JSS MAHAVIDYAPEETHA

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE

(Autonomous under University of Mysore)
Re-Accredited by NAAC with 'A' grade
Recognized by UGC as "College with potential for excellence"
Ooty road, Mysore – 570025

Credit matrix, Course of study and Scheme of Examination of

POSTGRADUATE DEPARTMENT OF ZOOLOGY

For M.Sc degree Programme in Zoology

With effect from 2023-24 onwards

PROGRAM CODE: ZOO17

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE
OOTY ROAD, MYSURU
PG DEPARTMENT OF ZOOLOGY
Syllabus Adopted from the academic year 2023-24

Semester	HC / SC	Paper title	CREDITS			Total Credits
			L	T	P	
I	HC - 1.1	Biosystematics & Non Chordata	2	0	0	**2**
	HC - 1.2	Laboratory Biosystematics & Non Chordata	0	0	2	**2**
	HC - 1.3	Biological Chemistry	2	0	0	**2**
	HC - 1.4	Laboratory Biological Chemistry	0	0	2	**2**
	HC - 1.5	Cytogenetics	2	0	0	**2**
	HC - 1.6	Laboratory Cytogenetics	0	0	2	**2**
	SC - 1.7	Tools and techniques in Biology	3	1	0	**4**
	SC - 1.8	Chronobiology	3	1	0	**4**
	SC - 1.9	Histology and Histopathology	3	1	0	**4**
	Any two of the Soft core paper may be opted					**20**
II	HC - 2.1	Chordata	2	0	0	**2**
	HC - 2.2	Laboratory Chordata	0	0	2	**2**
	HC - 2.3	Animal Physiology	2	0	0	**2**
	HC - 2.4	Laboratory Animal Physiology	0	0	2	**2**
	HC - 2.5	Entomology	2	0	0	**2**
	HC - 2.6	Laboratory Entomology	0	0	2	**2**
	SC - 2.7	Developmental Biology	3	1	0	**4**
	SC - 2.8	Immunology	3	1	0	**4**
	SC - 2.9	Evolutionary Biology	3	1	0	**4**
	Any two of the Soft core paper may be opted					**20**
III	HC - 3.1	Molecular Biology & Biotechnology	2	0	0	**2**
	HC - 3.2	Laboratory Molecular Biology & Developmental Biology	0	0	2	**2**
	HC - 3.3	Reproductive Biology	2	0	0	**2**
	HC - 3.4	Laboratory Reproductive Biology	0	0	2	**2**
	HC - 3.5	Ecology and Wildlife**	2	0	0	**2**
	HC - 3.6	Laboratory Ecology and Wildlife	0	0	2	**2**
	SC - 3.7	Ethology *	3	1	0	**4**
	SC - 3.8	Pollution and Toxicology *	3	1	0	**4**
	OE - 3.9	Concepts of Zoology	3	1	0	**4**
	***Any one of the Soft core paper may be opted** ****Field visits are included in this paper**					**20**
IV	HC - 4.1	Advanced Genetics and Computational Biology	2	0	0	**2**
	HC - 4.2	Laboratory Advanced Genetics and Computational Biology	0	0	2	**2**
	HC - 4.3	Applied Zoology*	2	0	0	**2**
	HC - 4.4	Laboratory Applied Zoology	0	0	2	**2**
	HC - 4.5	Major Project	0	2	6	**8**
	***Field visits are included in this paper**					**16**

	Course	Hard Core (HC)	Soft Core (SC)	Open Elective (OE)	Total credits
	Credits	**52 Credits**	**20 Credits**	**04 Credits**	**76**

SCHEME OF ASSESSMENT

Course code	Course type	Course title	Exam hrs	Max Marks			Total
				IA		Main exam	
				C1	C2	C3	
Semester I							
	HC - 1.1	Biosystematics & Non Chordata	03	15	15	70	100
	HC - 1.2	Laboratory Biosystematics & Non Chordata	04	15	15	70	100
	HC - 1.3	Biological Chemistry	03	15	15	70	100
	HC - 1.4	Laboratory Biological Chemistry	04	15	15	70	100
	HC - 1.5	Cytogenetics	03	15	15	70	100
	HC - 1.6	Laboratory Cytogenetics	04	15	15	70	100
	SC - 1.7	Tools and techniques in Biology	03	15	15	70	100
	SC - 1.8	Chronobiology					
	SC - 1.9	Histology and Histopathology					

***Any two of the Soft core paper may be opted**

Course code	Course type	Course title	Exam hrs	Max Marks			Total
				IA		Main exam	
				C1	C2	C3	
Semester II							
	HC - 2.1	Chordata	03	15	15	70	100
	HC - 2.2	Laboratory Chordata	04	15	15	70	100
	HC - 2.3	Animal Physiology	03	15	15	70	100
	HC - 2.4	Laboratory Animal Physiology	04	15	15	70	100
	HC - 2.5	Entomology	03	15	15	70	100
	HC - 2.6	Laboratory Entomology	04	15	15	70	100
	SC - 2.7	Developmental Biology	03	15	15	70	100
	SC - 2.8	Immunology					
	SC - 2.9	Evolutionary Biology					

***Any two of the Soft core paper may be opted**

Course code	Course type	Course title	Exam hrs	Max Marks			Total
				IA		Main exam	
				C1	C2	C3	
Semester III							
	HC - 3.1	Molecular Biology & Biotechnology	03	15	15	70	100
	HC - 3.2	Laboratory Molecular Biology & Developmental Biology	04	15	15	70	100
	HC - 3.3	Reproductive Biology	03	15	15	70	100
	HC - 3.4	Laboratory Reproductive Biology	04	15	15	70	100
	HC - 3.5	Ecology and Wildlife**	03	15	15	70	100
	HC - 3.6	Laboratory Ecology and Wildlife	04	15	15	70	100
	SC - 3.7	Ethology *	03	15	15	70	100
	SC - 3.8	Pollution and Toxicology *					
	OE - 3.9	Concepts of Zoology	03	15	15	70	100

***Any one of the Soft core paper may be opted**

Course code	Course type	Course title	Exam hrs	Max Marks			Total
				IA		Main exam	
				C1	C2	C3	
Semester III							
	HC - 4.1	Advanced Genetics and Computational Biology	03	15	15	70	100
	HC - 4.2	Laboratory Advanced Genetics and Computational Biology	04	15	15	70	100
	HC - 4.3	Applied Zoology*	03	15	15	70	100
	HC - 4.4	Laboratory Applied Zoology	04	15	15	70	100
	HC - 4.5	Major Project	-	15	15	70	100

Program Outcome

PO	PO ID	PO Statement
PO1	ZOO17.PO1	Demonstrate an in-depth understanding of the principles, theories, and current research across the broad spectrum of Zoology.
PO2	ZOO17.PO2	Possess advanced skills in designing, conducting, analyzing, and interpreting experiments in a laboratory and field setting.
PO3	ZOO17.PO3	Be able to critically evaluate scientific literature, integrate cross-disciplinary knowledge, and apply analytical skills to solve complex problems in biology.
PO4	ZOO17.PO4	Demonstrate expertise in the use of modern techniques and instruments in biological research.
PO5	ZOO17.PO5	Be skilled in communicating scientific information effectively, both orally and in writing, to a variety of audiences.
PO6	ZOO17.PO6	Understand the ethical implications of scientific research and its impact on society and the environment.
PO7	ZOO17.PO7	Recognize the importance of continuing education and professional development in their field.
PO8	ZOO17.PO8	Have the ability to apply their knowledge and skills to address practical problems in biological sciences and biotechnology.

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Programme Specific outcome:

At the completion of M.Sc. in Zoology the students are able to:

PSO	PSO ID	PSO Statement
PSO1	ZOO17.PSO1	Acquire expert knowledge in biological taxonomy, systematics, and ecological significance through classification and nomenclature practices.
PSO2	ZOO17.PSO2	Develop proficiency in advanced laboratory techniques, including microscopy, spectrophotometry, and genetic engineering, for comprehensive biological research.
PSO3	ZOO17.PSO3	Master the assessment of species' ecological roles, biodiversity conservation, and ecosystem health evaluation through field and lab research.
PSO4	ZOO17.PSO4	Understand and analyze physiological systems and biochemical roles of biomolecules in various organisms, emphasizing metabolic functions.
PSO5	ZOO17.PSO5	Gain hands-on experience in genetic engineering and cytogenetics, focusing on DNA replication, gene regulation, and the analysis of genetic disorders.
PSO6	ZOO17.PSO6	Deepen knowledge of embryogenesis, developmental biology, and metamorphosis, emphasizing molecular and evolutionary perspectives.
PSO7	ZOO17.PSO7	Comprehend immunology principles, vaccine development, and disease pathology, including tumor differentiation and disease histopathology.
PSO8	ZOO17.PSO8	Equip with professional skills including project management, scientific communication, and ethical research practices for a career in biological sciences.

M.Sc, I SEMESTER
HC 1.1 Biosystematics & Non Chordata

32hrs

Course Outcome:
After completing the course student will be able to

CO1	Classify and name any animal species, understand taxonomy's history, principles, and nomenclature.
CO2	Classify non-chordates, explain their locomotion and nutrition mechanisms, and assess their ecological roles.
CO3	Understand and analyse physiological adaptations in excretion, osmoregulation, and nervous system complexity.
CO4	Interpret life's geological history through the study of fossils and larval forms, understanding biodiversity development.

UNIT I Basic concepts of animal taxonomy: **8 hrs**

A. Introduction and history of taxonomy
B. Species concept
C. Zoological classification - theories of classification - taxonomic ranks – hierarchy
D. Zoological nomenclature: Binomial nomenclature, trinomial nomenclature-ICZN
E. taxonomical keys: key to the species
F. Linnaean taxonomy and classical taxonomy - level of taxonomy.

Unit II : Classification, Locomotion and Nutrition: **8 hrs**

A. General Characteristics of Non chordata
B. Locomotion: Muscle filaments and myonemes,
Flagella and cilia, Amoeboid movement
C. Nutrition in Protozoa: Filter feeding in polychaetes, Filter feeding and digestion in Deuterostomia and molluscs
D. Respiration:
Structure and function of respiratory organs- Skin, gills, book lungs and Trachea. Respiratory pigments

Unit III: **8 hrs**

A. Excretion and osmoregulation:
Osmoregulation in fresh water and marine Invertebrates
Structure and function of excretory organs- Coelom, Coelomoducts, Nephridia, Maliphigian tubules and Coxal glands
B. Nervous system:
Primitive nervous system: Coelenterata and Echinodermata
Advanced nervous system: Annelida, Arthropoda(Crustacea and Insecta) and Mollusca (Cephalopod)
C. Sense organs and their importance

Unit IV: **8 hrs**

A. Invertebrate palaeontology and larval forms:
Free living and parasitic larval forms
B. Fossil: types and importance of fossil study, overview of Geological Time Scale

M.Sc., I SEMESTER
HC 1.2 Laboratory Biosystematics & Non Chordata

PRACTICALS 4x16=64 Hrs

Course outcomes

At the end of the course the student will be able to:

CO1	Identify invertebrates across major phyla and master microscopy and laboratory techniques.
CO2	Learn the functioning of nervous, respiratory, reproductive, and excretory systems in invertebrates.
CO3	Explain larval forms and life cycles, and understand developmental biology and evolutionary significance within invertebrates.
CO4	Develop field and lab research skills, and conduct studies on invertebrates in their natural habitats.

