

**NEHRU MEMORIAL COLLEGE
(AUTONOMOUS)**

(Nationally Accredited with 'A' Grade by NAAC)

PUTHANAMPATTI – 621 007

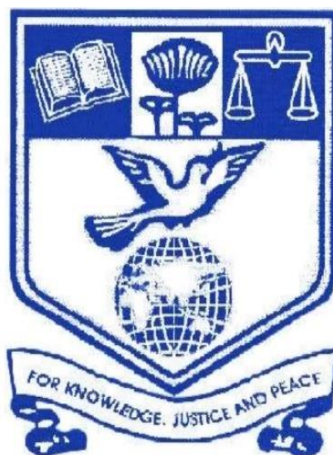
TIRUCHIRAPPALLI DISTRICT

TAMIL NADU - INDIA

(Post Graduate Programme – Under CBCS Pattern)

Revised

**M.Sc., ZOOLOGY SYLLABUS
(WITH EFFECT FROM THE ACADEMIC
YEAR 2019 -2020 ONWARDS)**



**PG AND RESEARCH DEPARTMENT
OF ZOOLOGY**

APRIL – 2019

**POST GRADUATE AND RESEARCH DEPARTMENT OF
ZOOLOGY**

VISSION AND MISSION

Vision:

- Students get individual attention and focus on the prevailing challenges by way of giving strong foundation.
- Create a conducive environment for students to develop innate skill to discover themselves and explore scientific pursuits with various opportunities.
- The students grow in a fully equipped environment rich in its infrastructure which creates physically sound, mentally serene, spiritually humane and scientifically excelling.
- Creativity is a spark that lasts long. We provide ample opportunity for our students to think and make outside the box. We treasure their pride of being a creator.

Mission:

- Our mission is to mould the students into a world class community who would feel legitimately proud to think critically and innovatively.
- We focus more on the approach of making the students observe, analyze, interpret, evaluate and solve problems.
- Providing very good opportunity to the students who willing to do novel approach on research in various fields.
- The Post Graduate and Research Department of Zoology providing very good learning information with an excellent academic and research facilities to the students of all category and enhance their natural and artificial intelligence.

PROGRAM SPECIFIC OBJECTIVES

1. To enable the students to learn the application of Zoological principles to the animal and human biology.
2. Understand the impact of Zoology on basic human needs such as, health care, agriculture, industrial, chemical, energy etc.,
3. To know the current development in Zoological Sciences.
4. Evaluate the future priorities in Zoological Research.
5. Know the practical areas for application of Advanced Zoological Research.
6. To develop skill in the various modern bio-techniques.

PROGRAM OUTCOMES

Students of Zoology will be able to

1. To become knowledgeable person in the subject of Zoology and apply the principles of the gained knowledge in different fields and to the needs of Society and Nation.
2. Acquisition of technical competence in specialized areas, to develop confidence and gain analytical skills in the fields of taxonomy, cell biology, developmental biology, physiology, research methodology, environmental biology, toxicology, immunology, endocrinology and biotechnology.
3. To understand and appreciate professional ethics, community living and Nation Building initiatives.
4. Ability to conduct investigation and research on problems in a chosen field of study.
5. Ability to work effectively as an individual and as a member leader in a team and to be a multi-skilled person in the field of Zoology with good technical knowledge, management, leadership and entrepreneurial skills.
6. Awareness of the social, cultural, global and environmental responsibilities as a Zoologist in various fields.
7. Capability and enthusiasm for self-improvement through continuous professional development and life-long learning.

MAPPING OF PROGRAM SPECIFIC OBJECTIVES WITH PROGRAM OUTCOMES

A relation between the Program Specific Objectives and the Program Outcomes is given in the Table.

Program Specific Objectives	Program Outcomes				
	A	B	C	D	E
I	3	3	2	2	3
II	3	3	1	2	3
III	3	3	2	3	2
IV	2	3	3	1	2
V	3	2	2	3	3
VI	3	3	3	2	3

Contribution: Reasonable = 1 ; Significant = 2 ; Strong = 3

NEHRU MEMORIAL COLLEGE (AUTONOMOUS)
M.Sc., ZOOLOGY Programme - Course Structure
Under CBCS (Choice Based Credit System)
(For the candidates admitted from the academic year 2019 – 2020 onwards)

Semester	Courses	Course Code (s)	Course Title	Hrs/ week	Credits	Exam Hrs.	Marks		Total
							Int	Ext	
I	CC-I		Invertebrata and Chordata	6	4	3	25	75	100
	CC-II		Cell and Molecular Biology	6	4	3	25	75	100
	CC-III		Genetics	6	4	3	25	75	100
	CC-IV		Biochemistry	6	4	3	25	75	100
	CC-V		Practical- I (Covering CC-I to CC-IV)	6	4	3	40	60	100
				30	20		140	360	500
II	CC-VI		Immunology	5	4	3	25	75	100
	CC-VII		Animal Physiology	5	4	3	25	75	100
	CC-VIII		Developmental Biology	4	4	3	25	75	100
	CC-IX		Practical- II (Covering CC-VI to CC-VIII)	6	4	3	40	60	100
	EC-I		Microbiology	6	5	3	25	75	100
			Wildlife and Conservation Biology						
OEC		Medical Zoology	4	4	3	25	75	100	
		Human Health and Hygiene							
				30	25		165	435	600
III	CC-X		Research Methodology and Biotechniques	5	4	3	25	75	100
	CC-XI		Evolution	5	4	3	25	75	100
	CC-XII		Entomology	4	4	3	25	75	100
	CC-XIII		Biotechnology	4	4	3	25	75	100
	CC-XIV		Practical- III (Covering CC-X to CC-XIII)	6	4	3	40	60	100
	EC-II		Clinical Analysis and Laboratory Techniques	6	5	3	25	75	100
		Aquaculture							
				30	25		165	435	600
IV	EC-III		Ecology and Ecotoxicology	6	5	3	25	75	100
			Nanobiotechnology						
	EC-IV		Cancer and Stemcell Biology	6	5	3	25	75	100
			Endocrinology						
CC-XV		Project work	18	10	-	40	40+20*	100	
				30	20		75	225	300
			Total	120	90	-	545	1455	2000

*20 Viva

**M.Sc., ZOOLOGY – SEMESTER - I
CBCS: 2019-2020 - CORE COURSE**

CC – I: INVERTEBRATA AND CHORDATA

Course Code:
Hours/Week: 6 (Total 90 hours)
Credits: 4

Max Marks: 100
Internal Marks: 25
External Marks: 75

Course objectives:

- The course aims to give a thorough understanding in the principles and practice of taxonomy.
- To help students acquire an in-depth knowledge on the diversity and relationships in animal world.
- To develop a holistic appreciation on the phylogeny and adaptations in animals. The Animal diversity which is an essential topic for biologists to know the distribution of animal kingdom of various forms.
- To impart the significance of Invertebrate and Chordate organization and their evolving adaptations in organ systems. Also to highlight the importance of minor phyla.
- Enlighten about the terrestrial vertebrates of amphibians, reptiles, aves and mammals and their evolutionary significance.

18 hours

UNIT I: Taxonomy: Definition and basic concepts of taxonomy – importance and applications of taxonomy in biology - taxonomic collections, preservations, Taxonomic keys and their merits and demerits. International Code of Zoological Nomenclature (ICZN) - formation of scientific names of various taxa. Origin of higher taxa from living forms – evidences for the origin of higher taxa from the fossil record. Diversity indices – Shannon and Weinear diversity index.

18 hours

UNIT-II: Animal Diversity: Origin of Protists. Prokaryotes and Eukaryotes. Levels of organization in animal kingdom. **Multi-cellularity:** Edicaran and Burgess Shale fauna. Cambrian explosion – causes and consequences. Cropping and Red Queen principle. Theories of metazoan origin. Symmetry, Coelom and Metamerism – evolutionary advantages.

18 hours

UNIT-III: Lower Metazoans: Porifera, Cnidaria-Polymorphism, Ctenophora, Acoelomata, Placozoa, Mesozoa and Pseudocoelomata – evolutionary relationship and adaptive modifications only. **Protostomes and Deuterostomes:** Phylogenetic position of Molluscs, adaptive radiation in Molluscs and Annelids. Phylogeny of Arthropod –

Monophyly and Polyphyly, reasons for the success of Arthropods. Major classes under Arthropoda and adaptive radiation.

18 hours

UNIT-IV: Lesser Protostomes: Sipuncula, Echiura, Phoronida, Brachipoda, Onychophora and Chaetognatha-Phylogeny only. **Echinoderms:** Classification and adaptive radiation. **Hemichordates:** Position in the animal kingdom, phylogeny and evolutionary significance. **Ancestry of Chordates:** Cephalochordates and Urochordates. Vertebrate Phylogeny – Agnatha, Ostracoderms and Gnathostomes – Placoderms, Acanthodians, Chondrichthyes and Osteichthyes. Structural and functional adaptations of fishes.

18 hours

UNIT-V: Terrestrial Vertebrates: Tetrapod phylogeny-modern Amphibians, diversity, distribution, status and threats. Reptiles- origin and adaptive radiation, Skull of reptiles and its importance. Mesozoic world of reptiles and extinction. **Birds and Mammals:** Origin of birds and mammals, Structural and functional modifications for aerial life. Orders under class Aves. **Class Mammalia:** Prototheria, Metatheria and Eutheria. Phylogeny of Mammalian orders. Adaptive radiation in Mammals.

Course Outcomes:

- To develop taxonomic experts strength.
- Distinguish animal kingdom of various taxonomic forms.
- To evaluate mode of living of various taxonomic forms living in various environments.
- Reveal the taxonomic and characteristic features of minor phyla and lower metazoans.
- Identify the characters of phylum echinoderms and reveal the phylogeny and evolutionary significance of hemichordate.

TEXT BOOKS:

1. Kotpal, R.L. 1982. Protozoa, Porifera, Coelenterata, Helminthes, Annelida, Arthropoda, Mollusca, Echinodermata and Minor Phyla. Rastogi Publications.
2. Simpson, G.G. 1987. Principles of animal taxonomy. Oxford IBH Publishing Co. P 247.
3. Mayer, E. 1969. Principles of Systematic Zoology. McGraw Hill Book company, Inc.
4. Clark, R.B and A.L. Panchen. 1971. Synopsis of animal classification. Chapman and Hall Publications, London. P 126.
5. Newman, H.H. 1987. The Phylum Chordata. Sathis book Enterprise Publishers.

REFERENCE BOOKS:

1. Barnes R. D. 1982. Invertebrates Zoology (6th edn). Toppan International Co.,
2. Hyman L.H. 1940 - 1959. The Invertebrata, Vol. I to VI.

3. Carter, G. S. A. 1946. General Zoology of Invertebrates 2nd edn. (Wick and Jackson Ltd., London).
4. Borradile, L.A. 1955. The Invertebrata (2nd edn). Cambridge University Press.
5. Barrington, E. J. W. 1969. Invertebrate Structure and functions. English Language. Book Society.
6. Gardinar, M. S. 1972. Biology of the invertebrates, Mc Graw Hill Book Co., New York.
7. Waterman, AJ. 1971. Chordate Structure and Function. Macmillan Co. London.
8. Jolie, M. 1968. Chordate Morphology. East West Press.
9. Young, J.Z. 1950. Life of Vertebrates. Clarendon Press Oxford.
10. Kapoor, V.C. 1991. Theory and Practice of Animal Taxonomy. Oxford and IBH Publishing Co., Pvt. Ltd. New Delhi.
11. Alfred, J.R.B. and Ramakrishnan. 2004. Collection, preservation and identification of animals. Zoological survey of India publications, Calcutta.
12. Anderson, T.A. 2001. Invertebrate Zoology (2nd edn). Oxford University Press, New Delhi.

