvest and processing. Entrepreneurship in Vermiculture: Compost making, Vermiwash and marketing	
Unit 5.	Poultry Science Introduction to poultry science: Biology and Breeds of fowls, Entrepreneurship and Production: the deep litter system, practical aspects of chick rearing, management of growers and layers, feed formulations. Diseases, management vaccines	12 hrs

Total Hours: 60

Text Books:

1. Upadhyay VB. Economic Zoology. Rastogi Publications, Meerut 2006
2. Yadav and Manju. Economic Zoology. Discovery Publishing House, New Delhi 2003
3. JawaidAhsan, Sinha SP. A Handbook of Economic Zoology. S. Chand Group Publ., New Delhi 2008

Reference Books:

1. Bone TQ and Moore R. Biology of Fishes, Talyor and Francis Group, CRC Press, U.K.
2. Srivastava CBL. Fish Biology, Narendra Publishing House
3. Prost PJ. Apiculture. Oxford and IBH, New Delhi 1962.
4. Bisht DS. Apiculture, ICAR Publication.
5. Singh S. Beekeeping in India, Indian council of Agricultural Research, New Delhi
6. Ullal SR and Narasimhanna MN. Handbook of Practical Sericulture: CSB, Bangalore
7. Bhatt JV and Khambata SR. "Role of Earthworms in Agriculture" Indian Council of Agricultural Research, New Delhi 1959

Course Outcomes:

1. Demonstrate and learn the beneficial role of animals in human life
2. Understand the rearing of animals.
3. Awareness on the diseases that affect the animals and poultry
4. Knowledge on the significance of by-products and their income generation.

DEPARTMENT OF ZOOLOGY

Professional Certification Course

Radioecology

Semester II
21MZOPC1

Hours of Instruction / week: 41
No. of credits: 2

Objectives:

1. To understand the fundamentals of radioactivity
2. To learn about trace level and elucidations
3. To study the biological effects of radiation

Unit 1.	Radioactivity, measurement and trace determination of nuclides – Radiological fundamentals- Nuclear physics, radiological units, quantities, and measurements. Linear energy transfer - Some mathematical principles statistics of measurement.	10hrs
Unit 2.	Introduction to radioecology:- Cosmogenic and Primordial nuclides, transuranic elements, radium and radon in the environment. Disequilibrium and Anthropogenic sources.	3 hrs
Unit 3.	Biochemical properties of radionuclides-uptake, accumulation and elimination of radionuclides by biota. Measurement of transfer coefficient. ICRP recommendations on transfer coefficients.- Trace level determination-analytical techniques including.	8 hrs
Unit 4.	Biological effects of radiation, Effect of radiation exposure to human and animal kingdom- - Biodosimetry techniques- Dose response curve- linear and non-linear response Experimental methodology -Chromosome aberration, FISH techniques, premature chromosome condensation.; Molecular techniques- Gene expression studies- Biomarkers.	20 hrs

Total Hours: 41

If time permits some of the models can be discussed and students can be asked to calculate the dose to the population due to various anthropogenic nuclides and compare with that obtained due to NORM.

References:

1. Radionuclide behaviour in the natural environment: Science, implications and lessons for the nuclear industry- Edited by Ch. Poinssot and H. Geckis, Woodhead Pub. Ltd.
2. Radiochemistry and Nuclear chemistry , Gregry Choppin, Jan- OlovLiyenzein and Jan- Rydberg., Butterworth- Heimann Pub.
3. Introduction to Health Physics, Hermenn Cember and Thomas Edward Johnson, McGraw Hill Company, 2008.

4. IAEA. 1992. Effects of Ionizing Radiation on Plants and Animals at Levels Implied by Current Radiation Protection Standards, Technical Reports Series No. 332. International Atomic Energy Agency, Vienna
5. ICRP, 2009. Environmental Protection: The concept and use of reference animals and plants. Publication 108, Elsevier, ISBN-13 978-0-444-52934-3.
6. Whicker, F. W. and V. Schultz.. 1982. Radioecology: Nuclear Energy and the Environment. CRC Press, Boca Raton, FL., USA.
7. IAEA, 2010. Radiation biology: A handbook for teachers and students. IAEA-TCS-42. ISSN 1018-5518. Vienna, Austria.

Course outcomes:

1. Understand the classification of natural and artificial ionizing radiation.
2. Describe the radiological fundamentals of measurement and trace determination of nuclides.
3. Portray the origin of ionizing radiation from the earth.
4. Explain the biological influence of radiation on an animal kingdom including human beings.
5. Gain knowledge on the risks of radiation from living and working environment and the ways to protect themselves from radiation.

DEPARTMENT OF ZOOLOGY
Professional Certification Course
Cytogenetic and Molecular Biology Techniques

Semester II
21MZOPC2

Hours of Instruction / week: 56
No. of credits: 2

Objectives:

1. To learn the fundamentals of clinical cytogenetics.
2. To understand the ethnology of chromosome disorders.
3. To outline basic principle of prenatal diagnosis.

Unit 1.	History of Human Chromosome Research: Nomenclature of human chromosomes. Identification of human diploid chromosomes Practicals: Identification of 23 pairs of human chromosome by band position	20 hrs
Unit 2.	Peripheral blood culture-Procedures Practicals: Peripheral blood cultures-harvesting 71 st hour-fixative addition-staining techniques-view chromosome under microscope	10 hrs
Unit 3.	Banding techniques-G-banding ,Q-banding ,C-banding ,R-Banding Practicals: Banding techniques-G-banding	9 hrs
Unit 4.	Chromosomal syndromes: Autosomal syndromes-Sex chromosomal syndromes-structural chromosomal syndromes Practicals: Identification of autosomal syndrome-sex chromosomal syndromes-structural chromosomal syndromes	8 hrs
Unit 5.	Prenatal diagnosis: chorionic villi sampling-foetoscopy-ultrascopy-amniocetesis Practicals: Prenatal diagnosis	9 hrs

Total Hours: 56

References:

1. G.P.Jayanthi (2009) Molecular Biology, M.J.P.Publishers, Chennai
2. Veer BalaRastogi (2007) Molecular Biology, Kedarnath Ram Nath Publishers, Meerut(UP)
3. Alice Marcus. 2010. Human Genetics. Narosa publishing House, 1st edition, Delhi, Chennai, Mumbai, Kolkata.

Course Outcomes:

1. Understand the history of human chromosome research and its application.
2. Identify chromosomal syndromes.
3. Able to interpret and use standard and use standard ISCN nomenclature to describe karyotypes.
4. Recognize numerical and structural Chromosomal abnormalities.
5. Diagnose prenatal chromosomal disorders.