1. PROTOZOA

Noctiluca, Entamoeba histolytica , Plasmodium vivox, Opalina ,Vorticella

2. PORIFERA

Grantia , Hyalonema , Euspongia, Sponge gemmules

3. CNIDARIA

Pennaria, Aurelia &Aurelia-tentaculocyst ,Gorgonia ,Favia, Obelia polyp and Medusa

4. HELMINTHES

Platyhelminthes -Planaria, Fasciola hepatica, Taenia solium

Aschelminthes -Ancylostoma, Male and female Ascaris lumbricodes,

5. ANNELIDA

Terebella , Pheretima postuma, Leech, Bonellia, Sipunculus, Priapulus

6. ARTHROPODA

Daphnia, Julus, Belostoma, Limulus , Peripatus

7.MOLLUSCA

Chaetoderma , Chiton , Murex ,Doris , Aplysia, Unio, Loligo

8. ECHINODERMATA

Antedon, Holothuria, Sea Urchin , Astropecten, Echinodiscus, Ophiothrix

9. LARVAL FORMS

Amphi-blastula larva, Ephyra Larva, Trochophore larva, Nauplius Larva, Glochidium Larva, Bipinnaria Larva.

10.Culture preparation and observation of different Protozoans- Paramecium, Euglena, Amoeba,Vorticella

11.Mounting of Foraminiferans / Sponge spicules

12. Field Study: Visit to different areas around the college campus, to observe and study Non chordates in their natural habitat.

13. Study of Nervous system, Respiratory system, Reproductive system and Excretory system in invertebrates by employing computer animation/charts

14. Repitation.

REFERENCES :

1. Barnes, R.D.1974. Invertebrate Zoology, III edition. W.B Saunders Co., Philadelphia
2. Barrington, E.J.W, 1976. Invertebrate Structure and Function. Thomas Nelson and Sons Ltd.,London.
3. Hyman L,H. 1940. The invertebrates. Vol. 1. Protozoa through Ctenophora, McGraw hill Co.,N.Y.
4. Hyman. L H. 1959. The Invertebrates smaller coelomate groups, Vol. V. McGraw Hill Co.,
5. Hyman. L. H. 1951. The Invertebrates. Vol. 2. McGraw Hill Co., N.Y.
6. Hyman. L H. 1968. The invertebrates Vol. 8. McGraw Hill Co., N.Y and London.
7. Simpson, G C. Principles of Taxonomy.

M.Sc, I SEMESTER
HC -1.3 Biological Chemistry

32 hrs

Course Outcome:
After completing the course student will be able to

CO1 Understand chemical bonding and the significance of carbohydrates in biological systems.

CO2 Gain insights into the biological roles and chemical structures and properties of proteins and lipids.

CO3 Understand about enzyme functions, dynamics, and their importance in biological reactions.

CO4 Comprehend the structures and roles of nucleic acids and vitamins in health and disease.

UNIT I Chemical Bonds and Carbohydrates: 8 Hrs

A. Structure of an atom, orbitals, chemical bonds - covalent, co-ordinate, ionic and hydrogen; Vander-Waal's force; hydrophobic interactions; Normality and Molarity of solutions.

B. Carbohydrates – Chemistry and biological properties

UNIT II Proteins and Lipids: 8 Hrs

A. Proteins- Chemistry and biological properties, Christian Anfinsen's experiment, Biological values of proteins

B. Lipids: Chemistry, triglycerides; prostaglandins and steroids –biosynthesis, Chemical importance of lipids.

UNIT III Enzymes: 8 Hrs

A. Enzymes: Nomenclature – current status; factors influencing velocity of enzyme reaction, enzyme dynamics and enzyme inhibition.
Ribozymes and abzymes; co-enzymes, isozymes, clinical importance.

UNIT IV Nucleic acids & Vitamins: 8 Hrs

A. Nucleic acids: Chemistry, alternative models of DNA,

B. Vitamins and trace elements – chemical nature, vitamins as co-enzymes, Deficiency diseases, role of trace elements

M.Sc., I SEMESTER
HC 1.4 Laboratory Biological Chemistry

Course Outcome: **4x16=64 Hrs**

After completing the course student will be able to

CO1 Demonstrate proficiency in biochemical analysis techniques, successfully identifying and distinguishing between various carbohydrates and proteins.

CO2 Understand protein behavior and precipitation methods.

CO3 Understand spectrophotometry principles and accurate substance concentration determination.

CO4 Develop advanced laboratory skills, deepen their understanding of biochemical processes.

1. Qualitative analysis for identification of carbohydrates (Starch, Glycogen, Sucrose, Lactose, Maltose, Glucose, Fructose).
2. Qualitative analysis for identification of Proteins (Egg albumin, Casein, Gelatin, Peptone)

3. Precipitation reaction of proteins (Egg albumin, Peptone)
4. The absorbance curves for two dyes and demonstration of Beer-Lambert's law.
5. Estimation of amino acids by Sorenson's formal titration (Arginine, Alanine, Leucine, lysine)
6. Determination of concentration of Glucose and Maltose by calibration curve.
7. Determination of amylase activity.
8. Determination of effect of temperature, pH and incubation period on amylase activity.
9. Test for non-esterified fatty acid.
10. Demonstration of gel electrophoresis.

REFERENCES

1. Barrington, E. J. W (1976) An introduction to general and comparative endocrinology, Oxford University press, London.
2. Conn, E. E., Stumpt, P. K., Bruencing, G. and Dol, R. G. 1995. Outlines of Biochemistry. Pub. John Wiley, Singapore.
3. Eckert, R and Randall, D. 2002, Animal physiology, 2nd Edn, W.H..Freman
4. Guyton. A.G. 1986, Text book of Medical Physiology, 7th Edn., Saunders Publication
5. Harper, H. A. 1993. A review of Physiological Chemistry, Lange Medical Publication, 2nd Edn.
6. Lehninger, A. L., Nelson, D. L. and Cox, M. M., 2nd Edn. 1993. Principles of Biochemistry,CBS Publishers and Distributors, New Delhi.
7. Oser, B. L. (Ed.) 1993. Hawk's Physiological Chemistry. Tata Graw Hill Publishing Co. Ltd.New Delhi.

M.Sc., I SEMESTER
HC – 1.5 Cytogenetics

32 Hrs

Course Outcome:

After completing the course student will be able to

CO1 Understand the evolution of cells, membrane functions, and the roles of key organelles.

CO2 Understand the cell cycle phases, regulation mechanisms, signal transduction, and aspects of cellular aging and death.

CO3 Comprehend various mutation types, their molecular mechanisms, and detection methods.

CO4 Grasp the structure, variations, and consequences of chromosomal rearrangements, including the practical applications and effects of radiation.

Unit I: Introduction to the Cell & Cell Organelles 8 hrs

A. The origin and evolution of the cell, From molecules to first cell, from Prokaryotes to eukaryotes, from single cell to multicellular organisms.
B. Membrane Structure and Function,
C. Structural organization and functions of intracellular organelles- The nucleus, mitochondria, lysosomes, peroxisomes, golgi apparatus, and endoplasmic reticulum.

Unit II: Cell Cycle and Cell signalling 8 Hrs

A. Phases of cell cycle.
B. Biochemical studies with oocytes, eggs and early embryos.
C. Regulation of cell cycle: Molecular mechanisms regulating mitotic events.
   Regulation of cell cycle progression.
   Check points in cell cycle regulation.
   Cell cycle control in polytene cells.
D. Molecular basis of signal transduction
E. Cellular aging and death: (a)Causes of aging

(b)Cellular changes due to aging
(c)Theories of aging
(d) Apoptosis
(e) Longivity genes

UNIT III Gene mutations **8 Hrs**

A. Types of mutations (Spontaneous, Induced, Base substitutions and frameshifts - Transitions, Transversions, gain in function, loss in function, Neutral mutations),
B. Molecular mechanism of mutations (Base analogs, alkylating agents); Detection of mutations: Dominant lethal test, Sex-linked recessive lethal test, II-III translocations, Ames test, P-mediated mutagenesis

UNIT IV Chromosomal mutations **8 Hrs**

A. Structure and organization of eukaryotic chromosomes
B. Structural and numerical variations of chromosomes, Chromosomal rearrangements and their cytogenetic consequences with examples from plants, Drosophila and Man, Practical applications of chromosome rearrangements - Balancers and attached X-chromosome in Drosophila. Cytogenetic effects of ionizing and nonionizing radiations

M.Sc., I SEMESTER
HC – 1.6 Laboratory Cytogenetics

Course Outcome:
After completing the course student will be able to

CO1 Understand the life cycle of Drosophila melanogaster, preparation of culture media, maintenance methods, morphology study, and mounting techniques.
CO2 Develop practical skills in working with Drosophila melanogaster mutants, preparing genital plates, and performing Chi-square analysis to understand inheritance patterns
CO3 Gain proficiency in cytogenetic techniques.
CO4 Develop observational skills and an appreciation for the ecological and evolutionary aspects of Drosophila biology.

4X16 =64 Hrs

1) Life cycle of *Drosophila melanogaster* 1x4=04hrs
2) Preparation of culture media. Culture of Drosophila - Methods of maintenance. 1x4=04hrs
3) Study of morphology of *Drosophila melanogaster* 1x4=04hrs
4) Mounting of Sex comb of *Drosophila melanogaster* 1x4=04hrs
5) Mounting of Wing of *Drosophila melanogaster* 1x4=04hrs
6) Study of mutants of *D. melanogaster* 1x4=04hrs
7) Preparation of genital plate of *D. melanogaster* 2x4=08hrs
8) Chi square Analysis of F1, F2 and Test cross progeny in *Drosophila melanogaster* to understand pattern of inheritance of different characters and to demonstrate. 3x4=12hrs
   a) Law of segregation
   b) Law of Independent assortment
   c) Sex-linked inheritance
9) Temporary squash preparation of Mitotic chromosomes from root tip meristem of *Allium cepa* 2x4=08hrs
10) Study of Barr body using buccal smear of volunteers 1x4=04hrs
11) Collection of Drosophila from the nature to study the diversity in a given habitat 1x4=04hrs
12) Study of different species of Drosophila 1X4=04hrs

REFERENCES:

1. Alberts, B., A. Jhonson, J. Lewis, M. Raff, K. Roberts and P. Walter 2008. Molecular Biology of the cell. V Ed. Garland Science, New York.
2. Brachet, J. 1985. Molecular Cytology, Academic Press, N. Y.
3. Furukawa, R., and M. Fechheimer. 1997. The structure, function and assembly of actin filament bundles. Int. Rev. Cytol. 175: 29-90.
4. Lewin B. (1997) Gene VI Oxford University Press, Oxford
5. Lodish, H., A. Berk, C.A Kaiser, M.P. Scott, A Bretscher, H. Ploegh, P. Matsudaira. 2008. Sixth Edition, Molecular Cell Biology. W. H. Freeman and Co., N. Y.
6. Pollard, T. D. and W. C. Earnshaw. 2002. Cell Biology. Saunders
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8. Snustad D.P and M.J.Simons. (1997) Principles of Genetics. John Wiley and Sons Inc. N.Y.
9. Strickberger M.W. (1977) Genetics. MacMillan Collier Co. Pvt Ltd
10. Watson J.D, Hopkins, N.H, Roberts J.A, Steitz and A.M.Weiner. (1987) Molecular biology of gene. The Benjamin Cummings Publishing Co Inc.
11. Wolfe, A. 1995. Chromatin: Structure and function. Academic Press, N. Y.