**M.Sc., ZOOLOGY – SEMESTER - I
CBCS: 2019-2020 - CORE COURSE**

CC – II: CELL AND MOLECULAR BIOLOGY

Course Code:

Hours/Week: 6 (Total 90 hours)

Credits: 4

Max Marks: 100

Internal Marks: 25

External Marks: 75

Course Objectives:

- To enlighten our students about the DNA and its functions.
- The knowledge in the molecular biology and genetics will provide diagnosis of genetical disorders and treatment.
- This course facilitates to understand the structure at molecular level and function of prokaryote and eukaryote cell.
- To know about gene organization and regulation.
- To understand the structure and functions of cell and cell organelles.

15 hours

UNIT-I: Cell organization: Cell, Type of cells - General organization of eukaryotic cells - membrane structure and function - cytoplasm - Intracellular compartments - mitochondria, Golgi bodies, endoplasmic reticulum.

21 hours

UNIT-II: Nuclear material: Nucleus - Chromatin structure and nucleosome concept - Structure of DNA and RNA. DNA Replication - Mechanism of DNA replication in eukaryotes. Recombination- mechanism of recombination – DNA repair – mechanism of DNA repair.

18 hours

UNIT-III: Gene and protein relationship: Central Dogma – Transcription – translation - post translation modification. Regulation of protein synthesis– The operon system,

gene regulation in higher eukaryotes. Mechanism of positive and negative control of gene expression.

18 hours

UNIT-IV: Cell cycle and programmed cell death: Cell cycle - Components of cell cycle control system Programmed cell death - extra cellular control of cell division - cell growth and cell death - Biology and genetics of cancer and cell aging.

18 hours

UNIT-V: Cell communications: General principles of cell communication - signaling through G-protein linked cell surface receptors - signaling through enzyme-linked cell surface receptors - signaling pathways that depend on regulated proteolysis.

Course outcomes:

- Discuss the most significant discoveries and theories through the historical progress of biological scientific discoveries, and their impacts on the development of molecular biology.
- Compare the structure of eukaryotic cells with the structure of simpler prokaryotic cells and with the structure of viruses.
- Explain the fundamental structure, properties and processes in which nucleic acids play a part.
- Discuss the molecular mechanisms by which DNA controls development, growth or morphological characteristics of organisms.
- Independently execute a laboratory experiment using the standard methods and techniques in molecular biology, with the appropriate analysis and interpretation of results obtained.

TEXT BOOKS:

1. Watson. J. D, Baker. T. A, Bell. S. P, Gann. A, Levine. M, Losick. R. Molecular Biology of Gene. 6th The Benjamin / Cummings Pub. Co. Inc, 2008.
2. Lehninger's Principles of Biochemistry, sixth Edition, 2009 Publisher: W. H. Freeman; 6th edition.
3. Alberts, B., Johnson, A., Lewis, J, Raff, M., Roberts, K and Walter, P. 2002. Molecular biology of the Cell. Garland science, New York.
4. Bolsover, S.R, Hyams, J.S, Shephard, E.A, White, H.A and Wiedemann, C.G. 2004. Cell Biology. John Wiley & sons, Inc. Publication, New Jersey.
5. De Robertis, E.D.P., and De Robertis, Jr. E.M.F. 2001. Cell and molecular biology. Williams & Wilkins, USA.
6. Hartl, D.L. and Jones, E.W. 2005. Genetics analysis of genes and genomes. Jones and Barlett. UK.

REFERENCE BOOKS:

1. Darnell, Lodish and Baltimore. 2000. Molecular Cell Biology, Scientific American Publishing Inc.
2. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. 2002. Molecular biology of the Cell. 4th ed. Garland publishing Inc.
3. Klug, W.S and Cummings, M.R. 2005. Concepts of Genetics. Pearson Education P(ltd), Singapore.
4. Lewin, B. 2000. Genes VII. Oxford University Press Inc. New York.
5. Lewis, R. 2005. Human genetics – concepts and applications. McGraw-Hill. New Delhi.
6. Watson, J.D, Baker, T.A, Bell, S.P., Gann, A., Levine, M and Losick, R. 2004. Molecular biology of the gene. Pearson Education P(ltd), Singapore.

**M.Sc., ZOOLOGY – SEMESTER - I
CBCS: 2019-2020 - CORE COURSE**

CC-III: GENETICS

Course Code:

Hours/Week: 6 (Total: 90 hours)

Credits: 4

Max Marks: 100

Internal Marks: 25

External Marks: 75

Course Objectives:

- This paper gives information about the structure and function of nucleic acids.
- This course Genetics helps the students in understanding how mutations cause genetic disorders.
- And it also explains history and evolution of human genome and mapping to treat genetic diseases.
- To give knowledge about DNA and mapping of genome.
- To study human gene structure and function in elaborate manner.

17 hours

Unit I: Classical Genetics: Chemical Basis of Heredity, DNA as genetic material, Experiments of Griffith; Avery, McCleod; McCarthy and Harshey Chase. RNA as genetic material- Experiment of Fraenkel and Singer. Nucleic acids: DNA structure, types and their functions. RNA types, structure and their functions. Ribozymes. Chromosome – structure and function.

14 hours

Unit II: Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction and sex-duction. Human genetics: Pedigree analysis, karyotypes, Genetic disorders: Chromosomal Syndromes, Gene based disorders, mitochondrial gene disorders.

14 hours

Unit III: Transposable elements: Maize and Drosophila. **Mutations:** Introduction and Types of Gene mutations - Base substitution, Frame shift mutation (insertion, deletion, missense, nonsense mutation). Mutagens - Physical and chemical. Reverse mutation in bacteria.

15 hours

Unit IV: Features of the Genome: Organization and expression of the human genome – human multigene families and repetitive DNA – Footprints of evolution. **Mapping of genome:** physical mapping – genetic mapping – human genome project.

15 hours

Unit VI: Dissecting and manipulating gene: Studying human gene structure and function and creating animal models of disease. Gene therapy and other molecular-genetic based therapeutic approaches.

Course Outcomes:

- Chemistry of nucleic acids and inheritance and different experimental evidences to prove DNA and RNA as genetic materials.
- Molecular level genetic of microbial reproduction.
- Genetics of heritage of human and syndromes at molecular level.
- Role of jumping genes and gene mutations at molecular level.
- History and evolution of gene families and human genome project.

TEXT BOOKS:

1. Benjamin Levin. 2005. Genes VIII, Oxford University Press, New York.
2. Daniel L. Hartl. 1996. Genetics, III Ed., Jones Bartlett Publishers. Boston.
3. David Friefelder. 1998. Microbial Genetics, Narosa Publishing House, New Delhi.
4. Jenkins, J. B. 1983. Human Genetics, The Benjamin Cummings Publishing Co.,
5. John D. Hawkins. 1996. Gene Structure and Expression, III Ed., Cambridge University Press.
6. Robert H. Tamarin. 1996. Principles of Genetics, WCB Publishers.

REFERENCE BOOKS:

1. Strickberger Monnroe, W. 1996. Genetics, Prentice Hall of India Pvt. Ltd., New Delhi.
2. Tom Strachan, Andrew P. Read Garland. 2011. Human Molecular Genetics 4, Science/Taylor & Francis Group.
3. Gestel, R, T. Cech and J. Atkins. 1999. The RNA World (2 edition). Cold Spring Harbor, New York.
4. Turner et al. P.C. 2002. Instant Notes in Molecular Biology by Viva Books.
5. Hames, B.D and N.M. Hooper. 2002. Instant Notes in Biochemistry 2 edition, Viva Books.

6. Brown, T.A. 2002. Genomes by Viva Books.
7. Darnell.J, H. Lodish and D.Baltimore. 1990. Molecular cell Biology, 2nd edition, Scientific American Books, New York.

**M.Sc., ZOOLOGY – SEMESTER - I
CBCS: 2019-2020 - CORE COURSE**

CC -IV: BIOCHEMISTRY

Course Code:

Hours/Week: 6 (Total 90 hours)

Credits: 4

Max Marks: 100

Internal Marks: 25

External Marks: 75

Course objectives:

- The main objective of the Biochemistry course is to provide a basic approach to students.
- This paper equips about system and their surroundings; thermodynamics and its laws; the structure of the atom and molecules.
- To know composition, structure and function of biomolecules.
- Understand the bioenergetics and enzymes.
- Acquire knowledge on pH and Buffer and to understand the structure and functions of biomolucules.

10 hours

UNIT I: Thermodynamics: Intra and inter molecular interaction in biological system. Bioenergetics: Laws of thermodynamics, concept of free energy, oxidation reduction (radox) reactions. Energy of coupling reactions and energy rich compounds.

18 hours

UNIT II: Atoms and Molecules: Atom: structure, atomic particles, atomic mass, atomic number and mass number. Isotopes. Molecules. Chemical bonding and its types. Chemical interaction: Electrostatic, Hydrogen bonding, hydrogen interaction, Van – der – Waal forces. pH and Buffer: Acid, bases, pH scale, Principles of buffering, common buffer compound used in biology, blood as a buffer.

22 hours

UNIT III: Biomolecules: Carbohydrates: Structure, classification, properties of functional group. **Protein:** Classification based on chemical structure, function and solubility; properties, primary, secondary and tertiary, principles of isolation and purification, synthesis of polypeptides. Structural configuration (Ramachandran Plot, Motif and Fold). **Lipid:** Structure, classification, properties – saturated and unsaturated fatty acids – plant waxes, steroids, cholesterol and lecithin. **Vitamins:** structure, composition and functions. BMR, Balanced diet.

20 hours

UNIT IV: Bioenergetics: Glycolysis, oxidative phosphorylation. **Enzyme:** Classification, Co – factors and enzyme substrate compounds. Kinetics: Michaelis – Mentoen equation. Km value and its significance. Enzyme velocity and factors influencing enzyme velocity. Kinetics of enzyme inhibition, suicide inhibition and feedback inhibition. Enzyme regulation: Allosteric regulations – Key enzymes, Covalent modification, Enzyme engineering.

20 hours

UNIT V: Nucleic acid: Structure, composition and functions of nucleic acid. Characteristic features of A, B, C and Z DNAs. Catabolism of purine and pyrimidines. **Minerals:** Major and minor nutrients. Role of calcium, Phosphorus, Magnesium, Sodium, Potassium, Chloride, Sulphur and Iron. **Free radicals and antioxidant:** Generation of free radicals. Reactive oxygen species. Free radical scavenger systems. Lipid peroxidation. Preventive antioxidants.

Course outcomes:

- Explain the laws of thermodynamics and describe the intra and inter molecular interaction in biological system
- Explain the structure of atom and molecule and analyze the chemical interaction.
- Describe buffer system in living things.
- Explain biochemical structure and function of biomolecules.
- Describe the mechanism of enzymes activity and relates the structure and function of nucleic acids and Identify the types of nutrients and functions

TEXT BOOKS:

1. Lehninger, A.L. 2008. Principles of Biochemistry. (5 th edn). CBS publishers and distributors. New Delhi.
2. Garret, R.H.and C.M. Grisham. 1995. Biochemistry. Saunders college publishers, USA.

REFERENCE BOOKS:

1. Deb, A.C. 2004. Fundamentals of Biochemistry. New Central Book agencies (P). Ltd. New Delhi.
2. Baldwin, E. 1964. An introduction to comparative Biochemistry, CUP, London.

3. Dubay, G. 1989. Biochemistry. Mac Millan publishing company, New York.
4. Elliott, W.H and C. Elliott. 2003. Biochemistry and Molecular Biology. Oxford University Press, Oxford, UK.
5. Eric, E. Conn, Paul, K. Stumpf, George Bruening, Roy H. Doi. 2007. Outlines of Biochemistry. (5th Edition). John Wiley and Sons Inc., NY.
6. Freifelder, D. 1993. Physical Biochemistry. W.H. freeman and company. New york.
7. Frunton J.S. & S. Simmonds, G.General and R.H.Dol. 1987. Outlines of Biochemistry, John Wiley & Sons.
8. Jain, J.L. 2003. Fundamentals of Biochemistry, S. Chand & Compnay Ltd. New Delhi.
9. Mallikarjuna Rao. 2006. Medical biochemistry. New Age International publishers, New Delhi.

**M.Sc., ZOOLOGY – SEMESTER - I
CBCS: 2019-2020 - CORE COURSE**

CC – V: PRACTICAL – I (COVERING CC-I to CC-IV)

Course Code:

Hours/Week: 6 (Total 90 hours)

Credits: 4

Max Marks: 100

Internal Marks: 40

External Marks: 60

Course objectives:

- To impart knowledge on Taxonomy and Biology of chosen Invertebrate and Chordate representatives. To develop skill in cytological techniques, Molecular biology and to estimate water Quality Parameters.
- To obtain knowledge about the identification and classification of animals.
- To impart training on the technique of dissection of invertebrate and vertebrate animals and to understand the various systems present in the body.
- To get the information of animal population and – to know the fossil forms in the title of animal diversity.
- To train the students to discriminate the various external body parts of invertebrates and vertebrates and to observe the preserved animals (wet and dry) and to study their characteristics features.

I. INVERTEBRATA AND CHORDATA

(25 Hours)

1. Identification and study of selected Protozoans and Helminthes of medical importance.
2. **Dissection:** Digestive/Nervous system of Earthworm and Cockroach. Urino genital system of Fish.
3. **Mounting:** Appendages of Prawn and Honey bee sting.

4. Composition assessment of the taxonomic diversity/biodiversity of birds/mammals in a habitat.
5. Diversity indices – Shannon and Weinear diversity index.
6. Collection of insects and identification up to order level (Field work).
7. Use of taxonomic keys for identification of stuffed animal (birds).
8. Study of prepared slides of mouth part of Honey bee, Housefly, Mosquito, Bed bug and Butterfly to relate structure and function.

Spotters: Euglena, Paramecium, Obella, Physalia, Scorpion, Chiton, Balanoglossus, Torpedo panther, Sea Horse, Cat fish, *Ophocephalus punctatus* (snake headed fish), Ichthyophis sp, Draco, Chameleon, Indian cobra, king fisher, blue rock pigeon, rat, bat.

II. CELL AND MOLECULAR BIOLOGY

(25 Hours)

1. Cell size determination using micrometer.
2. Human blood smears.
3. Cell counting and cell viability using trypan blue dye exclusion assay.
4. Buccal smear.
5. Isolation of DNA from human saliva.
6. Isolation of DNA from liver tissue.
7. Quantitative estimation of DNA/RNA.
8. Observation of Barr body.

Spotters: Gel electrophoresis, Gel cutter, Transilluminator, Western blotting. Mammal nerve cell, cardiac muscle, non-striated muscle, compound microscope, micrometer.

CC-III: GENETICS

(15 Hours)

1. Culture of *Drosophila*.
2. Identification of Mutant in *Drosophila*.
3. Pedigree analysis.
4. Human karyotyping and chromosomal abnormalities.
5. To prepare a survival curve for the given bacterial culture using UV radiation as a mutagen.

Spotters: Klienfelter's syndrome, Down's syndrome, Turner's syndrome, *Drosophila* mutant and wild type.

IV BIOCHEMISTRY

(25 Hours)

1. Preparation of solution- molar, millimolar, micromolar and nanomolar; solutions of normality and percentage.
2. Determination of pH using pH meter.

3. To verify Beer Lambert's Law.
4. Preparation of standard graph using Spectrophotometer.
5. Chromatographic techniques:
 - a. Paper Chromatographic technique to separate amino acids.
 - b. Thin layer chromatographic technique to separate lipids.
6. Electrophoresis – PAGE.
7. Quantitative estimation of amino acid, protein, carbohydrate and lipid in animal tissues.
8. To isolate the Casein from milk.
9. To determine the iodine value for different fat/lipid samples.
10. Ammonium sulphate precipitation of protein.

Spotters:

Thin layer chromatography, paper chromatography, silica gel, spectrophotometer, Centrifuge.

Course outcomes:

- Identification and classification of animals give to improve the knowledge among students to give an idea about new discovery of various taxa.
- The training technique of dissection of invertebrate and vertebrate animals and to understand the various systems present in the body useful for drug design by the students in future.

TEXT BOOKS

1. Barnes, R.D. 1982. Invertebrate Zoology, IV Ed., Holt Saunders – International Edition.
2. Odum, E.P. 1971. Fundamentals of Ecology, W.B. Saunder's Co. Philadelphia.
3. De Robertis, E.D.P. and De Robertis, E.M.F. 1987. Cell and Molecular Biology, VIII Ed. Lea and Febiger, Philadelphia.
4. Amsath, A. 2009. Practical manual in zoology. M.M.A Publications, Pattukkottai.
5. Gunasekaran, P. 2008. Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi
6. Janarthanan, S. and S.Vincent 2007. Practical Biotechnology, Methods and Protocols. University Press, Hyderabad., India
7. Rajamanickam, C.2001. Experimental protocols in basic molecular biology, Osho Scientific Publications, Madurai.

REFERENCE BOOKS:

1. Kotpal, R.L., Minor Phyla., Rastogi Publication, Meerut. 2nd Edition, 2002.
2. Clarke, G.L. Elements of Ecology. John Wiley & Sons, New York. 1954.
3. Geoffrey M. Cooper and Robert E. Hausman. 2004. The Cell –A Molecular approach. 3rd Edition. Asm Press, Washington D.C. USA.

4. Due, S and N. Garg. 2010. Biochemical methods of analysis, Narosa Publishing, New Delhi.
5. Plummer, D. T. 2008. An introduction to Practical Biochemistry, Tata McGraw-Hill Publication, New Delhi.

Practical record to be submitted by the candidates at the time of practical examination.

**M.SC., ZOOLOGY – SEMESTER II
CBCS: 2019-2020 - CORE COURSE**

CC-VI: IMMUNOLOGY

Course Code:

Hours/Week: 5 (Total: 75 hours)

Credits: 4

Max Marks: 100

Internal Marks: 25

External Marks: 75

Course objectives:

- Acquire knowledge and understanding of theoretical concepts of Immunology and to understand the structure and functions of lymphoid organs.
- Acquire knowledge on structure and properties of antigens and immunoglobulins.
- Understand and analyse the structure, types and organization of MHC and understand the immune response to tumour.
- Understand and analyse the process of immune tolerance, autoimmunity, hypersensitivity and immune response to microbial infection.
- Acquire skills and competence in specialized immunological techniques in the diagnosis and management of health related disorders.

13 hours

UNIT : Introduction : Cells of immune system; innate and acquired immunity; primary and secondary lymphoid organs; antigens: chemical and molecular nature; haptens; adjuvants; types of immune responses; theory of clonal selection.

18 hours

UNIT II: Cellular Responses : Development, maturation, activation and differentiation of T-cells and B-cells; TCR; antibodies: structure and functions; antibodies: genes and generation of diversity; antigen antibody reactions; monoclonal antibodies: principles and applications; antigen presenting cells; major histocompatibility complex; antigen

processing and presentation; regulation of T-cell and B-cell responses. **Tumour Immunology:** Tumour antigens, immune response tumour.

18 hours

UNIT III: Infection and Immunity: Injury and inflammation; immune responses to bacterial (tuberculosis) parasitic (malaria) and viral (chikungunya) infections. Cytokines; complement; immunosuppression. Immune tolerance – natural and acquired (mechanism of T & B Cell). Autoimmunity – Mechanisms, disorders (Organ specific and systemic). Hypersensitivity – types, mechanisms and disorders; Congenital and acquired Immunodeficiencies. Resistance, immunization and vaccines.

13 hours

UNIT IV: Transplantation and Tumor Immunology: Transplantation: genetics of transplantation; laws of transplantation; tumor immunology, Autoimmunity; Autoimmune disorders and diagnosis.

13 hours

UNIT V: ImmunoTechniques : ELISA, Immuno electrophoresis, RIA, SDS-PAGE, non-isotopic methods for detection of antigens, chemiluminescence assay, immunohistochemistry, monoclonal and polyclonal antibody production.

Course Outcomes:

- Explain the structure and functions of lymphoid organs and types of immunity. Explain the structure, types and properties of antigens and immunoglobulin and analyses the role of gene rearrangement process in antibody diversity.
- Describe the process and mechanism of Humoral and Cell mediated immune response and Complement pathways. Explain and analyses the structure and genetic organization of MHC.
- Explain Organ transplantation and tumour immunology and relates the process of immune tolerance and autoimmunity.
- Exemplify the types of hypersensitivity and explain immune response in microbial infection and to describe Hybridoma technique and its applications.
- Explain and analyses antigen – antibody reactions, immunodiffusion techniques, ELISA, RIA, Western Blot, IF, Flow cytometry, FISH and GISH.

TEXT BOOKS :

1. Roitt I, 2002. Male, Brostoff, “Immunology”, Mosby Publ.,
2. Kuby J. 2000. Immunology”, WH Freeman & Co.,. USA.

REFERENCE BOOK:

1. Ashim K. Chakravarthy. 1998. “Immunology”, TataMcGraw-Hill,
2. Fathimunisa Begum, 2014. Immunology. PHI learning Pvt. Ltd., New Delhi.
3. Kuby,J. 2007. Immunology. 6th edition. W.H. Freeman and company,New York.
4. Lydyard M., A.Whelan and M.V. Fanger. 2000. Instant notes in Immunology.
5. Peter Delves, Seamus Martin, Dennis Burton, Ivan Roitt. 2006. XI edition. Roitt’s Essential Immunology Wiley - Blackwell.

6. Roitt, I., 2002. Essentials Immunology. VI edition, Elsevier Science Publishing Company, New York.
7. Tizard, I.R. 1995. Immunology – An Introduction, IV Ed. Saunders College Publications, Philadelphia.

**M.Sc., ZOOLOGY – SEMESTER - II
CBCS: 2019-2020 - CORE COURSE**

CC-III: ANIMAL PHYSIOLOGY

Course Code:
Hours/Week: 5 (Total 75 hours)
Credits: 4

Max Marks: 100
Internal Marks: 25
External Marks: 75

Course objective:

- This paper gives information about the structure and function of body organs.
- This course Animal Physiology helps the students in understanding how the body functions adapt with respect to its external and internal environment, related to internal transport system, nervous integration, osmoregulation and sensation.

10 hours

Unit I: Digestion: Digestive tube and its evolution - Primary divisions of the tube - Types of teeth and dental formula in mammals. Feeding, food types and mechanisms - digestion, enzymes, metabolic rate, energy storage.

18 hours

Unit II: Internal Transport and Gas exchange: System of circulation, peripheral circulation, Regulation of heart beat and blood pressure, Transport and exchange of gases, Neural and chemical regulation of respiration, Gas exchangers, Circulatory and respiratory responses to extreme conditions, Acid-base balance, Regulation of blood pH.