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M.Sc., I SEMESTER
SC – 1.7 Tools and Techniques of Biology

48 hrs

Course Outcome:

After completing the course student will be able to

CO1 Master the principles and applications of various microscopy techniques

CO2 Understand the principles and applications of centrifugation, electrophoresis, and chromatography.

CO3 Learn the use of radioisotopes in biological research, and understand techniques in immunodetection and immunological assays.

CO4 Understand the basic principles and applications of cell culture, cytological preparations, and molecular biology techniques.

UNIT I: MICROSCOPY: 12hrs

Basic principles of microscopy, Types of microscopes and their biological applications Bright-field microscope, numerical aperture, limit of resolution, types of objectives, ocular & stage micrometers, Electron Microscope, SEM, Confocal microscope.

Dark-field microscope

Phase-contrast microscope

Differential interference contrast microscope

Fluorescence microscope

Photomicrography and image processing

UNIT II: SEPARATION TECHNIQUES: 12hrs

Centrifugation - Basic principles, Types of rotors, Clinical, high speed & ultracentrifuge

Electrophoresis – Agarose and polyacrylamide gel, Two-dimensional, Isoelectrofocussing

Chromatography - Paper and Thin layer chromatography, Column chromatography, Gel filtration, Ion-exchange, Affinity, Introduction to FPLC and HPLC

UNIT III: 12hrs

A. Radio-tracer techniques

Unit of radioactivity and half life, Measurement of radioactivity (β and γ emission), Applications of radioisotopes, Safety measures

B. Techniques in immunodetection: Immunoblotting and immunofluorescence

C. Immunological techniques: Immunodiffusion and Imunoelectrophoresis

UNIT IV: **12hrs**

A. Cell culture techniques: Design and functioning of tissue culture laboratory; Culture media, essential components and preparation; Cell viability testing

B. Cytological techniques: Mitotic & Meiotic chromosome preparations from insects and vertebrates Chromosome banding techniques (G-, C-, Q-, R- banding etc.)

C. Molecular cytological techniques: In situ hybridization (radiolabelled & non-radiolabelled methods), FISH, and Restriction banding

D. Molecular biology techniques: Southern hybridization and Northern hybridization DNA sequencing Polymerase chain reaction (PCR)

TUTORIALS **2x16 = 32 Hrs**

REFERENCES

1. Alberts et al: Molecular Biology of the Cell, Garland, 2002
2. Karp: Cell and Molecular Biology, John Wiley & Sons, 2002
3. Lodish et al: Molecular Cell Biology, Freeman, 2000
4. Pollard & Earnshaw: Cell Biology, Saunders, 2002
5. Ruthman: Methods in Cell Research, Bell & Sons, 1970.
6. Boyer: Modern Experimental Biochemistry and Molecular biology (2nd Ed.), Benjamin/Cumin, 1993
7. Freifelder: Physical Biochemistry (2nd Ed.), Freeman, 1982
8. Holme and Peck: Analytical Biochemistry (3rd Ed.), Tata McGraw Hill, 1998
9. Plumer: An Introduction to Practical Biochemistry (3rd Ed.), Tata-McGraw Hill, 1990
10. Switzer and Garrity: Experimental Biochemistry 92nd Ed.), Freeman, 1999
11. Wilson and Walker: Practical Biochemistry (3rd Ed.), Cambridge Univ. Press, 2000

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M.Sc., I SEMESTER
SC – 1.8 Chronobiology

48 hrs

Course Outcome:

After completing the course student will be able to

CO1 understand the concept of Chronobiology

CO2 identify the way by which circadian rhythms affect life from the genome to the complex behaviour of the individual

CO3 acknowledge the role of Chronobiology and chronodisruption on several physiopathological events

CO4 acknowledge the input of the synchronizers on homeostasis

CO5 characterize the biological relevance of several chronotypes

UNIT I: Introduction: **4 hrs**

History, Biological rhythms, Biological clocks, Significance of biological timekeeping

UNIT II: Biological rhythms: **10 hrs**

A. Types of rhythms- Circadian, Circatidal,Circalunar, Circannual
B. Methods of measurement
C. Properties: Entrainment, Re-entrainment, Phase angle difference, Freerun, Phase shift, Phase response curve, Arrhythmia.

UNIT III: Factors influencing biological rhythms: **10 hrs**

A. Environmental: Photoperiod -Photoreception and photo-transduction;
The physiological clock and measurement of day length;

Role of photic and non-photic cues in seasonality,Other zeitgebers
Reversal of roles of principal and supplementary cues.

B. Evolution of photoperiodism: comparative studies; Circannual rhythms and seasonality.

UNIT III: Circadian pacemaker system: 8 hrs

A. Suprachiasmatic nuclei, B. Pineal gland, C. Optic lobes.

UNIT IV: Molecular basis of circadian rhythms 8 hrs

A. Clock genes, B. Drosophila, C. Mouse

UNIT V: Applied Chronobiology: 8 hrs

A. Human circadian rhythms: Melatonin: Input or output signal of the clock system, Clock function (dysfunction); Human health and diseases
B. Applications of circadian rhythm principles: Jet-lag/shift work, Depression and sleep disorders, Chronopharmacology and Chronotherapy

TUTORIALS 2X16=32 Hrs

References

1. Binkley, S. (1990): The clockwork sparrow: time, clocks, and calendars in biological organisms, Prentice-Hall, New Jersey.
2. Chandrashekaran, M. K. (1985): Biological rhythms, Madras Science Foundation, Chennai.
3. Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004: Chronobiology Biological Timekeeping, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA
4. Nelson, R. J. (2000) An Introduction to Behavioural Endocrinology, 2nd edition, Sunderland Publishers, Massachusetts.
5. Saunders D.S., C.G.H. Steel, X., afopoulou (ed.)R.D. Lewis. (3rd Ed) 2002: Insect Clocks, Barens and Noble Inc. New York, USA
6. Shapiro, C. M. and Heslegrave, R. J. (1996): Making the shift work, Joli Joco Publications, Inc. Toronto.
7. Vinod Kumar (ed 2002) : Biological Rhythms Narosa Publishing House, Delhi/ Springer-Verlag, Germany

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M.Sc., I SEMESTER
SC – 1.9 Histology and Histopathology

48 Hrs

Course Outcome:

After completing the course student will be able to

CO1 Grasp the objectives, applications, and methods of tissue fixation and staining.

CO2 Understand the histological organization and relate structure to function of key mammalian organs and tissues.

CO3 Understand the principles and classical histochemistry techniques for localizing glycoproteins, nucleic acids, and enzymes.

CO4 Understand the principles and techniques of immunohistochemistry and immunofluorescence.

CO5 Analyze morphological alterations in cells due to disease and understand the etiology, pathogenesis, and histopathology of common diseases like liver cirrhosis and atherosclerosis.

CO 6 Differentiate between malignant and non-malignant tumors, understand the histopathology of specific tumors in breast and prostate cancer.

UNIT – I Basics of Histology **8Hrs**

A. Objectives and applications
B. Tissue fixation : Objectives, methods, chemical fixatives-types and chemistry of fixation; Physical methods-:freezing and microwave fixation; choice of fixatives, fixation artifacts.
C. Dyes. –Natural and Synthetic, Classification

UNIT-II Functional Morphology (mammalian) **8 Hrs**

A. Histological organization of GI tract- stomach and intestine,
B. Histological organization of lungs & kidney
C. Histological organization of spleen & thymus,
D. Bone and bone marrow.

Unit-III Histochemistry **8 Hrs**

A. Principles and methods of application
B. Classical histochemical Techniques: for localization of glycoproteins (PAS), nucleic acids (Feulgen) and steroid dehydrogenase activity.

Unit-IV Immunohistochemistry **8 Hrs**

A. Principles, method of application
B. Immunohistochemistry techniques for localization of proteins in endocrine cells (Pituitary cell types or islet of Langherhans)
C. Immunofluorescence: In situ hybridization of nucleic acids

UNIT-V Histopathology **8 Hrs**

A. Morphological alterations in cells due to disease,
B. Types of degeneration: clouding, hyaline, hydrophic and fatty degeneration.
C. Etiology, pathogenesis and histopathology of liver cirrhosis and atherosclerosis
D. Neuropathology of alcoholism and methanol poisoning.

Unit-VI Histopathology of tumors **8 Hrs**

A. Malignant and non-malignant
B. Types of carcinoma
C. histopathology of breast and prostate tumors

TUTORIALS **2X16=32 Hrs**

REFERENCES:

1. Neelam vasudev
2. Sontakke
3. Harsh Mohan
4. Boyd,W. 1976:A text book of Pathology. Structure and function in disease, 4th edition. Lea and Fibiger, Philadephia.
5. Pearse, A.G.E. (1980): Histochemistry, theoretical and Applied ,J & A, Churchill Ltd., London.
6. Rogers, A.W.(1983): Cells and Tissues, An introduction to Histology and Cell Biology, Academic Press, NY.
7. Telford, I.R. and Bridgman,C.F.(1990). Introduction to Functional Histology, Harper and Row, NY.

M.Sc., II SEMESTER
HC – 2.1 Chordata

32 Hrs

Course Outcome:
After completing the course student will be able to

CO1 Understand the comparative anatomy and evolutionary adaptations of protochordates and vertebrates.
CO2 Understand the structure and functions of the integumentary system across chordates.
CO3 Understand the evolution and diversity of respiratory and circulatory systems in chordates.
CO4 Analyse the digestive and urinogenital systems of vertebrates and understand the anatomical diversity and physiological functions of these systems in different chordate classes.