20 hours

Unit III: Homeostasis: Osmoregulation in aquatic and terrestrial environments - Kidney functions and diversity, Extra-renal osmoregulatory organs, Patterns of nitrogen excretion. Thermoregulation – Heat balance in animals, adaptations to temperature extremes, torpor, Aestivation and hibernation, Counter current heat exchangers,

Adaptations to stress – basic concept of environmental stress, acclimation, acclimatization, avoidance and tolerance, stress and hormones.

15 hours

Unit IV: Nerve Physiology: General plan of brain and spinal cord, Evolution of cerebral hemispheres and cerebellum, Neuromast organs of lower vertebrates. **Muscle Physiology:** Striated and smooth muscle, Adaptations of muscles for various activities, Neuronal control of muscle contraction, Electrical organs.

12 hours

Unit V: Sensory Physiology: Chemical senses, vibration and sound, light and vision, animal electricity, bioluminescence, transmission and sorting of information, information processing.

Course outcomes:

- After the course, the student should be able to be a competent Physiologist.
- Conduct such clinical/experimental research as would have significant bearing on human health and patient care.
- Acquire skills in conducting collaborative research in the field of physiology & allied sciences.
- Must be able to demonstrate to the students how the knowledge of physiology can be used in a variety of clinical settings to solve diagnostic and therapeutic problems.
- Encourage the student to participate in various workshops/seminars/journal clubs/ demonstration in the departments, to acquire various skills for collaborative research.

TEXT BOOKS:

1. Schmidt-Nielsen, K. 1997. Animal Physiology: Adaptation and Environment, 5TH Ed. Cambridge: Cambridge University Press
2. Hoar, W.S. 1991. General and Comparative physiology (3rd edition). Prentice Hall of India, New Delhi.
3. Nelson, K.S. 1997. Animal physiology. Cambridge University press. Oxford.

REFERENCE BOOKS:

1. Barrington, E.J.W. 1975. An introduction to general and comparative endocrinology 2nd edition. Clarendon Press, Oxford.
2. Welson, A. 1979. Principles of Animal Physiology. Macmillan publishing co., Inc. New York.
3. Herkat, P.C. and Mathur, P.N. 1976. Text book of Animal physiology. S. Chand and Co. Pvt. Ltd., New Delhi.
4. Pradeep V. Jabde. 2005. Text of general Physiology. Discovery Publishing House, New Delhi.

**M.Sc., ZOOLOGY – SEMESTER - II
CBCS: 2019-2020 - CORE COURSE**

CC–VIII: DEVELOPMENTAL BIOLOGY

Course Code:

Hours/Week: 4 (Total: 60 hours)

Credits: 4

Max Marks: 100

Internal Marks: 25

External Marks: 75

Course objectives:

- This course is an experimental science, which provides understanding of the process of early embryonic development, manipulation of developing embryos and to review the current development in the field of embryology.
- To enlighten knowledge about formation of embryo and also provides embryological disorders and treatment methodology.
- To teach the students the information of development and evolution of various cells and embryo.
- To learn the stages of organ development.
- To know the reproductive technology.

15 hours

UNIT-I: Developmental Biology: The stages of animal development, human spermatogenesis and oogenesis, Structure of the human sperm and the egg, Molecular events during mammalian fertilization: Action at a distance, Induction of the mammalian acrosomal reaction, Translocation and capacitation, Hyperactivation and chemotaxis, Fusion of genetic material in mammals, Prevention of Polyspermy.

10 hours

UNIT-II: An introduction to early developmental processes in mammals: The unique nature of mammalian cleavage, Mammalian gastrulation, Formation of extra embryonic membranes, Mammalian anterior-posterior axis formation, Mammalian dorsal-ventral and left-right axes formation.

13 hours

UNIT-III: Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.

10 hours

UNIT-IV: Properties of stem cells: Pluripotency of human embryonic stem cells, Embryonic stem cell lines, Hematopoietic stem cells, Markers commonly used to identify stem cells, Embryonic stem cells and their applications.

12 hours

UNIT-V: Reproductive Technology: MOET- Invitro oocyte maturation, Superovulation, Invitro fertilization. Assisted Reproduction technologies- Embryo sexing and cloning, Screening for genetic disorders, ICSI, GIFT, Cloning of animals by nuclear transfer. Test tube baby. Contraceptive technologies.

Course outcomes:

- Be able to list the types of characteristics that make an organism ideal for the study of developmental biology.
- Be able to label macromeres, mesomeres, and micromeres and know which cell types are derived from each of these cell layers in the early embryo (e.g. primary and secondary mesenchyme, ectoderm, endoderm, mesoderm).
- Be able to describe the stages and cellular mechanisms (ingression, invagination, convergent extension) of gastrulation in the sea urchin. Be able to describe the functions of gastrulation.
- To develop the skill of observing developing organisms and recording by notes and drawings; to introduce some of the surgical and cellular experimental techniques of developmental biology.
- To give training in analysing primary research papers, and in assessing experimental evidence and its interpretation.

TEXT BOOKS:

1. Balinsky, B.I. 2004. An Introduction to Embryology. W. B. Saunders Publishing Company.
2. Scott F. Gilbert. 2000. Developmental Biology. Sinauer Associates, INC Publishers, Sunderland.
3. Arumugam, N. 2014. A Text book of Embryology (Developmental Zoology). Saras Publications, Nagarcoil.

REFERENCE BOOKS:

1. Jonathan, M.W. 1991. Essential Developmental Biology. Wiley Blackwell Publishers.
2. Longo, F.J. 1997. Fertilization. Chapman and Hall publishers, New York.

M.Sc., ZOOLOGY – SEMESTER - II
CBCS: 2019-2020 - CORE COURSE

CC – IX: PRACTICAL II: (COVERING CC-VI & CC-VIII)

Course Code:

Hours/Week: 6 (Total: 90 hours)

Credits: 4

Max Marks: 100

Internal Marks: 40

External Marks: 60

Course objectives:

- To introduce the basic principles and mechanisms involved in imparting immunity and to obtain knowledge on understanding the structure of lymphoid organs.
- Acquire knowledge on structure and properties of antigens and immunoglobulins and acquire skills and competence in specialized immunological techniques.
- To understand knowledge of blood chloride and body fluid function practically.
- To help the students in understanding how the body functions adapts with respect to its external and internal environment.
- Acquire knowledge on experimental science, which provides understanding of the process of early embryonic development, manipulation of developing embryos and to review the current development in the field of embryology.

IMMUNOLOGY

30 Hours

1. Identification of lymphoid organs in rat.
2. Heam – agglutination test.
3. Widal slide test (kit method).
4. Immuno diffusion test.

Spotters.

- i. Lymphoid organs (model)
- ii. Immunoelectrophoresis
- iii. ELISA reader
- iv. Antigen and Antibody complex (picture)
- v. Malarial lifecycle (picture)

ANIMAL PHYSIOLOGY

30 Hours

1. Estimation of amylase activity in relation to different pH.
2. Quantitative estimation of Ammonia & Urea.
3. Rate of salt loss and gain in fish using different experimental media.
4. Estimation of blood chloride.
5. Blood grouping and coagulation.
6. Estimation of Hemoglobin .
7. Estimation of Blood glucose level in human (GOD kid).

Spotters: i. Vital organs (model) Brain of man, Heart of man, Kidney of man,
ii. ECG.
iii. Sphygmomanometer.
iv. Clinical Thermometer.

DEVELOPMENTAL BIOLOGY

30 Hours

1. Examination of fresh sperms of rat (count, motility and vitality).
2. Suspension and smear preparation of bull sperm and observation of spermatozoa.
3. Vaginal smear preparation in rat.
4. Mounting of different stages of chick embryo.
5. Pregnancy test.

Spotters:

- i. Different developmental stages of chick embryo and frog embryo.
- ii. Blastula of Frog, Gastrula of Frog

Practical record to be submitted by the candidates at the time of practical examination.

Course Outcomes:

- Knowledge among students to give an idea about various immunological techniques to be applied for their research work in future.
- Justify various tests to detect the disorders of our body.
- Describe the role of pH in our body and its impact related to body.
- Relates the importance of Hemoglobin in our body.

- Assess the reproductive technology and to find out structure of spermatozoa and to compare the type of embryo of lower forms.

TEXT BOOKS:

1. Arumugam, N. 2015. A Text book of Embryology, Saras Publication.
2. Berry, A.k. 2003. An introduction to Embryology. Emkay Publications, New Delhi.
3. Amsath, A. 2009. Practical manual in zoology. M.M.A Publications, Pattukkottai.
4. Schmidt-Nielsen, K. 1997. Animal Physiology: Adaptation and Environment, 5TH Ed. Cambridge: Cambridge University Press
5. Roitt I, 2002. Male, Brostoff, “Immunology”, Mosby Publ.,

REFERENCE BOOKS:

1. Verma, P.S. and Agarwal, V.K. 2007. Chordate Embryology, S. Chand and Company, Pvt Ltd.
2. Twymann, R.M. 2003. Developmental Biology. Viva Books Private Ltd., New Delhi.
3. Hoar, W.S. 1991. General and Comparative physiology (3rd edition). Prentice Hall of India, New Delhi.
4. Kuby J. 2000. Immunology”, WH Freeman & Co., USA.

**M.Sc., ZOOLOGY – SEMESTER - II
CBCS: 2019-2020 – ELECTIVE COURSE**

EC – I a: MICROBIOLOGY

Course Code:

Hours/Week: 6 (Total: 90 hours)

Credits: 5

Max Marks: 100

Internal Marks: 25

External Marks: 75

Course Objectives:

- To get a fundamental knowledge about microbes and to understand the role of microbes in different spheres of life.
- To enlighten the students with the new information related to microbes.
- To teach the students understanding development of antibodies responses to a vaccine.
- To give the idea about environmental microbes which hamper the life in society in various ways.
- To give knowledge about preventive measures on microbes attach on various stages.

14 hours

Unit-I: Microbes in our lives: History of Microbiology- Discovery of microorganisms (Robert Hooke & Leeuwenhoek). Contributions of Francesco Redi, Needham, Splallanzani, Pasteur, Robert Koch, Edward Jenner, Ehrlich, Fleming, Dubos and Winogradsky. Classification based on–Carolus Linnaeus, Carl Woese and Robert –H. Whittaker (Five Kingdom system).

19 hours

Unit-II: Microbial Growth: Physical and Chemical requirements - Growth of bacterial culture –Physical & Chemical requirements for growth; Phases of growth - Prokaryotic cell –ultra structure and functions of bacterial cell wall, plasma membrane, flagella, pili, capsules, nuclear materials and spores. Structure of enveloped (Morphology and structure of Herpes) and non-enveloped virus (Morphology and structure of Tobacco Mosaic

Virus) and bacteriophages (Morphology and structure of T4 Bacteriophage). Distinguishing characteristics of Fungi –Filamentous, non-filamentous and dimorphic fungi; Morphology and structure of *Aspergillus niger* and *Saccharomyces cerevisiae*.

14 hours

Unit-III: Metabolic diversity among organisms – Photoautotrophs, Photoheterotrophs, Chemoautotrophs, Chemoheterotrophs. Energy production –oxidation –Reduction reactions, Oxidative and Phosphorylation. Metabolic pathways of energy production – Glycolysis, Entner –Doudoroff pathway, Aerobic and Anaerobic respiration, Photosynthetic metabolisms –Light & Dark reactions.

14 hours

Unit-IV: Food Microbiology: –Types of foods –Spoilage process (souring, putrefaction, rancidity and soft rot) Preservation of foods (Physical and Chemical agents) Food poisoning and Microbial toxins. Environmental Microbiology – Role of microorganisms in nutrient cycling -Nitrogen, Carbon, Sulphur and Phosphorous.

14 hours

Unit-V: Applied Microbiology –Sewage Treatment, Biofertilizer (Rhizobium, Azolla) Production of Penicillin and SCP. Microorganisms and Human disease – Causative agent, symptoms, transmission, prevention and control of Tuberculosis, Cholera, Typhoid, AIDS, Hepatitis, Polio and Candidiasis.

Course Outcomes:

- The students will be able to recognize the scope of microbiology.
- Narrate the nutrition for bacterial growth and the factors affecting the growth.
- Ability to produce fermented products using bacteria.
- To emphasise the importance of bioremediation bacteria and its importance to clean the environment which hamper the society in various ways.
- To gain knowledge about microbes as disease causing agent in various environment such as soil, water and atmosphere.

TEXT BOOKS:

1. Pelczar, M.J., E.C.S. Chan and N.R. Kreig. 2009. Microbiology, fifth edition. McGraw-Hill. Book Co. Singapore.
2. Tortora, G.J., Funke, B.R. and Case, C.L. 2009. Microbiology: An Introduction. 9th Edition, Pearson Education, Singapore.
3. Madigan, M.T., Martinkl, J.M. and Parker, J. 2009. Brock Biology of Microorganisms, 12th Edition, MacMillan Press, England.
4. Prescott, L.M., Harley, J.P. and Klein, D.A. 2008. Microbiology (7th edition) McGraw Hill, Newyork.
5. Stanier, R.Y., Adelberg, E.A. and Ingram, J.L. 1991. General Microbiology, 5th Ed., Prentice Hall of India Pvt. Ltd., New Delhi.
6. Cappuccino and Sherman, 2012. Microbiology – A Laboratory Manual. 7th Edition, Dorling Kindersley (India) Pvt. Ltd., New Delhi
7. Gunasekaran, P. 2008. Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi.

8. Harry W. Seeley, J.R., Paul, J.VanDemark and John J.Lee. 1997. *Microbes in Action – A Laboratory Manual of Microbiology*. W.H.Freeman and Company, New York

REFERENCE BOOKS:

1. Alcamo, I.E. 2001. *Fundamentals of Microbiology*, sixth edition, Addison wesley Longman, Inc. California.
2. Alexopoulos, C.J., C.W. Mims and M.Blackwell. 2000. *Introductory Mycology*. fifth edition John Wiley & Sons. Chichester.
3. Atlas, R.A. and Bartha, R. 2000. *Microbial Ecology. Fundamentals and Application*, Benjamin Cummings, New York.
4. Black, J.G.2005. *Microbiology-principles and explorations*, 6th edition. John Wiley & Sons, Inc. New York
5. Dubey, R.C. and Maheswari, D.K. 2010. *A Text Book of Microbiology*. S Chand, New Delhi.
6. Johri, R.M., Snehlatha, Sandhya Shrama, 2010. *A Textbook of Algae*. Wisdom Press, New Delhi.
7. Kanika Sharma, 2011. *Textbook of Microbiology – Tools and Techniques*. 1st Edition, Ane Books Pvt. Ltd., New Delhi.
8. Kanika Sharma, 2009. *Manual of Microbiology – Tools and Techniques*. 2nd Edition, Ane Books Pvt. Ltd., New Delhi.
9. Kulanthaivel,S and S. Janarthanam 2012. *Practical Manual on Fermentation Technology*. I.K. International Publishing house. New Delhi.

M.Sc., ZOOLOGY – SEMESTER - II
CBCS: 2019-2020 – ELECTIVE COURSE

EC-I b: WILDLIFE AND CONSERVATION BIOLOGY

Course Code:

Hours/Week: 6 (Total: 90 hours)

Credits: 5

Max Marks: 100

Internal Marks: 25

External Marks: 75

Course objectives:

- The main aim of this paper is to know the status of wild animals, contribution of NGOs and to explain the importance of sanctuaries and national parks.
- To create an awareness to the students about wildlife and this paper is used for conservation and management issues wildlife.
- To teach the students about the scientific methods and its application in wildlife conservation.
- To know the various wildlife laws and its importance to safeguard the wildlife and to prevent the man and animal conflict among public.
- To emphasize to the students about the contribution of NGOs in wildlife conservation in national and international level.

15 hours

UNIT-I: Introduction to Wildlife: Definition – importance of wildlife, causes for wildlife depletion - methods of wildlife conservation. IUCN classification: Rare, threatened, vulnerable, Endangered and Extinct animals. Endangered animals of India-amphibians, reptiles, birds and mammals. Forest types in India – characteristics and animal adaptation.

15 hours

UNIT-II: Wildlife management and conservation: Convention on wetlands of International Importance (Ramsar convention). Climate changes and wildlife conservation – *in situ* and *ex situ* methods. Bird migration and conservation. Captive Breeding of Wild Animals. Community participation in wildlife management.

17 hours

UNIT-III: Sanctuary, National park and Zoo: Aim and management of Sanctuaries, National parks and Zoos. Brief account of Mudumalai, Periyar Tiger reserve, Point Calimere, Vedanthangal wildlife sanctuary, Barathpur Kealadeo, Silent Valley, Kaziranga and Gulf of Mannar National parks. Project Tiger- aims and tiger reserves. Project elephant – aims and elephant reserves. Biosphere reserves.

13 hours

UNIT-IV: Population Estimation: Direct count (Total counts, Drive counts, Transect methods, block count) - Indirect counts (play back, track count, pellet count, pugmark, camera trap) – Mark-recapture method. Different capturing technique (avian and mammal).

15 hours

UNIT-V: Wildlife Health and conservation: Importance of wildlife health management. Major diseases of wild animals (Anthrax, Foot and Mouth Disease, Rabies, Tuberculosis, Yellow fever). Wildlife Forensics and postmortem examinations. Wild life Trade & legislation. Salient features of Indian wildlife protection act (1972). Role of governmental and non-governmental organizations in wildlife conservation: IUCN, WWF, BNHS, SACON.

Course outcomes:

- To know about various wild animals' status and their importance by reading this course.
- To find out the conservation issues and wildlife act to safeguard the various wild animals.
- To get information of various sanctuaries and national parks and their importance so as to enable the students to face various competitive exams like IFS.
- The role of NGOs and their importance by carrying out various projects to safeguard the Indian wildlife.
- Students get through the employment opportunities in various research institutions and the students are able to understand the Indian Wildlife Protection Act (1972).

TEXT BOOKS:

1. Dasmann, R.F. 1964. Wildlife Biology, John Wiley and Sons New York. P 231.
2. Giles, R.H.Jr. (Ed.). 1984. Wildlife Management Techniques 3rd edition. The Wildlife Society, Washington. D.C. Nataraj Publishers, Dehra Dun. India. P 547.
3. Robinson, W.L. and Eric, G. Bolen, 1984. Wildlife Ecology and Management. Max Millan Publishing Co, New York. P 478.

REFERENCE BOOKS:

1. Rodgers, W.A. 1991. Techniques for Wildlife census in India – A field Manual: Technical Manual – TM – 2. WII.
2. Saharia, V.B. 1982. Wildlife of India, Nataraj Publishers, Dehra Dun, P 206.

3. Teague, R.D. (Ed.). 1987. A manual of wildlife conservation. The wildlife Society, Washington. D.D.Nataraj Publisheers, Dehra Dun, P 206.

M.Sc., ZOOLOGY – SEMESTER - II
CBCS: 2019-2020 – OPEN ELECTIVE COURSE (OEC)
(OPEN TO ALL)

OEC a – MEDICAL ZOOLOGY

Course Code:

Hours/Week: 4 (Total: 60 hours)

Credits: 4

Max Marks: 100

Internal Marks: 25

External Marks: 75

Course objectives:

- The main aim of this paper is to give information about life cycle and diseases caused by parasites (viral, bacterial, fungal, helmenths) in human being and also their effects and control measures.
- Students able to know about various ecto and endo parasites in human and its effect, preventive measures.
- To enlighten the students about the contribution of various sources such as government and non governmental agencies to prevent the diseases.

10 hours

UNIT I: Medical Protozoology: Definition – human welfare - Detailed study – Malarial parasite – Structure, Life cycle – Mode of transmission-Disease Symptoms-treatment and preventive measures. Pyorrhoea, Diarrhoea, Leishmaniasis, Trichomoniasis.

13 hours

UNIT II: Medical Helminthology: Detailed study – *Ascaris*, *Taenia solium*: Structure, Life cycle-Mode of transmission – Disease caused and symptoms – treatment and preventive measures. Helminth diseases: General account and diseases of Schistosomiasis, Ancylostomiasis, Enterobiasis, Trichuriasis, Trichinosis, Trichinella, Strongyloidiasis and Filariasis. Accommodation and tolerance in host-parasite relationship.

10 hours

UNIT III: Medical Entomology: Morphology and life cycle of Mosquitoes and Housefly – role as vectors and control measures. General account and diseases transmitted by cockroach, Flea, ticks, mites, Louse, Bedbug.

10 hours

UNIT IV: Methods of diagnosing diseases: Examination of stool: Direct examination – sedimentation technique, floatation technique and egg counting technique. Examination of blood – thick smear and thin smear methods. Examination of urine: Bacterial examination – Gram Positive and Gram Negative. Plate count method, Direct microscope count. Health Education: Health Plans of India – Role of WHO

12 hours

UNIT V: Bacterial and Viral diseases: Bacterial diseases: Cholera, Typhoid, Tuberculosis – Mode of transmission – Symptoms and diagnosis – Treatment and preventive measures. Viral diseases: Dengue, Chickungunya, Swine fever, Measles, Influenza, Rabies, Encephalitis, Polio, Plague, AIDS and SARS. Mode of transmission – symptoms and diagnosis – treatment and preventive measures - Geographical influence of diseases and step taken by government.

Course outcomes:

- To aware the students about personal and public health hygiene.
- Analyse the importance of medical care among students in the initial stage and its preventive measures.
- Explain the importance of medical care among students.
- The students may take care of the society and their family or surrounding against disease causing agents.
- Drug design may be attempted by the students in future.

TEXT BOOKS:

1. Manson-bahr, P.E.C and Bell, D.R. 1892. Manson’s Tropical diseases. English Language Book Society Bailliere Tindoll. P 1535.
2. Asa. C Chanler and Clark, P. Read. Introduction to Parasitology. Wiley Eastern Private Ltd. New Delhi. P 822.

REFERENCE BOOKS:

1. Ramnik sodd. 1993. Parasitology. CBS Publishers & Distributor, Delhi. P 281.
2. Park, K. 2005. Park’s Text Book of Preventive and social medicine (18th Edition). M/s. Banarsidas Bhanot Publishers, Jabalpur, India.
3. Shryock, H. 1979. Modern Medical Guide. Pacifica Press Publishing Association, California, USA.

**M.Sc., ZOOLOGY – SEMESTER - II
CBCS: 2019-2020 – OPEN ELECTIVE COURSE (OEC)
(OPEN TO ALL)**

OEC b – HUMAN HEALTH AND HYGIENE

Course Code:
Hours/Week: 4 (Total: 60 hours)
Credits: 4

Max Marks: 100
Internal Marks: 25
External Marks: 75

Course objectives:

- The main aim of this paper is to give information about human health and diseases and preventive measures.
- To aware the students about personal and public health hygiene.
- To understand the importance of micro and macronutrients and their sources.
- To teach the students home as an health centre.
- To teach the students importance of balanced diet for good health.