UNIT I General characters and outline classification of Chordata 8hrs

A. General and Comparative study: Comparision of three Protochordates, Subphyla in terms of General comparision, Habits and habitats,
B. Alimentary canals and associated glands, Pharynx, Food and feeding and excretory system in Protochordates.
C. Adaptive radiation in vertebrates – fishes, amphibians, reptiles, aves and mammals

UNIT II 8hrs

A. **Integument and its Derivatives**: Epidermal Integument or Skin Functions, Structure & its Derivatives (Glands, Scales and scutes, digital cornifications, horns, feathers, hairs), Integument in different classes of Chordates.
B. **Nervous system**- Development of Brain, spinal cord, Peripheral nerves and sense organs

UNIT III 8hrs

A. **Respiratory System**: Introduction Respiratory organs: Gills (Internal or true gills, External or Larval gills). Lungs and Ducts, Accessory Respiratory organs and Swim Bladders.
B. **Circulatory system:** Evolution of heart and aortic arches

UNIT IV 8hrs

A. **Digestive System:** Introduction Embryonic Digestive Tract
Alimentary Canal: Divisions, Digestive Glands
B. **Urinogenital System:** Vertebrate kidneys and ducts, Gonads and their ducts

REFERENCES :

1. Alexander, R. M. 1975. The Chordata. Canbridge University Press, London.
2. Barrington, E.J.W. 1965. The Biology of Hemichordata and Protochordata, Oliver and Boyd, Edinbourgh.
3. Colbert, E. H, 1969. Evolution of the vertebrates, John Wiley and Sons, Inc., N.Y.
4. Kent, C. G. 1954. Comparative anatomy of vertebrates
5. Kingsley, J.S. 1962. Outlines of Comparative anatomy of vertebrates. Central book depot Allahabad.

M.Sc., II SEMESTER

HC – 2.2 Laboratory Chordata **4X16=64hrs**

Course Outcome:

After completing the course student will be able to

CO1 Acquire in depth knowledge on the diversity of chordates and their systematic position.

CO2 Understand the economic importance of some classes.

CO3 Understand the evolutionary importance of selected chordate groups.

CO4 Know the organization of various organ systems of chordates.

1. **Protochordates**
   Amphioxus , Herdmania, Salpa (sexual), Doliolum
2. **Fishes**
   Rhinobatus, Acipenser, Hippocampus Clarius, Anabus, Coffer fish, Periopthalamus, Tricanthus, Notopterus, Exocoetus, *Diodon hystrix, Echenies*
3. **Amphibians**
   Ichthyophis, Axolotl Larva, *Rana tigrina* , Amblystoma
4. **Reptiles**
   Calotes,Mabuya,Chameleon,Phrynosoma, *Chelone mydas*, Varanus , *Naja naja* ,Krait , Hydrophis ,Viper
5. **Birds**
   Blue jay , Indian koel -male and female ,Kite
6. **Mammals**
   Guinea pig ,Domestic cat ,Loris ,*Megaloderma lyra* (bat), Pangolin
7. **Integuments of vertebrates**
   Scales of fish, Hoofs, nails, horns, claws, plastron and carapace of tortoise, snout of saw fish
8. **Osteology**
   Study of Skull and lower jaw:- Frog, Pigeon, Cat, Dog, Crocodile, Horse
9. **Study of vertebrae-** Amphibia, Birds & Mammals
10. **Study of girdles**- Amphibia, Birds & Mammals
11. Study/Mounting of scales in Fishes
12. **Study of following systems in rat by using charts:** Circulatory system ,Nervous system , Reproductive system
13. **Study of following systems in rat by using charts:**Digestive system ,Sense organs ,Urinary system
14. Repetition

M.SC., II SEMESTER
HC – 2.3 Animal Physiology

32 Hrs

Course Outcome:
After completing the course student will be able to

CO1 Understand the molecular mechanisms of membrane transport, the principles of bioenergetics and comprehend the physiological aspects of circulation.
CO2 Understand muscle and neurophysiology, and comparative physiology of excretion.
CO3 Gain insights into the chemical nature of hormones, the human endocrine system, and the synthesis and physiological roles of hormones in homeostasis
CO4 Explore the structure, function, and hormone biosynthesis of major endocrine glands and understand their roles in metabolism.

UNIT I: Membrane Transport, Bioenergetics & Circulation 8 Hrs

A. Membrane Transport:

Molecular mechanisms of passive and active transport.

B. Bioenergetics:

a) Energy – Concept, laws of thermodynamics
b) Redox potential
c) Stepwise release of energy through cytochromes, production of ATP, uncoupling of oxidative phosphorylation,inhibitors.
d) Anaerobic and aerobic breakdown of glucose, alternate pathway – HMP shunt and glucoronic acid pathway.
e) Citric acid cycle as common metabolic pathway.

C. Circulation:

a) Major types of body fluids and their composition.
b) Neurogenic and myogenic hearts.
c) Mammalian heart – cardiac cycle, ECG.

UNIT II: Physiology of excitation & Excretion 8 Hrs

A. Muscle Physiology:

a) Molecular organization of sarcomere.
b) Mechanism of contraction with emphasis on sliding filament and Davies models, regeneration of storage phosphate.
c) Physiological adaptations of muscles for jumping, swimming and flight.

B. Neurophysiology:

a) Axonal and synaptic transmission of nerve impulses.
b) Synaptic integrity, synaptic plasticity.
c) Molecular mechanism of sensory transduction and neural output in receptor cells.

C. Excretion:

a) Comparative physiology of excretion in animals- Nitrogenous wastes and waste elimination.
b) Mammalian kidney- Structure and physiology of urine formation.

Unit III: Basic Concepts of Endocrinology 8 hrs

A. Chemical messengers:

Autocrine, Paracrine and endocrine secretions,
Types of hormones, an overview of human endocrine system

B. Hormone synthesis: Peptide and steroid hormones.

Role of Hormones in homeostasis- Glucose and Water balance

C. Hypothalamus and pituitary gland:

Structure, function and control of hypothalamic hormones.
Pituitary hormones and their physiological actions

chemical structure and. Feedback regulation. Pathophysiology.
Hyppothalamo - hypophysial portal system

D. Pineal gland–Structure and function**.**

Unit IV: 8 hrs

A. Thyroid gland: Structure, function and biosynthesis of thyroid hormone

B. Parathyroid : Structure and PTH – Calcitonin – Role of hormones in calcium and phosphate metabolism.

C. Adrenal gland hormones

Adrenal cortex hormones: Corticoids: role played in Stress management – Aldosterone and the rennin- angiotensin system

Adrenal medullary hormones: Catecholamines as emergency hormones

D. Gastrointestinal hormones: Secretion, control and function

E. Pancreatic Hormones: Insulin and glucagons, their role in the regulation of Carbohydrate, protein and lipid metabolisms.

M.SC., II SEMESTER

HC – 2.4 Laboratory Animal Physiology

4x16=64 Hrs

Course Outcome:

After completing the course student will be able to

CO1 Demonstrate proficiency in biochemical analysis techniques.
CO2 Develop practical skills in clinical sample analysis.
CO3 Gain competency in haematological techniques.
CO4 Deepen their knowledge of endocrinology and hormone function

1. Estimation of Proteins by Lowry *et al* method. (in tissue sample from slaughter house)
2. Determination of glucose content by Anthrone method. ((in tissue sample from slaughter house)
3. Estimation of liver and skeletal muscle glycogen. (in tissue sample from slaughter house)
4. Determination of serum/ blood urea by DAMO method. (Clinical sample)
5. Estimation of creatinine in the urine sample.
6. Total count of RBC and WBC.
7. Differential count of WBC
8. Study of haematin crystals using blood sample.
9. Response of RBC's to Hypertonic, hypotonic and isotonic solutions
10. Observation of permanent slides of T.S of endocrine glands
    a. Pituitary gland b. Thyroid gland c. Adrenal gland d. Pancreas
11. Identification of chemical structures of steroid hormones

REFERENCES:

1. Adler N. T (1981) Neurcendocrinology of Reproduction, Physiology and Behaviour.Austin, C. R and R. V. Short (eds) (1972) Reproduction in mammals. (1) Germ cells andFertilization (2) Embryonic and Foetal development (3) Hormones in Reproduction (4) Reproduction pattern (5) Artificial control of reproduction, Cambridge University press,London.
2. Barrington, E. J. W (1976) An introduction to general and comparative endocrinology,Oxford University press, London
3. Eckert, R and Randall, D. 2002, Animal physiology, 2nd Edn, W.H..Freman
4. Guyton. A.G. 1986, Text book of Medical Physiology, 7th Edn., Saunders Publication

M.Sc., II SEMESTER
HC – 2.5 Entomology

32hrs

Course Outcome:
After completing the course student will be able to

CO1	Understand the classification of Insecta, along with the fundamentals of insect endocrinology.
CO2	Understand the impact of insects on agriculture and master the identification, life cycles, and control methods for major pests.
CO3	Gain knowledge on the structure, life history, and control measures of general pests.
CO4	Understand the role of insects as vectors of human diseases and learn strategies for their control.

Unit I: General Entomology **10 hrs**

A. Classification of class Insecta up to orders with suitable examples; Integument appendages.

B. Insect Endocrinology

I. Insect Hormones and their regulation**:** Chemistry and functions of hormones, Hormones in metamorphosis, Ecdysis and Diapause

II. Semiochemicals:**:** Allelochemicals and Pheromones (Primer & releaser)

Unit II: Agricultural Entomology **10hrs**

A. Role of insects in plant pollination

B. Insects pests: Classification and categories of pests, origin and emergence of pests, pest out breaks and pest resurgence
Structure, life history, significance, nature of damage and control methods of major pests of sugarcane, Paddy and Coconut.

C. Structure, life history, significance, nature of damage and control measures of stored grain pests: (a) *Sitophilus* (b) *Trogoderma* (c) *Rhizopertha* (d) *Tribolium* (e) *Bruchus* (f) *Sitotruga* (g) *Ephestia*

Unit III: General and household insect pests **06hrs**

A. Structure, life history, significance, nature of damage and control measures of following general pests: (a) grasshoppers & locusts (c) termites (d) aphids (e) hairy caterpillars

B. Household pests: Cockroaches, Ants, Wasps, Silverfish, furniture beetle, and their control

Unit IV: Medical Entomology **06hrs**

A. Insect vectors: Role of insect as vectors of human diseases (Malaria, filariasis, Kala azar and their control)
Mosquitoes as pests and their control.
Housefly: A human health hazard and its control

B. Arboviral diseases: Dengue, chicken gunya, swine flu.

M.Sc., II SEMESTER
HC – 2.6 Laboratory Entomology

Course Outcome:
After completing the course student will be able to

CO1 Understand systematic study of insect classification up to the order level.
CO2 Develop practical skills in insect preservation techniques and documentation methods.
CO3 Enhance their understanding of insect diversity, ecology, and importance in different ecosystems.
CO3 Explain the adaptations and morphological variations in antenna, wings and mouth parts.

4x16=64 Hrs

1. Systematic study of classification of insects upto order level
2. Study of insect preservation techniques such as flag labeling, drying, wholemount preparation etc
3. Study of few insects under different orders
4. Study of pests of different categories – agricultural pests, stored grain pests, house hold pests, etc
5. Study of some insect vectors Ex – mosquito, housefly, cockroach
6. Demonstration of Fixing and preservation of dead insects by plastination technique
7. Collection and preservation of dead insects for systematic studies available in and around college campus & field report
8. Study of diversity of ants species in the college campus
9. Study of diversity of butterfly species in the college campus
10. Study of different types of mouth parts in insects
11. Study of different types of antenna in insects
12. Study of different types of wing in insects

REFERENCES:

1. Awasti V.B. 2009 Introduction to general entomology 3rd Ed. Scientific publication (India), Jodhpur
2. Awasti V.B.2007, Agricultural Insect Pests and their control. Scientific publishers (India) Jodhpur
3. Trigunayat M.M. 2009, A Mannual of practical entomology, scientific publishers, Jodhpur, India.
4. Dhaliwal G.S. Ramsingh and B.S. Chillar 2006, Essentials of Agricultural entomology. Kalyani Publishers, New Delhi.
5. L . K Jha. Applied Agricultural Entomology. New central book agency. Culcutta

M.Sc., II- SEMESTER
SC – 2.7 DEVELOPMENTAL BIOLOGY

48 Hrs

Course Outcome:

After completing the course student will be able to

CO1 Understand the structural and functional aspects of gametes, and the molecular events during fertilization.