10 hours

Unit I: Health: Definition – dimensions of health – Health education: definition – objectives – principles – Nutrition and health: malnutrition - Balanced diet – food hygiene Environment & Health: Water, Air and Noise pollution -Pollutants, effects, prevention and control – effects of smoking and alcoholism.

14 hours

Unit II: Concept of disease: Phases of disease – Prepathogenesis and Pathogenesis – concept of prevention and control – common Arthropod borne diseases. Classification of communicable diseases – agent factors - mode of transmission – symptoms and treatment of Tuberculosis, Typhoid, Hepatitis A & B and AIDS - Family planning: Definition – scope – contraceptive devices

10 hours

Unit III : Mental health: Definition - characteristics – causes and prevention of mental health - Occupational health & hazards – prevention – Health care services – primary

health care – hospitals –Principles of First Aid. Production of human insulin. Disease Diagnosis. Gene therapy and Transplantation therapy.

8 hours

Unit IV: Structure and function of various organs: eye, ear, skin, heart, lung, digestive system, reproductive system, excretory system, nervous system – pathogens affecting the various system – effects of smoke, drug on human health. UTI infections. Drug side effects.

8 hours

Unit V: Air borne, water borne diseases: heavy metal contamination on human health – food toxins – climate change and diseases – organ transportation and success – plastic surgery – role of herbal drugs in human health - role of WHO in human health and hygiene.

Course Outcomes:

- To aware the students about personal and public health hygiene.
- Analyse the importance of medical care among students in the initial stage and its preventive measures.
- Explain the importance of medical care among students.
- The students may take care of the society and their family or surrounding against disease causing agents.
- Drug design may be attempted by the students in future.

TEXT BOOKS:

3. Manson-bahr, P.E.C and Bell, D.R. 1892. Manson’s Tropical diseases. English Language Book Society Bailliere Tindoll. P 1535.
4. Asa. C Chanler and Clark, P. Read. Introduction to Parasitology. Wiley Eastern Private Ltd. New Delhi. P 822.

REFERENCE BOOKS:

4. Ramnik sodd. 1993. Parasitology. CBS Publishers & Distributor, Delhi. P 281.
5. Park, K. 2005. Park’s Text Book of Preventive and social medicine (18th Edition). M/s. Banarsidas Bhanot Publishers, Jabalpur, India.
6. Shryock, H. 1979. Modern Medical Guide. Pacifica Press Publishing Association, California, USA.

**M.Sc., ZOOLOGY – SEMESTER - III
CBCS: 2019-2020 - CORE COURSE**

CC- X: RESEARCH METHODOLOGY AND BIOTECHNIQUES

Course Code:

Hours/Week: 5 (Total 75 hours)

Credits: 4

Max Marks: 100

Internal Marks: 25

External Marks: 75

Course objectives:

- To give information about basic concept of research and how to write/publish a thesis and its basic steps.
- Critically analyze Microtechniques, cryotechniques and tissue culture techniques.
- To know the statistical problems in biological science, this is useful for the students for their research works.
- To train the students to collect, organize and analyze data.
- Learn to apply different statistical tools in presenting biological data.

18 hours

UNIT I: Research Methodology: Concept of Scientific research – selection of a research problem – Research design – sampling methods –Data collection – Making observation and records. Reference collection – Preparation of index and reference cards. Refereed journals, Impact factor, Citation index –H-factor. **Thesis Preparation:** Components of thesis - Preparation of scientific paper for publication in a journal. Internet and e-journals. Using computers in research.

13 hours

UNIT II: Model organisms: Culture and Maintenance of Hydra, C. elegans, drosophila, xenopus, zebra fish, rat, mouse.– CPCSEA regulations - animal maintance and handling. **Microtechniques :** Permanent mounting: Narcotization and killing – fixing – washing –

processing – staining – mounting – labeling. Histological preparation of tissues for SEM and TEM.

13 hours

UNIT III: Biotechniques: Design and functioning of tissue culture laboratory - cell proliferation measurements – Cell viability testing – Culture media preparation. Types of culture: – Flask, Test tube, Organ and Embryo culture. Cryopreservation techniques. Cryotechniques for microscopy. Biosensors and biochips – Applications.

13 hours

UNIT IV: Biostatistics: Measures of Central Tendency - Introduction, Characteristics, Merits and Demerits of Mean, Median and Mode. **Measures of Dispersion:** Range and Standard Deviation. Standard Error and Relative Measures of Dispersion, Skewness and Kurtosis.

18 hours

UNIT V: Correlation Analysis: Correlation - types and methods of correlation analysis, Problems for Karl Pearson's correlation coefficient and Spearman's rank correlation. Regression and Line of Best Fit, Types and methods of regression analysis. Graphic Methods (Scatter method, Curve fitting). **Testing of Hypothesis:** Hypothesis and types, Sampling, Methods and Errors. Tests of significance. Chi- Square Test, Student's 't' and Analysis of Variance (ANOVA - One way). SPSS and its application.

Course outcomes:

- Relate to the learning process of how to write thesis and how to publish papers in various journals and to produce transformants by employing the various transfer techniques in the applied research.
- Experiments with the concept of permanent mounting and its application.
- Critically evaluate cell culture techniques in various experiments.
- Explain the scope of Biostatistics
- Test the hypotheses using chi-square test, compare the data using 't' test, analyze the data using ANOVA, explain types of Correlation and regression and to analyze and apply various statistical tools.

TEXT BOOKS:

1. Gurumani, N. 2006. Research methodology for biological science, MJP Publishers, Chennai, P 753.
2. Sathyanarayana, U. 2006. Biotechnology. Books and Allied (P) Lit. India.
3. Dubey, R.C. 2001. A text book of biotechnology, Rajendra Printers, New Delhi.
4. Das, H.K. 2005. Text book of biotechnology (second edition). Wiley Dreamtech India Pvt Ltd., New Delhi. P 149.
5. Arumugam, N., Gopi, A., Sundaralingam, R., Meena, A. and Kumaresan, V. 2009. Biostatistics, Computer Application, Bioinformatics and Instrumentation. Saras Publication, Nagercoil.
6. Ramakrishnan, P. 1995. Biostatistics. Saras Publications, KanyaKumari.

7. Gurumani, N. 2005. An Introduction to Biostatistics 2nd Edition, MJP Publishers, Chennai.
8. Sharma, A.K 2005. Text book of Biostatistics, Discovery publishers House, New Delhi.

REFERENCES BOOKS:

1. John, R.W and Masters, D. 2000. Animal cell culture. A practical approach. IRC Press.
2. Ignacimuthu, S. 1996. Basic Biotechnology. Tata McGraw – Hill publishing company Limited, New Delhi.
3. Anderson, Dunston and Pole. 1970. Thesis and Assignment writing. Wiley Eastern Ltd., New Delhi.
4. Gupta S.C.& Kapoor V.K, (2000): Fundamentals of & Mathematical Statistics, Sultan Chand Sons 10th edition.
5. Croxton F.E., Cowden D.J. & Kelin S, (1967): Applied General Statistics, Prentice Hall.
6. Hogg and Craig, Introduction to Mathematical Statistics, (2013): Prentice Hall, 7th edition.
7. Daniel, W.W. 2000. Biostatistics - A foundation for analysis in the Health science. John Wiley and sons, New york.
8. Sokal, R.R. and Rohlf, F.J. 2000. Biometry. Freeman, San Francisco.
9. Zar, J.H. 2003. Biosatistical Analysis. Person Edition Asia, New Delhi.

**M.Sc., ZOOLOGY – SEMESTER - III
CBCS: 2019-2020 - CORE COURSE**

CC-XI: EVOLUTION

Course Code:

Hours/Week: 5 (Total 75 hours)

Credits: 4

Max Marks: 100

Internal Marks: 25

External Marks: 75

Course objectives:

- To enlighten details and knowledge about evolution.
- To provide basic information of evolution of various kinds.
- To know the pattern of evolution.
- To know various theories of origin of evolution.

15 hours

UNIT I: Evolution: Evolution Origin, evolution and diversification of life; natural selection; levels of selection. Types of selection (stabilizing, directional etc.); sexual selection; genetic drift; gene flow; adaptation; convergence; species concepts; Life history strategies; adaptive radiation; biogeography and evolutionary ecology;

15 hours

Unit II: Theories of Evolution: Lamarckism, Neo-Lamarckism, Darwinism and Neo-Darwinism, Mutation Theory, Biogenetic Law. Genetic variability, Natural selection, Genetic drift, Isolation, Origin of new species. Evolution of Social interaction and Cooperation; Sexual selection, Group selection, Hamilton's Rule, Red queen hypothesis, Kin selection, Parent – offspring conflict, mating systems.

UNIT III: Variations: Nature and Kinds of Variation, Cytological basis of variations, Chromosomal aberrations, polyploidy, aneuploidy, Population genetics - Gene frequency, genetic equilibrium, Hardy Weinberg's Law of equilibrium.

UNIT IV: Speciation: Isolating mechanisms. Concept of Species, Migration and Gene flow, Darwin finches, Theories of Speciation, Micro and Macro evolution, Adaptive divergence, Radiation evolution. Monophyly and Polyphyly.

UNIT V: Evolutionary pattern of invertebrate: DNA Barcoding; Cladogenesis and anagenesis - Evolutionary pattern of Birds. Evolutionary pattern of mammals; Evolution of Man, Origin of Man, Special features of primates, Compelling causes of evolution of Man, Evolutionary trends, Cultural evolution, Civilization, human races, future of man.

Course outcomes:

- Describe the basic methods that are used to reconstruct the evolutionary histories of, and relationships among, groups of organisms.
- Based on evolutionary theory, predict how differences in population size, natural selection and gene flow will affect genetic variation and future adaptability of populations.
- Apply knowledge of evolution to the solution of problems facing the human population and to the preservation of biodiversity.
- Exemplify problems in human society that are caused by a misunderstanding of the scientific process generally, and of evolution specifically.

TEXT BOOKS:

1. Moody, P.A. 1978. Introduction to Evolution. Harper International.
2. Dodson. 1990. Evolution, Reinhold, New York.
3. Arumugam, N. 2015. Evolution, Saras Publication, Nagarkoil.
4. Dodson, E.V. 1960. Evolution process and product, East West Press, New Delhi.
5. Paulamos Moody, 1978. Introduction to Evolution. Kalyani Publishers, Ludhiana, New Delhi.
6. Camilo J.Cela - Conde and Francisco J. Ayala. 2007. *Human Evolution-Trails from the Past*. Oxford University Press.Oxford ,UK
7. Campbell.B.G.2009. *Human Evolution*. Transaction Publishers, NJ, USA.
8. Gould, S,J. 2002. *The Structure of Evolutionary Theory*. Harvard University Press, MA, USA.

REFERENCE BOOKS:

1. Darwin, C.D. 1859. *On the Origin of Species by Means of Natural Selection*. John Murray, London.
2. Elliott,Sober.2008. *Evidences and Evolution: The Logic Behind the Science*. Cambridge University Press,UK.
3. Monroe W. Strickberger. 2000. Evolution. 3rd Edition John & Bartlett Publishers.
4. Brian k. Hall, Benedikt, 2014. Hallgrimsson Strickberger's Evolution. 5th Edition. John & Bartlett learning, an Ascend learning company.
5. Nicholes H. Barton, Berek E.G. Briggs, Jonathan A. Eisen, David B. Goldstein &

- Nipam H. Patel. 2007. Evolution. John Inglis publisher, Cold Spring Harbor Laboratory Press.
- Care T. Bergstrom. Lee Allan Dugatkin, 2012. Evolution Printed in the United States of America. International Student edition.
 - Jobling. M, Hollox. E, Hurles .M, Kivisild. T, Tyler Smith .C. 2014. Human evolutionary genetics. 2nd Edition. Published by Garland Sciences, Taylor & Francis group New York & London.
 - Arthur, W. 2011. *Evolution – A Developmental Approach*. Wiley-Blackwell, Oxford, UK
 - Futuyma, D.J. 1986. *Evolutionary Biology*. (2nd edn.). Sinauer Associates Inc. MA, USA.

M.Sc., ZOOLOGY – SEMESTER - III
CBCS: 2019-2020 - CORE COURSE

CC-XII: ENTOMOLOGY

Course Code:

Hours/Week: 4 (Total 60 hours)

Credits: 4

Max Marks: 100

Internal Marks: 25

External Marks: 75

Course objectives:

- To teach the basics of insect structure and function.
- To provide the concepts of beneficial insects; predators and parasitoids, pollinators, scavengers, weed feeders, insects of medicinal and aesthetic value.
- To enable the students know about principles and practices of biological control.

15 hours

UNIT I: Insect Morphology: External features and their articulation. Comparative study of head, antennae, mouth parts; thorax – legs, wings; abdominal appendages, genitalia.

Taxonomy: Classification of insects; origin and evolution of insects. **Insect physiology:** Structure and physiology of integumentary, digestive, excretory, circulatory, respiratory, endocrine, reproductive, nervous system and sensory receptors.

12 hours

UNIT II: Insect embryology: Egg - Egg development - Cleavage - Blastoderm formation - Germ bands - Gastrulation and segmentation - Extra embryonic membranes.

Viviparity: Ovoviviparity - Pseudoplacental viviparity - Adenotrophic viviparity - Hemocoelomic viviparity. Polyembryony. Metamorphosis and diapause in insect – Role of hormones in metamorphosis. Parthenogenesis in insects.

15 hours

UNIT III: Insect Molecular Entomology: DNA and RNA analysis in insects- transcription and translocation mechanisms. DNA recombinant technology, identification of genes/nucleotide sequences for characters of insects. Molecular basis of insect

functions (insect behavior, insecticidal resistance), gene knock-ins and knock-outs by RNA interference, DNA and protein sequence alignments. Genetic improvement of natural enemies.

10 hours

UNIT IV: Insect Pests and their Management: Pest of major crops –Pest of Fruits and vegetables – Pest of cereals - Pest of oil seeds and pest of domestic animals. **Management: Prophylactic measures:** Cultural – Mechanical – Physical and Chemical methods. **Pesticides:** Definition of pesticides, Dose-response relationship; mode of action of insecticide, carcinogenic, mutagenic and teratogenic effects, and evaluation of toxicity.

08 hours

UNIT V: Biological control of Insects: Parasites – Predators. **Non Conventional Methods:** IGR – Repellants – Pheromones – Genetic and Quarantine. **IPM:** IPM and their management.

Course outcome:

- Explain the morphology of insects and analyze the appendages and their function.
- Relates the structure and function of organ systems, describe classification, biology and control of insect vector and control.
- Explain insect metamorphosis and analyze role hormones in metamorphosis and to analyze genetic material in insects.
- Explain the recombinant technology in insects and to describe molecular basis of insect behavior. List the types of pesticides, modes of actions, and efficacy. Identify the insect pests of crops, vegetables, fruits, stored grains and household pests.
- Enhance the productivity of agricultural crops through insect pest management and to analyze and apply the biological control of insect pests. Explain the IPM

TEXT BOOKS:

1. Ashok Kumar and P.M. Nigam. 2010. Economic and Applied Entomology. Emkay Publications. Delhi.
2. Vasantharaj David, B, and T. Kumaraswami. 1975. Elements of Economic Entomology. Popular Book Depot, University of Minnesota.
3. Chapman, R.F., 1998. The Insects: Structure and Function. Cambridge Univ. Press, Cambridge.
4. David, B.V and Anan, Gullan, P.J. and Cranston, P. 2005. The Insects, an outline of Entomology, 3rd Edition Blackwell, Publishing Ltd., USA.
5. Mani, M.S. 1982. General Entomology, Oxford and IBH Publishing Co., New Delhi.
6. Tembhare, D.B. 2015. Modern Entomology, Himalaya Publishing House, Delhi.
7. Wigglesworth, V.B. 1992. Physiology of Insects, IX Ed., Chapman and Hall, London.

REFERENCE BOOKS:

1. Borror, D.H., and De Long. 1964. An Introduction to the study of Insects, Holt Reinhart & Winston Inc., New York.
2. Chapman, R.F. 1992. The Insects: Structure and Function, Hodder and Broughton Ltd., Kent, U.S.A.
3. Nayar, K.K., Ananthkrishnan, T.N., and David., M. 1995. General and Applied Entomology, Tata McGraw Hill Pub. Co., Ltd., New York.
4. Richards, O.W., and R.G. Davies. 1983. General Text Book of Entomology, X Ed., Vols. I and II, Chapman and Hall, New York.
5. Snodgrass, R.E. 1985. Principles of Insect Morphology, McGraw Hill and Co., New York.

**M.Sc., ZOOLOGY – SEMESTER - III
CBCS: 2019-2020 - CORE COURSE**

CC-XIII: BIOTECHNOLOGY

Course Code:
Hours/Week: 4 (Total 60 hours)
Credits: 4

Max Marks: 100
Internal Marks: 25
External Marks: 75

Course objectives:

- Familiarize on the molecular and genetic tools used to analyze genomes, modify genetic material and techniques for modifying organisms to produce desired products.
- Plan for and manage formulation and execution of protocols and innovative technologies and/or products.
- Enlighten issues of forensic and genetic identity with case studies.
- Educate basic philosophical and ethical considerations regarding genetic data, genetic manipulation and Biosafety issues.
- Demonstrate knowledge of essential facts of biotechnology and description of key scientific events of biotechnology

13 hours

Unit I: Tools and techniques of Genetic Engineering: Basic Principles of Genetic Engineering; Restriction enzymes, Linkers/Adaptors; Cloning Vectors – Salient Features and Types – Plasmids, Phages, Cosmids, Transposons, Shuttle and Expression Vectors; Insertion of a Foreign DNA into a Vector, Transfer of rDNA into a Bacterial Cell, Selection & Screening of Recombinants, Blotting Techniques.

12 hours

Unit II: Industrial & Environmental Biotechnology: Fermentation – Types, Fermenter Designs, Upstream and Down Stream Processing, Product Recovery and Purification; Production of Alcohol and Vitamins. Biofuels, Bioremediation, **Phytoremediation**,

Biodegradation, Biomining and Biosorption. **Energy:** Biofuel production using microorganisms (hydrogen and methane).

12 hours

Unit III: Farm biotechnology: Cultivation of Animal Cells in a Bioreactor; Somatic Cell Fusion, Applications of Cell Culture – tPA Blood Factor VIII and Erythropoietin; Organ Culture; Transgenic Animals – Transgenic Goat. **Fish:** sterile fish production through chromosomal and hormonal manipulation, androgenesis, gynogenesis, artificial hybridization, cryopreservation of milt, transgenic production of carp and catfish.

10 hours

Unit IV: Medical Biotechnology: Nanotechnology for drug targeting and gene therapy, DNA vaccines. Pharmacogenomics and personalized medicine. Molecular docking, molecular markers. Biotechnology of forensic medicine.

13 hours

Unit V: Enzyme Biotechnology: Microbial Production of Enzymes, Immobilisation of Enzymes and its applications. Agricultural Biotechnology: Agrobacterium as a natural genetic engineer; Single Cell Protein, Nitrogen fixation – nitrogen fixing organisms, mechanism and genetics of fixation; Bio-pesticides; Biofertilizers.

Course outcomes:

- Explain a thorough knowledge of the genome and provide basic practices for modifying organisms to produce desired products. Experiments with concepts of selection and screening of recombinants.
- Outline the methodology and the wide applications of biotechnology for the production of various industrial products. Appraise the environmental applications of biotechnology to clear the pollutants and production of bioenergy using microbe.
- Explains the large scale cell culture and somatic cell fusion. Whole organ culture. Transgenic animal – goat. Importance of sterile fish, monosex culture of male, female by steroid hormones, hybridization and genetic selection.
- Target tissue of choice for gene delivery system and application of nanotechnology in drug delivery. Concepts of pharmacogenomics and personalized medicine and their advantages. States the approaches used for molecular markers. Methods involved and the application in forensic medicine.
- Advantages of biotechnology in enzyme production using microbes. Aspects of biotechnology in the production of SCP, nitrogen fixing, Bio-pesticides and Biofertilizers to improve the agriculture.

TEXT BOOKS:

1. Dubey, R.C. 2008. A Text Book of Biotechnology, S. Chand & Co, New Delhi.
2. Kumaresan, V., 2006. Biotechnology, Saras Publication, Nagercoil.
3. Gupta, P.K. 2006. Elements of Biotechnology, Rastogi Publications, Meerut.
4. Lewin, B. 2002. Gene XI, Oxford University Press, New York.

5. Old R.N. and S.B. Primrose. 1996. Principles of Gene manipulation. Blackwell scientific publication.
6. Watson, J.D. Gilman, M. Witkowski, Zollu, M. 1992. Recombinat DNA scientific American books.

REFERENCE BOOKS:

1. The molecular biology of the Gene – J.D. Watson et al. Benjamin Cummings.
2. Glick. B.R and Pasteric Jack, J. 2001. Molecular biotechnology A.S.M press London.
3. Chopra, V.L and nanin, A. 1992. Genetic engineering and biotechnology. Oxford and IBH publishing company, New Delhi.
4. Marx, J.L. A revolution in biotechnology. Cambridge university press. Cambridge.
5. Das, H.K. 2005. Text book of biotechnology (second edition). Wiley dreamtech India Pvt Ltd, New Delhi. P 149.

**M.Sc., ZOOLOGY – SEMESTER -III
CBCS: 2019-2020
CORE COURSE**

CC – XIV: PRACTICAL - III (COVERING CC-X to CC-XIII)

Course Code:	Max Marks: 100
Hours/Week: 6 (Total 90 hours)	Internal Marks: 40
Credits: 4	External Marks: 60

Course Objectives:

- To introduce the basic principles and mechanisms involved in imparting various research methodology techniques.
- To obtain knowledge on how to write scientific papers, how to write thesis in various fields.
- Acquire knowledge on various instruments used for research and its application in research fields.
- To help the students the formation of evolution of various taxa and its importance in biological research.
- Acquire knowledge on experimental science, which provides understanding of the insect taxa morphology and internal structure.

RESEARCH METHODOLOGY AND BIOTECHNIQUES: 25 Hours

1. Preparation of index and reference cards.
2. Power point presentation.
3. Buffer preparation – phosphate and acetate, citrate and Tris-HCL
4. Agrose Gel Electrophoresis (AGE) to detect DNA.
5. Preparation of different media of animal tissue culture.
6. Microtechniques – slide preparation
7. Assay of cell viability

Spotters:

- i. Electrophoresis
- ii. Microtom
- iii. Buffer
- iv. Eosin stain
- v. Haemotoxylin stain

EVOLUTION:

10 Hours

1. Study of the skull of vertebrates - Varanus, Crocodile, Bird, Dog, Rabbit/ Rat

Spotters: Study of Fossils (Ammonoids, Trilobite, Nautiloids & Echinoderm fossils).