CO2 Explore nucleocytoplasmic interactions, cleavage, and gastrulation, including morphogenetic movements and regulatory mechanisms.

CO3 Learn about morphogenetic determinants and the establishment of the embryonic body plan.

CO4 Understand early embryogenesis in Drosophila.

CO5 Understand the role of cell adhesion molecules in morphogenesis, genetics of imaginal discs, and limb development.

CO6 Understand the endocrine and molecular control of metamorphosis, types of growth, regeneration mechanisms, and the impact of teratogenesis on development.

Unit I:

A) Introduction : Descriptive V/s. Experimental Embryology **8hrs**

B) Fertilization : a) An overview of structure and differentiation of egg and sperm
b) General sequence and molecular events during fertilization

Unit II: Early development - I **8 hrs**

a) Nucleocytoplasmic interactions in early development: An overview of Nuclear transplantation experiments in Amphibians and mammals
b) Creations of multicellularity: Cleavage-Regulatory mechanism
c) Gastrulation: Morphogenetic movements and regulatory mechanisms in amphibian and mammalian embryo.

Unit III: Early development - II **8hrs**

a) Morphogenetic determinants and their role in development:
Yellow cytoplasm in Ascidians, Polar body in Mollusca, Pole plasm in *Drosophila*

b) Laying down the embryonic body plan :
Determination of embryonic axes in *Drosophila* – Anterior-posterior (maternal effect genes) & Dorsoventral; Amphibians (cell-cell interaction) & Mammals (Hox Genes)

c) Cell lineage studies and cell death genes in *Caenorhabditis elegans*.

Unit IV: Morphogenesis –I **8 hrs**

a) Early embryogenesis in Drosophila : Regional specification by. Segmentation genes: Gap genes, Pair rule genes, Segment polarity genes, and Homeotic genes.
b) Cellular differentiation and morphogenesis:
i. Neuronal v/s epidermal fate specification in *Drosophila*.
ii. Vulval inducation in Caenorhabditis elegans.

Unit V: Morphogenesis-II **8 hrs**

a) Role of Cell Adhesion molecules in morphongenesis : Cadherins and Fibronectins

b) Genetics of imaginal discs and transdetermination

c) Limb development-an over view :
i. Proximo-distal axis specification in developing limb.
ii. Cell death and formation of digits.

Unit VI: Post embryonic development **8 hrs**

a) Metamorphosis : Endocrine and molecular control of metamorphosis in insects and amphibians b) Types of growth c) Regeneration : Types, Blastema formation,Sources of cells for regeneration d) Abnormal development as seen in Teratogenesis.

Tutorials 16hrs

REFERENCES:

1. Balinsky, B.I., 1965. An introduction to embryology, W.B.Saunders company.
2. Gilbert, S. F. 2006, Developmental Biology, 8th Ed.Sinauer Associates Inc.,
3. Kalthoff, 2000, Analysis of Biological Development, 2nd Ed., McGraw-Hill Science, New Delhi, INDIA. Massachusetts, USA.
4. Vasudeva Rao, 1994. Developmental Biology: A modern synthesis, Oxford & IBH, New Delhi.
5. Wolpert, Beddington, Brockes, Jessell, Lawrence,Meyerowitz, (3rd Ed., 2006)Principles of Development, , Oxford University Press, New Delhi, INDIA.
6. Wolpert, L, Beddington, R Jessell, T. Lawrence P, Meyerowitz, E, Smith J., 2001, Principles of Deveopment Oxford University Press Oxford.
7. Ann Kiessling and Scott C. Anderson, Human Embryonic Stem Cells: An Introduction to the Science and Therapeutic Potential, 2003. Jones and Bartlett Publishers, Boston MA, USA

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M.Sc., II SEMESTER
SC – 2.8 Immunology

48hrs

Course Outcome:

After completing the course student will be able to

CO1 Comprehend the types and components of innate and acquired immunity.

CO2 Explain about antigens, the structure and functions of immunoglobulins, and antigen-antibody reactions.

CO3 Explore both humoral and cell-mediated immune responses, the role of cytokines and the complement system.

CO4 Master a range of immunotechniques such as agglutination, precipitation, immunofluorescence, ELISA, and western blotting.

CO5 Understand about HLA complexes, mechanisms of transplant rejection, and hypersensitivity.

CO6 Grasp the types of vaccines, vaccine delivery systems, and the management of congenital and acquired immunodeficiencies.

Unit I: Introduction to immunity **8hrs**

A. History; types of immunity – Innate and acquired immunity.
B. Cells and Organs of immune system: Cells: Lymphocytes (T & B cells), monocytes, macrophage; eosinophills, basophills, neutrophils and mast cells.
C. Primary and secondary lymphoid organs: Bone marrow, Thymus, Spleen, Lymph nodes

Unit II: Antigens and Immunoglobulins **8hrs**

A. Antigens: factors influencing immunogenicity, adjuvant, epitope, hapten
B. Immunoglobulins: Basic structure of the immunoglobulin;
   Types and functions of immunoglobulins.
C. Monoclonal antibodies:Antigen-antibody reactions

Unit III: Immune response **8hrs**

A. Humoral and cell mediated immune responses

B. Primary and secondary immune modulation; Cytokines; role of complement system in immune response (Classical pathway, Alternate pathway);
C. Immune response against bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections;

Unit IV Immunotechniques **8hrs**

A. Agglutination; Precipitation;
B. Immunofluorescence; RIA, ELISA, Immuno-electrophoresis and Western blotting.

Unit V Major histocompatibility complex and Hypersensitivity **8hrs**

A. Transplantation and graft rejection,
B. Genetic organization of H2 and HLA complexes, HLA typing;
C. Immediate and delayed hypersensitivity.

Unit VI Vaccines and Vaccination **8hrs**

A. Types of Vaccines and their significance
B. Vaccine delivery systems.
C. Congenital and acquired immunodeficiencies

TUTORIALS **16Hrs**

References:

1. Austyn, J.M. and Kathym, J. Wood. 1993. Principles of cellular and molecular Immunology. Oxford University Press. Oxford.
2. Benjamin, Elisunshine, Geoffrey Leskowitz.1996. Immunology: A short course. 3rd Edition. New York.
3. Kubey, J.M. 1990. Essential Immunology. 6th Edition. Blackwell Scientific Publication, New York.
4. Rao, C.V. 2002. An introduction to Immunology. Narona Publishing House, New Delhi.
5. Rotti, I. 1994. Essential Immunology. Blackwell, London.
6. Stibes, D.P. and Terr, A.I. 1991. Basic and Clinical Immunology. 7th Edition. Appleton and Large. California.

M.Sc., II SEMESTER
SC – 2.9 Evolutionary biology

48 Hrs

Course Outcome:
After completing the course student will be able to

CO1 Understand that many of the organisms that inhabit the Earth today are different from those that inhabited it in the past
CO2 Understand that the propositions underlying Darwin's theory of evolution.
CO3 Explain adaptation, providing examples from several different fields of biology
CO4 Explain how the molecular record provides evidence for evolution
CO5 Understand the Human origin and evolution.

UNIT I Emergence of concept of evolution: **8 Hrs**

A. Pre Darwinian concepts, Darwinism and its impact in the development of synthetic theory.
B. Neodarwinism: Birth of population genetics, Components of population genetics, Mendelian population, gene pool, allele frequencies and genotype frequencies,

UNIT II Speciation: **8 Hrs**

A. Concept of species,
B. Types of species

C. Models of speciation,
D. Patterns and mechanisms of reproductive isolation,
E. Hybridization, polyploidy and speciation.

UNIT III Molecular evolution **8 Hrs**

A. Phyletic gradualism and punctuated equilibrium.
B. Micro and macroevolution.
C. Molecular evolution: Selectionists theory of evolution, Neutral theory of evolution and Molecular clock and emergence of non-darwinism,

UNIT IV Phylogeny **8 Hrs**

A. Phylogenetic trees : Construction with nucleic acid and amino acid sequences,
B. Types of trees and Techniques employed in construction of phylogenetic trees,
C. Molecular phylogenetics of Homo sapiens.

UNIT V Population genetics and Evolution **8 Hrs**

A. Gene pool, gene frequency, Hardy-Weinberg Law.
B. Destabilizing forces of evolutionary equilibrium (Mutation, Migration, Selection, Meiotic drive and genetic drift).
C. Founder effect, Isolating mechanisms and speciation.
D. Micro Macro and Mega evolution, Co-evolution.

UNIT VI Genome and Evolution **8 Hrs**

A. Genes and gene clusters
B. Origin of new genes by gene duplication (Ohno's concept)
C. Selfish DNA
D. Karyotypic evolution (Drosophila).

TUTORIALS **2X16=32Hrs**

REFERENCES:

1. Dobzhansky Th, (1951) Genetics and origin of species, 3rd Edn. Chapman and Hall, London.
2. Dobzhansky Th, Ayala F.J, Stebbins G.L and J.M. Valentine, (1976) Evolution, Surjeet Publication, New Delhi.
3. Futuyama D.J (1986) Evolutionary Biology, Sinuauer Associates Inc. USA
4. Hartl D.L (2000) A primer of population genetics, Sinuauer Associates Inc. USA
5. Jha A.P (1992) Genes and Evolution - John Wiley Publicaion, New Delhi
6. King M (1993) Species evolution - The role of chromosomal change. The Cambridge University Press, Cambridge

M.Sc., III SEMESTER
HC – 3.1 Molecular Biology and Biotechnology

32 hrs

Course Outcome:
After completing the course student will be able to

CO1 Understand the molecular events and mechanisms of DNA replication
CO2 Explore gene regulation mechanisms in prokaryotes and eukaryotes
CO3 Examine the procedural details and fundamental concepts of genetic engineering
CO4 Gain insights into the applications of biotechnology in genetic engineering, medicine and human health

Part A: Molecular Biology

Unit I Introduction to nucleic acids **8hrs**

A. DNA Replication: i) Enzyme components of replication unit ii) Mechanism with emphasis on Dna A in initiation, Co-ordinated synthesis, End replication in eukaryotes iii) Fidelity.
B. Transcription: i) Transcription apparatus and process (RNA polymerase, cisregulatory elements, terminators, transcription factors). ii) Post transcriptional modifications of mRNA in eukaryotes (G-cap, Poly tail, Splicing).
C. Translation: i) Genetic code (major features, usage of different codons). ii) Enzymes, factors and the process (Aminoacyl t-RNA synthatase, Peptidyl transferase, IFs, EFs, RFs and Ribosome)

Unit II Gene regulation 8hrs

A. Gene regulation in Prokaryotes: (i) Regulation at transcription initiation: Eg. lac operon (+ve and -ve control) (ii) Regulation beyond transcription initiation: trp attenuator (iii) Regulation in Lambda Phage - Lytic and lysogenic cycle induction.
B. Gene regulation in Eukaryotes: (a) Transcriptional activators (b) Transcriptional repression: (i) direct repression, indirect repression (ii) Gene silencing by modification of histones and DNA (c) RNA interference
C. Molecular basis of homologous recombination: Models and protein machinery
D. Molecular mechanisms of DNA damage repair**.**

Part B: Biotechnology

Unit III: 8 hrs

A. **Genetic engineering:**
Definition, objectives and outline of recombinant DNA technology procedure.
Enzymes**:** Restriction Enzymes; DNA ligase, Klenow enzyme,
T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase.
Cloning vectors: Plasmids, Phages, Cosmids, Phagemids, Artificial chromosomes (YAC, BAC, HAC),

B. **Cloning:**
Construction of Genomic and cDNA libraries.
Identification of Recombinants: Genetic selection, Use of chromogenic substrates, Insertional inactivation.
Analysis of recombinant DNA clones: Characterization of clones, Restriction mapping, Southern hybridization.
Polymerase chain reaction and DNA sequencing-Maxam and Gilbert's method, Sanger's method, Automated DNA sequencing

Unit IV: 8 hrs

C. **Applications of Biotechnology:**
Production of medicinally important products – vaccines, Gene therapy, AIDS therapy, Biofertilizers, biopesticides, medicine and human health

D. **Animal Biotechnology**
Animal cell and Tissue culture: Principles of cell culture, cell and tissue types, cell lines, transformation.
Cell and tissue culture media: Natural and defined, role and components of serum in culture.
Applications of tissue culture: Tissue culture in biomedical research karyological studies, amniocentesis, mutagenesis, Cytotoxicity assays.

M.Sc., III SEMESTER

HC – 3.2 Laboratory Molecular Biology and Developmental Biology

Course Outcome:

After completing the course student will be able to

CO1 Demonstrate proficiency in DNA extraction and estimation techniques.

CO2 Develop practical expertise in nucleic acid localization and visualization techniques.

CO3 Understand embryonic development processes and gain practical experience in studying imaginal disc formation and embryo mounting techniques.

CO4 Enhance their skills in Polytene chromosome preparation.

PRACTICALS **4x16=64 Hrs**

1. Extraction of DNA by rapid method. 1X4=04hrs
2. Extraction of DNA by standard method. 1X4=04hrs
3. Estimation of DNA concentration by Diphenylamine method. 1X4=04hrs
4. Localization of DNA in prefixed paramecium slides by Feulgen staining 2X4=08hrs
5. Localization of nucleic acids in prefixed paramecium slides by Toluidine blue staining 2X4=08hrs
6. Study of internal changes during early development of frog & chick (permanent slides) 2X4=08hrs
7. Development of chick-Embryo mounting-permanent preparation 1X4=04hrs
8. Study of early developmental stages of *Drosophila* (Live Observation of embryo) and dechorionation and observation of embryos 1X4=04hrs
9. Study of Imaginal discs – the precursors of adult structures in *Drosophila* 2X4=08hrs
10. Demonstration of window technique to observe chick embryo development 1X4=04hrs
11. Temporary squash preparation of salivary glands for polytene chromosomes from 3rd instar larvae of *D.melanogaster* 2X4=08hrs

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1. Griffiths A J F, H. J. Muller, D. T. Suzuki, R. C. Lewontin and W. M. Gelbart 2000. An introduction to genetic analysis. W. H. Greeman. New York.
2. Lewin, B 2003 Genes VIII. Oxford University Press. Oxford
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4. Das, H.K. 2007. Text book of Biotechnology.Wiley India Pvt. Ltd. New Delhi
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6. Pandian, T.T. and Kandavel, D.2008. Text Book of Biotechnology. I.K International Publishing House, New Delhi. 47
7. Primrose, S.B., Twyman, R.M., and Old, R.W. 2001. Principle of Gene Manipulation (6th edn). Blackwell Science Ltd, London
8. Singh .B.D. 2006. Biotechnology. Kalyani Publishers, New Delhi
9. Sobti, R. C. and Pachauri, Suparna S. 2009. Essentials of Biotechnology. Ane Books Pvt. Ltd. New Delhi

M.Sc., III SEMESTER
HC – 3.3 Reproductive Biology

32 hrs

Course Outcome:
After completing the course student will be able to

CO1 Understand the functional morphology of the male reproductive system
CO2 Understand the origin and migration of primordial germ cells, as well as the genetic and hormonal control of the differentiation of gonads and gonadal ducts in mammals.
CO3 Compare estrous and menstrual cycles, understanding reproductive strategies in mammals
CO4 Evaluate fertility control, understand contraceptive principles, and examine assisted reproduction techniques
CO5 Describe the principles of assisted reproductive technologies.

UNIT I: Male reproduction: 8 hrs

A. Functional morphology of male reproductive system
B. Kinetics of spermatogenesis – wave and cycle
C. Hormonal control of mammalian testis and spermatogenesis
D. Ultrastructure of spermatozoa
E. Abnormalities of sperm
F. Brief description of histomorphology and hormonal control of male accessory organs viz., epididymis, vas deferens, seminal vesicles, ventral prostate, bulbourethral gland and preputial gland
G. Sperm maturation – morphological and biochemical events, influence of accessory organ secretions
H. Biochemistry of semen and capacitation

UNIT – II Female reproduction : 8 hrs

A. Origin and migration of primordial germ cells; genetic and hormonal control of differentiation of gonads and gonadal ducts in mammals.
B. Female Reproductive System-Functional morphology of mammalian ovary, Fallopian tube and uterus.
C. Ovarian steroid hormones and their actions

UNIT III: Reproductive cycles in Mammals: 8 hrs

A. Comparison of estrous and menstrual cycles
B. Menstrual cycle : Different phases, changes in the ovary and uterus and hormonal control
C. Implantation – Process, Types and hormonal control
D. Pregnancy – length of gestation, hormonal control
E. Parturition – Process of birth and influence of hormones
F. Lactation – Hormonal control of mammary gland, development and lactogenesis

UNIT – IV: Fertility and reproductive management 8 hrs

A. Fertility control – Need, principles of different male and female temporary and permanent contraceptive methods.
B. Assisted Reproduction: Causes of infertility, Artificial insemination, different methods of assisted reproduction (*In-vitro* Fertilization, Gamete Intra Fallopian tube Transfer, Zygote Intra Fallopian tube Transfer).

M.Sc., III SEMESTER
HC – 3.4 Laboratory Reproductive Biology

32 hrs

Course Outcome:
After completing the course student will be able to

CO1 Describe the different types of reproductive cycles.
CO2 Understand the principle of tissue fixation and staining.
CO3 Know the principle of the contraceptives and its advantages.
CO4 Analyse the difference in histoarchitechture of reproductive organs.

16X4=64 hrs

1. Demonstration of estrous cycle using vaginal smear cells and staining
2. Demonstration of tissue fixation, sectioning and staining methods
3. Study of different contraceptive devices
4. Demonstration of surgical technique by video clipping
5. Counting of spermatozoa in semen sample collected from volunteers
6. Staining of spermatozoa for abnormalities in semen samples collected from volunteers/clinical samples
7. Observation of permanent Histology slides
   a. Comparative morphology of ovary
   b. Comparative morphology of testis
   c. Comparative study of male accessory organs
   d. Comparative study of female accessory organs
8. Observation of permanent slides of T.S of endocrine glands a. Thyroid gland b. Adrenal gland c. Pancreas
9. Study of principle and usage of pregnancy detection kit available in pharmacy
10. Study of histometry measurements of different tissues

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M.Sc., III SEMESTER
HC – 3.5 Ecology and Wildlife Biology

32 hrs

Course Outcome:

After completing the course student will be able to

CO1 Understand the fundamentals of ecosystems and ecological concepts such as habitat, niche, ecotones, and ecological pyramids.

CO2 Understand the various attributes of population ecology, measure species measurement, and factors influencing species diversity.

CO3 Gain insights into the bioecology of freshwater zooplankton and microbial ecology, understanding their types, adaptations, ecological importance.

CO4 Recognize the scope and values of wildlife and also understand causes of wildlife depletion and conservation strategies.

Part-A Ecology

UNIT - I **8 hrs**

A. Ecosystem: Historical account, Scope, Basic concepts and Approaches to the study of Environmental Biology. Components of Environment - An overview of abiotic factors and Biotic factors. Concepts of habitat and Ecological niche. Ecotone and Edge effect. Food chains, Food-webs and their structure in Ecological Pyramids in aquatic, terrestrial and parasitic Environments.

B. Population Ecology: Introduction. An overview of important population attributes – Density, Natality, Growth rates, Growth forms and concept of carrying capacity, Patterns in human population growth and its explosion -Remedial measures. Mortality - life tables and survivorship curve, sex ratio, age distribution, dispersal and dispersion, aggregation and Allee's principle, population fluctuation and cyclic oscillations and Population interactions.

UNIT - II **8 hrs**

A. Community Ecology Concept of community - community structure and attributes, concept of climax Species diversity in community and it's measurement- Alpha diversity- Simpson's diversity index, Shannon index, Fisher's alpha, rarefaction. Beta diversity- Sorensen's similarity index, Whittaker's index, Evenness, Gamma diversity. Drivers of species diversity loss and conservation.

B. Bioecology of Freshwater Zooplankton: Definition, Types and adaptations of Zooplankton. Brief study of organizations, life cycles and Ecological importance of Rotifers, Cladocerans, Copepods-Calanoids, Harpacticoids and Cyclopoids, and Ostracods. Mass culturing of Zooplankton.

C. Microbial Ecology: Ecological role, beneficial and pathogenic Microorganisms. Indicator Microorganisms. Role of microorganisms in biodegrading and bioremediation of organic and metal pollution.

Part B Wildlife Biology

UNIT – III **8hrs**

A. Scope and values of wildlife (Ecological, Aesthetic, Scientific, Recreational, Medicinal)

B. Causes of wildlife depletion: Degradation and destruction of natural habitats, Exploitation for commercial purposes, Deforestation, Agricultural expansion, Urbanization and Industrialization, forest fires and hunting.

C. Wildlife corridors, Human-wildlife conflicts

D. Wildlife awareness and education, Wildlife and tribal welfare

UNIT – IV

A. Conservation strategies: Red data book, protected area network, Role of NGOs in conservation.

B. Wildlife act and legislation: Wildlife Protection Act 1972; Biological Diversity Act 2002.

C. Wildlife conservation projects in India (with special reference to Project Tiger,

Project Hungul and Gir Project)

D. In-situ conservation: Bioreserves, National parks, Wildlife sanctuaries and Safari's in India

E. Management of Bioreserves, National parks, Wildlife sanctuaries and Safari.

F. Ex-situ conservation: Zoo garden, Management of Zoos, Captive breeding, Artificial insemination, Cryopreservation (techniques and applications) Germplasm banks,

M.Sc., III SEMESTER

HC – 3.6 Laboratory Ecology and Wildlife Biology

4X16=64 Hrs

CO1	Demonstrate expertise in freshwater plankton identification and diversity assessment.
CO2	Apply physico- chemical analysis Techniques for Water quality assessment.
CO3	Evaluate Dissolved oxygen, free carbon di-oxide, BOD and their interrelationships.
CO4	Utilize Diversity Indices to assess ecosystem health.

1. Qualitative study of freshwater zooplanktons.
2. Determination of species diversity by different types of diversity indices
3. Field visit to Sewage pond, Natural lake (and if possible river): Collection of water samples and study of physico-chemical parameters such as colour, pH, temperature, conductivity, total solids and turbidity
4. Estimation of Dissolved Oxygen in three natural (sewage, pond and Tap) water samples.
5. Estimation of free Carbon di-Oxide in three natural (sewage, pond and Tap) water samples.
6. To study the relationship between Dissolved Oxygen and free Carbon di-Oxide, if any, in three natural (sewage, pond and Tap) water samples.
7. Determination of BOD in three natural (sewage, pond and Tap) water samples
8. Determination of COD in three natural (sewage, pond and Tap) water samples
9. To study the relationship between BOD and COD, if any, in three natural (sewage, pond and Tap) water samples
10. Visit to RMNH, Mysore, to study models of freshwater, marine, estuarine and terrestrial habitats.
11. Visit to nearby Zoological garden, wildlife sanctuaries, Animal rehabilitation centres.

REFERENCES

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M.Sc., III SEMESTER
SC 3.7 Ethology

48 Hrs

Course Outcome:

After completing the course student will be able to

CO1 Differentiate between descriptive and experimental approaches in ethology, exploring reflexes, complex behavior, and instinctive behavior.

CO2 Understand the causes of behavioral changes during development, the development of bird song, and various aspects of learning

CO3 Understand anti-predator behavior, including strategies such as Mullarian mimicry, warning coloration, and Batesian mimicry.

CO4 Understand various forms of signals and communication like visual, auditory, tactile and chemical communication in ethology.

CO5 Comprehend the hormonal influence on sexual behavior in insects and mammals.

CO6 Understand the Social behaviour and organization in insects and subhuman primates.

UNIT - I **8 Hrs**

A. Descriptive versus experimental approaches

B. Reflexes and complex behaviour- Latency, after discharge, summation, warm up, fatigue inhibition and feedback control

C. Instinctive Behaviour - Fixed action pattern, Types of sign stimuli and releasers as triggers, Genetic basis of instinctive behaviour.

UNIT- II **8 Hrs**

A. Development and behaviour- Causes of behavioral changes during development, development of bird song.

B. Learning- Classical conditioning experiment, latent and insight learning. Social learning, learning sets and play.

C. Importance of early experience – Critical period- Filial imprinting, Sexual imprinting in birds, Imprinting like process in mammals.

UNIT- III Foraging and anti-predator behaviour **8 Hrs**

i. Anti predator behaviour – avoiding detection through colour and Markings (Mullarian mimicry)
ii. Warning coloration
iii. Batesian mimicry

UNIT-IV Biological communication **8 Hrs**

i. Forms of signals,
ii. Visual communication with suitable examples,
iii. Auditory Communication
iv. Tactile and Chemical communication

UNIT -V Sexual Behaviour **8 Hrs**

i. Hormones and sexual behaviour – Selected examples of courtship and mating behaviour.
ii. Pheromones in Insects and Mammals

iii. Lee Boot, Whitten, Bruce, Collidge and Castro-Vandenberg effect/s
iv. Selected examples of courtship and mating behaviour

UNIT-VI Social Behaviour **8 Hrs**

i. Introduction
ii. Advantages of grouping
iii. Social organization in insects with special reference to ants and honeybees
iv. Social organization in sub human primates
v. Altruism, Kin selection and Genetic control of behaviour

TUTORIALS – On the basis of the proposed chapters. **16Hrs.**

REFERENCES

1) Goodenough J.E., Mc Guire B. and Wallace R. A. (1993) Perspectives on Animal Behaviour. John Wiley and sons, New York.
2) Tinbergen (2006) Social ehaviour in Animals. J.V. Publishing House Jodhpur India.
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M.Sc., III SEMESTER
SC – 3.8 Pollution and Toxicology

48hrs

Course Outcome:

After completing the course student will be able to

CO1 Broader understanding of how science and the scientific method work to address environmental problems

CO2 Earth's major systems (ecosystems and biogeochemical cycles), how they function and how they are affected by human activity (population growth, air, water and soil pollution, ozone depletion, global warming, and solid waste disposal)

CO3 the interaction of human society (urban sprawl, energy use/generation, resource consumption and economics) with the Earth's systems

Part A - Pollution 24 hrs

Unit I: **8 hrs**

A. Concept of Biosphere: Its components, hydrosphere, atmosphere, and lithosphere, Origin of life in the biosphere.

B. Water pollution: Definition, sources Types and classification of pollutants. Effects of Water Pollution, River Pollution, Oxygen sag curves and Eutrophication Drinking water: Collection, purification and distribution. Wastewater treatment: Primary, secondary and tertiary treatment.

Unit II: **8 hrs**

A. Atmospheric pollution: Primary and secondary air pollutants. Biological effects of Nox, SOx, SPM, Hydrocarbons, Acid rain, Global warming, Photochemical smog and Ozone hole.

B. Solid waste and Biomedical waste: Sources, collection, transport, treatment and Disposal methods.. Noise Pollution: Sources, Biological effects, Control measures and OSHA standards.

UnitIII: **8hrs**

A. Radiation & Thermal pollution: Sources, types, effects, Atmospheric fallout and abatement.

B. Environmental Impact Assessment: Basic elements, Methods Guideline for industrial EIA, Aquaculture related EIA, Transport related EIA and Water related EIA. Case studies:

Konkan Railway, Silent valley, Bhopal Tragedy and Love canal tragedy, Mangalore Bojpe tragedy

Part B – Toxicology 24 hrs

Unit IV: 8hrs

A. General Principles of Toxicology: Introduction, Definition of toxicology Importance of Dose and Dose-response, factors influencing toxicity, Bioassay-toxicity evaluation studies using fish as model.

B. Toxic compounds: Heavy metals-Lead and mercury, Hydrocarbons- Aromatic and Aliphatic, and cyanides, and toxic gases - Bhopal tragedy.

Unit V: 8hrs

A. Biotransformation: Bioactivation, Biodetoxification of organo phosphates and organo chorines in the bodies of animals.

B. Natural toxins, Venoms and poisons: Properties and their effects, Major Sites and mechanism of action, Toxins in lower and higher organisms, Toxin and Venom therapy.

Unit VI: 8hrs

A. Smoking aids: Active and Passive smoking, Consumption of tobacco, Mariguana(Ganja), their effects and Prevention measures.

B. Cosmetics: Types of cosmetics, Chemical Characteristics, Applications, Exposure and risk assessment, Cosmetic safety regulations.

C. Risk assessment: Exposure assessment, Dose-Dosage, Risk characterization, Risk analysis and communications, Occupational health and illness.

TUTORIALS – On the basis of the proposed chapters 16 Hrs

REFERENCES:

1. Nandini, .N. Sunitha N. and T. Sucharita 2010. Environmental Studies, Sapna Book House Bangalore
2. Frant C.L.V. 1991, Basic Toxicology II (Eds.), Hemisphere publishing corporation, Washington, London
3. Sambasiva Rao K.R.S. 1999. Pesticide impact on fish metabolism. (Eds.) Discovery Publishing House, New Delhi.
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M.Sc., III SEMESTER:
Open elective - Concepts of Zoology

48 Hrs

Course Outcome:

After completing the course student will be able to

CO1 Understand and list various branches of Zoology and their significance.
CO2 Understand Carl Linnaeus's taxonomic hierarchy and binomial nomenclature.
CO3 Understand structural and functional diversity in animal cells and tissues, cell division types and significance.
CO4 Comprehend the various organ systems and accessory organs in Humans.
CO5 Comprehend abiotic and biotic factors, and gain a brief overview of environmental pollution.
CO6 Understand Mendel's laws of genetics, structure of chromosomes, and gain insights into DNA and RNA.

1. Introduction: **8 Hrs**

a) Branches of animal science: Taxonomy, Animal Physiology, Genetics, Developmental Biology, Evolution, Ethology, Ecology, Applied Zoology, Entomology, Histology, c) Indian Wildlife- Status, Causes of wildlife depletion, Wildlife corridors, Conservation strategies- *In situ* and *Ex situ* d) e) Animals and human welfare.

2. Animal Taxonomy: **4 Hrs**

a) Carl Linnaeus – Taxonomic hierarchy: Kingdom, Division, Phylum, Class, Order, Family and Binomial nomenclature

3. Animal cells and Tissues : **8 Hrs**

a) Brief description of animal cell (light and ultra structure) b) Functions of cell organelles c) Structure and functional diversity in animal cell d) Cell division: Types and significance e) Structure and functions of basic tissues.

4. Structure and functions of organ systems: **16 Hrs**

a) Human alimentary canal and outlines of digestion and absorption
b) Respiration: Human respiration – exchange of gases.
c) Circulation : Structure of human heart, Blood vessels and capillaries, composition of blood, blood coagulation.
d) Excretion : Mammalian kidney and urine formation.
e) Locomotion in vertebrates – Swimming, walking running, flying
f) Nervous system and their functions, A brief account of human endocrine system
g) Reproduction : Asexual and sexual reproduction, significance of sexual reproduction, outlines of human reproduction and fertility control

5. Ecology and Environmental Biology: **8 Hrs**

a) Abiotic and Biotic factors b) Environmental Pollution – brief account of Air, Water and Noise pollution.

6. Heredity: **4 Hrs**

a) Continuity of life – Mendel's laws b) Structure of chromosomes c) DNA and RNA

TUTORIALS **16 Hrs**

REFERENCES :

1. Barnes, R. D. 1974. Invertebrate Zoology, III edition, W. B. Saunders Co., Philadelphia.
2. Barrington, E. J. W. 1976. Invertebrate structure and function. Thomas Nelson and Sons
3. Ltd., London
4. Hyman L. H. 1940. The invertebrates Vol.1 Protozoa through Ctenophora, McGraw hill

5. co., N. Y.
6. Hyman. L. H. 1968. The Invertebrates Vol.8 McGraw Hill Co., N. Y and London.
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11. Clark, W. E 1963. History of the Primates IV Edn., Univ. of Chicago Press, Chicago.
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16. Young J Z 1957 Life of mammals, Oxford University Press, London.

M.Sc., IV SEMESTER
HC – 4.1 Advanced Genetics and Computational Biology

32 hrs

Course Outcome:
After completing the course student will be able to

CO1	Understand genome organization in prokaryotes and eukaryotes
CO2	Comprehend the types and causes of cancer along with genetic basis of carcinogenesis.
CO3	Understand various aspects of human genetics, pedigree analysis and genetic basis of several syndromes and disorders.
CO4	Understand the basics of quantitative genetics, types and nature of quantitative traits, and their inheritance
CO5	Understand genomics, gene sequencing, gene annotation, gene families, and clusters.
CO6	Understand proteomics and nucleic acid sequence and protein analysis. Familiarize themselves with genomics and proteomics databases/tools.

Part A-Advanced Genetics

Unit I: Genome organization: 3 hrs

Prokaryotes, Eukaryotic nuclear genomes - C-value paradox, Eukaryotic organelle genomes Split Genes Mobile genetic elements in Prokaryotes (bacteria) and Eukaryotes (Drosophila, maize and humans), Genome Projects of model organisms (*C. elegans*, *Drosophila* and Mouse).

Unit II: Cancer Genetics: 5 hrs

Cancer incidence and mortality, types of cancer, causes of cancer, properties of cancer cells, Genetic basis of Carcinogenesis- Oncogenes: proto-oncogenes, oncogenes, retroviral oncogenes in human cancer. Tumor suppressor genes: Functions of tumor suppressor gene products. Cancer as a multistep process. Animal models of cancer research: Transgenic mouse and Drosophila models.

Unit III: Human genetics: 5 hrs

History of human genetics, pattern of inheritance, pedigree analysis. Human genome: Organization, distribution of genes, gene families. Genetic basis of syndromes and disorders:

Cystic fibrosis, Neurofibromatosis, Schizophrenia, Anxiety disorder, Congenital heart diseases, Dyslexia.

Unit IV: Quantitative genetics: 3hrs

Introduction, types of quantitative trait, Nature of quantitative traits and their inheritance-Polygenic inheritance (Multifactorial hypothesis) – analysis of continuous variation; Variations associated with polygenic traits.

Part B-Computational Biology

Unit VII: Introduction and Scope of the Computational Biology 4 hrs

Genomics: Definition and types of genomics Structural genomics: whole genome shotgun sequencing, gene annotation, gene families and clusters. Orthologs and paralogs. Functional genomics: Transcriptome, Microarray technology.

Unit VIII: Proteomics: 4 hrs

Definition, Protein structure determination, protein domains, protein folding, Computer aided protein structure analysis, Protein-protein interactions, Protein microarrays.

Unit IX: Nucleic acid sequence and Protein analysis: 4 hrs

Alignment, similarity searches including remote similarity searches, secondary structure element, motifs, Single nucleotide polymorphism (SNP), Two dimensional polyacrylamide gel electrophoresis, Mass Spectrometry.

Unit X: Genomics and proteomics databases and tools: 4 hrs

Nucleic acid sequence databases and tools: Genbank, UCSC, ENSEMBL, EMBL, DDBJ, BLAST vs FASTA, file formats-FASTA, GCG, Genscan and ClustalW. Protein sequence databases and tools: Uni- prot, PDB, PIR, BLAST, PSI- BLAST (steps involved in use and interpretation of results).

M.Sc., IV SEMESTER

HC – 4.2 Laboratory Advanced Genetics and Computational Biology

Course Outcome:

After completing the course student will be able to

CO1 Study, construct the karyotype, identify numerical variations and associated syndromes .

CO2 Prepare and analyze the mitotic chromosomes of Drosophila melanogaster.

CO3 Able to analyze the pedigree charts to identify the patterns of inheritance in humans.

CO4 Describe method and tools to retrieve nucleotide and amino acid sequence from sequence databases.

PRACTICALS: 04X16=64 hrs

1. Karyotypic studies of normal human chromosomes and syndromes. 2X4=08hrs
2. Preparation of mitotic chromosomes from *Drosophila melanogaster* 3rd instar larval brain 1X4=04hrs
3. Temporary mounting of Sex combs of different species of *Drosophila- D.ananassae*, *D.bipectinata*. 2X4=08hrs
4. Temporary mounting of Sex combs of different species of *Drosophila- D.ananassae*, *D.nasuta*
5. Study of patterns of inheritance in humans using pedigree charts. 2X4=08hrs
6. Study of Quantitative characters: Sternopleurals, Acrosticals – mean, standard deviation. 2X4=08hrs
7. Data mining for sequence analysis using GENBANK tool. 1X4=04hrs
8. Web– based tools for sequence similarity searches and homology screening-BLAST, FASTA 2X4=08hrs
9. Proteomics data bases: Uni-Prot, PROSITE, PDB, PIR, ORF finder. 4X4=16hrs

REFERENCES:

1. The Human Genome 2001, Nature Vol. 409.
2. The Drosophila Genome. 2000, Science Vol. 267.
3. The Caenorhabditis elegans genome 1998. Science Vol. 282.
4. Introduction to Genetic Analysis. Griffiths, Anthony J.F.; Miller, Jeffrey H.; Suzuki, David T.; Lewontin, Richard C.; Gelbart, William M. New York: W.H. Freeman & Co.; 1999
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M.Sc., IV SEMESTER
HC – 4.3 Applied Zoology

32 hrs

Course Outcome:

After completing the course student will be able to

CO1 Understand scope, types, management, and importance of aquaculture
CO2 Understand scope, types, management, and importance of Sericulture
CO3 Understand scope, types, management, and importance of Apiculture
CO4 Understand scope, types, management, and importance of Vermiculture

UNIT I: Aquaculture **8hrs**

Aquaculture in India: an overview – nutritional value and food security - Site selection and preparation of culture ponds - Fish culture: carps, marine fishes and ornamental fishes. Prawn culture: Freshwater prawns and marine shrimps. Fattening of crabs. Crayfish and Lobster culture – Molluscs culture: mussels, and oysters including pearl oyster. Water quality management and maintenance of sanitation - Plant and animal nutrients - Artificial feed formulation – Low cost feed formulation - Aquatic weeds.

UNIT II: Sericulture **8hrs**

Salient features of Saturnidae and Bombycidae. Mulberry and non mulberry silkworms, classification based on voltinism, moulting and geographic origin.

Morphology and life cycle of *Bombyx mori*. Structure and functions of Silk glands.

Silkworm rearing technology: Building, equipments, disinfection, environmental factors, Seed cocoons, preservation, grainage activity, LSPs, egg production, incubation, artificial hatching.

Pests and diseases: Protozoan, Fungal, Viral and Bacterial diseases and their control measures. Silkworm pests and Predators

UNIT III: Apiculture **8hrs**

Scope and its importance, Classification and morphology of honey bees, species and races of honey bees, tribal life and bee hunting. sex seperation, comb building, orientation of comb, communication, collection of propolis and water.

Honey and its chemical composition, medicinal importance.

Eonomic importance of honey, wax, bee pollination, pollen and Venom.

UNIT IV: Vermiculture **8hrs**

A. Introduction to vermiculture. Definition, meaning, history, economic importance, their value in maintenance of soil structure. Useful species : Local species and Exotic species of earthworms. Role of four R's.

B. Earthworm Farming (Vermiculture) for home gardens, larger scale, Extraction (harvest), vermicomposting harvest and processing.

C. Nutritional Composition of Vermicompost for plants, comparison with other fertilizers

D. Enemies of Earthworms, Sickness

M.Sc., IV SEMESTER
HC – 4.4 Laboratory Applied Zoology

Course Outcome:

After completing the course student will be able to

CO1 Demonstrate the morphometric measurement of selective fishes.
CO2 Describe the morphological and anatomical details of honeybees and its application.
CO3 Understand the life cycle of silkworm, and their specialized silk glands.
CO4 Know the morphology and locomotory details of earthworm.

PRACTICALS: **16X4=64 hrs**

1. Study of morphometric characters of Indian major carps
2. Diversity of fishes
3. Study of morphology of honey bee and cast system.
4. Study of mouth parts of honey bee
5. Study of stinging apparatus of honey bee.
6. Study of pollen grains in honey samples
7. Study of bee plants
8. Study of morphology and lifecycle of *Bombyx mori*
9. Study of digestive system and silk gland of *Bombyx mori*
10. Study of Non mulberry silkworms and their food plants.
11. Study of systematic position & External characters of locally available earthworm species.
12. Mounting of setae in earthworm species.

REFERENCES

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7. R. L. Kotpal (2000) Modern Textbook of Zoology. Rastogi Publications
8. Satchel, J.E. (1983) “Earthworm Ecology” Chapman Hall, London.
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M.Sc., IV SEMESTER
HC – 4.5 Major Project

Course Outcome:
After completing the course student will be able to

CO1 Understand the concepts of Project Management from planning to the execution of project.
CO2 Recognize the importance of reference work using tools of information such as periodicals, journals, and online resources.
CO3 Break down the tasks of the project and determine handover procedures.
CO4 Interpret, analyze, and present the results obtained, comparing them with similar works, and draw conclusions.

M.Sc., Examination
(Scheme CBCS)
M.Sc., ZOOLOGY
HARD CORE (Theory)- Model question paper

Time: 3 hrs **Max Marks: 70**

Instructions: ***1. Answer all questions***
2. Illustrate your answer wherever necessary

I. Write short notes on the following: **[8×2=16]**

1.
2.
3.
4.
5.
6.
7.
8.

II. Write elaborate notes on any FIVE of the following: **[5×6=30]**

9.
10.
11.
12.
13.
14.
15.
16.

Q3. Answer the following: **[2×12=24]**

17. (i)
Or
(ii)

18. (i)
Or
(ii)

M.Sc Examination
(Scheme CBCS)
M.Sc., ZOOLOGY
Softcore - Model question paper

Time: 3 hrs **Max Marks: 70**

Instructions: ***1. Answer all questions***
2. Illustrate your answer wherever necessary

I. Write short notes on the following: **[8×2=16]**

1.
2.
3.
4.
5.
6.
7.
8.

II. Write elaborate notes on any FIVE of the following: **[5×6=30]**

9.
10.
11.
12.
13.
14.
15.
16.

Q3. Answer the following: **[2×12=24]**

17. (i)
Or
(ii)

18. (i)
Or
(ii)

M.Sc Examination
(Scheme CBCS)
M.Sc., ZOOLOGY
Open Elective-Model question paper

Time: 3 hrs **Max Marks: 70**

Instructions: ***1. Answer all questions***
2. Illustrate your answer wherever necessary

I. Write short notes on the following: **[8×2=16]**

1.
2.
3.
4.
5.
6.
7.
8.

II. Write elaborate notes on any FIVE of the following: **[5×6=30]**

9.
10.
11.
12.
13.
14.
15.
16.

Q3. Answer the following: **[2×12=24]**

17. (i)
Or
(ii)

18. (i)
Or
(ii)

M.Sc Examination
(Scheme CBCS)
M.Sc., ZOOLOGY
Scheme of Practical examination

Time: 4 hrs **Max Marks: 70**

I. Major experiment: **25 Marks**

II. Minor experiment: **15 Marks**

III. Identifications: **20 Marks**

IV.Viva-Voce **10 Marks**