ENTOMOLOGY

25 Hours

1. Dissection: Digestion system of Cockroach.
Nerve system of Cockroach.
Reproductive system of Cockroach.
2. Mounting: Grass hopper ovipositor.
3. Isolation of protein in Housefly.
4. Isolation of DNA in Housefly.
5. Behavioural analysis of pheromone in Red ants.
6. Determination of LC₅₀.
7. Study on silk gland of silkworm.
8. Study on salivary gland of cockroach.
9. Fieldwork: Collection of insects from various habitats and preserved in insect boxes and submit a field report.

Spotters: Moth, Butterfly, life cycle of insects (silk worm, honey bee), pest of cereals, DDT, wasp, lice, bed bug, repellents, rhinoceros beetle, insect net, aspirator, spreading board, killing jar.

BIOTECHNOLOGY

30 Hours

1. Immobilization of yeast cell.
2. Immobilization of bacteria.
3. Determination of SDS PAGE of protein.
4. Blotting techniques: Southern (demo only).
5. Blotting techniques: Northern (demo only).
6. Transformation.
7. Synthesis of Nanoparticles (AgNO₃).
8. Culture of single cell protein – Algae.

Spotters: Restriction site for ECO RI, Restriction site for Bam HI, Genetic map of pBR 322 vector, Transgenic Goat, automated DNA sequence, cat fish.

Course Outcomes:

- Knowledge among students to give an idea about various biotechniques to be applied for their research work in future.
- Justify various tests to detect the disorders of our body.
- Describe the role of pH in our body and its impact related to body.
- Relates the importance of insect pest in various fields and its impact may be analysed.
- Assess the various research techniques to solve the problems in near future.

TEXT BOOKS:

1. Amsath, A. 2009. Practical manual in zoology. M.M.A Publications, Pattukkottai.
2. Ashok Kumar and P.M. Nigam. 2010. Economic and Applied Entomology. Emkay Publications. Delhi.
3. Vasantharaj David, B, and T. Kumaraswami. 1975. Elements of Economic Entomology. Popular Book Depot, University of Minnesota.
4. Snodgrass, R.E. 1985. Principles of Insect Morphology, McGraw Hill and Co., New York.
5. Moody, P.A. 1978. Introduction to Evolution. Harper International.
6. Dodson. 1990. Evolution, Reinhold, New York.
7. Arumugam, N. 2015. Evolution, Saras Publication, Nagarkoil.
8. Dodson, E.V. 1960. Evolution process and product, East West Press, New Delhi.
9. Gurumani, N. 2006. Research methodology for biological science, MJP Publishers, Chennai, P 753.
10. Zar, J.H. 2003. Biostatistical Analysis. Person Edition Asia, New Delhi.

REFERENCE BOOKS:

1. Sathyanarayana, U. 2006. Biotechnology. Books and Allied (P) Lit. India.
2. Dubey, R.C. 2001. A text book of biotechnology, Rajendra Printers, New Delhi.
3. Das, H.K. 2005. Text book of biotechnology (second edition). Wiley Dreamtech India Pvt Ltd., New Delhi. P 149.
4. Arumugam, N., Gopi, A., Sundaralingam, R., Meena, A. and Kumaresan, V. 2009. Biostatistics, Computer Application, Bioinformatics and Instrumentation. Saras Publication, Nagercoil.
5. Ramakrishnan, P. 1995. Biostatistics. Saras Publications, KanyaKumari.
6. Gurumani, N. 2005. An Introduction to Biostatistics 2nd Edition, MJP Publishers, Chennai.
7. Sharma, A.K 2005. Text book of Biostatistics, Discovery publishers House, New Delhi.
8. Sokal, R.R. and Rohlf, F.J. 2000. Biometry. Freeman, San Francisco.

Practical record to be submitted by the candidates at the time of practical examination.

**M.Sc., ZOOLOGY – SEMESTER - III
CBCS: 2019-2020 - ELECTIVE COURSE - II**

EC- II a: CLINICAL ANALYSIS AND LABORATORY TECHNIQUES

Course Code:	Max Marks: 100
Hours/Week: 6 (Total 90 hours)	Internal Marks: 25
Credits: 5	External Marks: 75

Course objectives:

- Learn to follow safety methods and different clinical lab techniques.
- Preamble to start a clinical lab.
- To know about tools and techniques available for studying biochemical and biophysical nature of life.
- To acquaint with the applications and handling of various instruments.
- To understand the analytical techniques in the field of biology.

18 hours

Unit - I: Instrumentation: The laboratory: Accidents – Universal work precautions (UWP) for laboratory personnel. Sterilization : Introduction – sterilization by heat – cold – ultra violet radiation – Ionizing radiations – Filtration – chemical sterilization – Glass preparation for use.

18 hours

Unit – II: Blood counting: Knowledge and skill in collecting blood samples. Analysis of blood and basic haematological techniques. Blood cell morphology in health and disease – RBC, WBC, Total count and differential count, Haemoglobin estimation.

18 hours

Unit – III: Haematological techniques: Haematocrit, packed cell volume, MCH, MCHC, MCV, Erythrocyte sedimentation rate, RBC fragility test, platelet count. Reticulocytocrit, haemorrhagic disorders, clotting time, Bleeding time, prothrombin time.

18 hours

Unit – IV: Clinical Analysis: Knowledge and skill in the study and analysis of urine. Physical parameter, Colour, Odor, pH, Density. Chemical parameters routinely required

to be analysed –Sugar, Albumin, Ketone bodies and their clinical significances
pregnanacy tests.

18 hours

Unit – V: Clinical Studies: Analysis of faeces, semen, cerebrospinal fluid for clinical investigation. Study of vectors in the transmission of diseases with suitable examples. Techniques - RIA, ELISA, WESTERN BLOT and WIDAL TEST.

Course outcomes:

- Explain the principle, types and biological application of various instruments.
- Knowledge and skill in the study and analysis of various biological samples.
- To get employment opportunities in various government and non governmental organizations in the field of clinical laboratory.
- The learned techniques may be applied to the villagers against various disease awareness (lab to land techniques).
- Laboratory accidents may be prevented to learn this course.

TEXT BOOKS:

1. Sood, Ramnik. 1985. Medicinal Laboratory Technology, Jaypee brothers, New Delhi – 384 pp.
2. Kanai. L Mukherjee. 1988, Medical Laboratory Technology, vol. I to III, Tata McGraw Hill publishing company Ltd., New Delhi.64.
3. Palanichamy, S and Shunmugavelu, M. 1993. Principles of Biochemistry and Biotechniques, Palani Paramount Publications, Palani.
4. Veerakumari, L. 2006. Bioinstrumentation, MJP Publication, Chennai.

BOOK FOR REFERENCES:

1. Sood, Ramnik, 1985. Medicinal Laboratory Technology, Jaypee brothers, New Delhi
2. Kanai. L Mukherjee. 1988. Medical Laboratory Technology, vol. I, II and III, Tata McGraw Hill Publishing Company Ltd., New Delhi.
3. Skoog, A., Douglas, J and Leary, J.J. 1992. Principles of Instrumentation analysis. Sanders Golden Sunberst Series, Philadelphia.
4. Webster, J.G. 2004. Bioinstrumentation. Wiley, India.

**M.Sc., ZOOLOGY – SEMESTER -III
CBCS: 2019-2020 - ELECTIVE COURSE – II**

EC –II b: AQUACULTURE

Course Code:

Hours/Week: 6 (Total 90 hours)

Credits: 5

Max Marks: 100

Internal Marks: 25

External Marks: 75

Course objectives:

- To give information about the culture of fishes and crabs with different procedures. It gives an idea for the self employment opportunities to the students.
- To get information on different research organizations and funding agencies on aquaculture.
- To train the students to maintain water quality management in aquaculture.
- To aware the students about creation of employment opportunity in various fields in rural areas.
- To aware the students about governmental organization for supporting aquaculture and to study the breeding, rearing, and harvesting of plants and animals in all types of water environments including ponds, rivers, lakes, and the ocean.

18 hours

UNIT-I: Introduction: History of Aquaculture. Present status and scope of Aquaculture. Types of culture: General culture techniques- Extensive, semi intensive, intensive, pond culture. Age and growth - method of age determination. Fish nutrition – FCR, Energy Budget, Food and feeding habits of important cultivable species.

18 hours

UNIT-II: Pisciculture: Selection of species- Biological characteristics, Design and Construction of aquaculture pond: Inland and coastal pond farms, pens and enclosures- hatcheries. Farm management. Harvesting methods: Crafts and Gears, Preservation, Transport and Marketing strategies. Management of ornamental fishes and aquarium.

18 hours

UNIT-III: Culture of Prawns, Crabs, Mussels: Selection of species- Biological characteristics Design and Construction of aquaculture pond: Inland and coastal pond

farms, pens and enclosures- hatcheries. Nutrition and feeds: Requirements and sources- live feeds - Artificial feeds. Reproduction: Reproductive cycle, induced breeding techniques, Preservation of Gametes, genetic selection and hybridization.

16 hours

UNIT-IV: Different culture: Mono culture, poly culture, raceway culture and Integrated fish farming. **Health and diseases:** Nutritional disorders. Parasitic diseases: Bacterial, Viral, Fungal, Protozoan and Helminthic diseases. Predators and eradication of algal bloom.

20 hours

UNIT-V: Role of Organizations: ICAR, CMFRI, CIFRI, CICFRI, CIFA, CIBA, CIFT & MPEDA Legal and environmental factors. Biotechnology in aquaculture: Genetic engineering methods- Genomic manipulation- Hybridization, Androgenesis, Gynandrogenesis and Polyploidy. Economical status in aquaculture case study (income benefit rate).

Course outcomes:

- Ability to setup the pond layout, construction and preparation, hatchery and nursery operations in local areas to full fill the employment needs.
- Describe the water quality management techniques.
- Explain how to set up various aquarium systems and to maintain them.
- Identify the pathogens, diseases and their treatment in fishes.
- Identify global cultural, social, economic and historical factors that affect various aquaculture in natural and artificial forms.

TEXT BOOKS:

1. Jhingran.V.C. 1991. Fish and fisheries of India, Hindustan Pub. Cord. New Delhi.
2. Pillay, T.V.R. 1995. Aquaculture principles and practices. Fishing New Books, Blackwell Science Ltd., Oxford.
3. Santhanam, Sugumaran and Natarajan, P. 1997. A Manual of freshwater aquaculture. Oxford and IBH Pub. Co. Ltd., New Delhi.
4. Kurian,C.V and Sebastin. 1992. Prawn and prawn fisheries of India, Hindustan Pub. Cord. New Delhi.
5. Chadar, S.L. 1980. Hypophysation of Indian major carps. Satish Book Enterprise, Agra, PP.146
6. Exporters manual and Documentation. 1999. Jain Book Agency. New Delhi.
7. Shanmugam, K. 1992. Fishery Biology and Aquaculture, LEO Pathippagam. Chennai.

REFERENCE BOOKS:

1. Shukla, G.S, and Upadhyay V.B., 2000. Economic Zoology, Rastogi Publications Meerut.
2. Thingran V.G., 1983. Fish and Fisheries of India 2nd Edition, Hindustan Publications, Delhi.

3. Kamaleswar Pandey and Shukla, J.P., 2005. Fish and Fisheries, Rastogi Publications.
4. Hobler, E.R., and Noble, G.A., 1982. Parasitology 2nd Edition, Lea & Febieger U.S.A
5. Smit. D.G., 1997. Introduction Animal Parasitology 2nd Edition, Johns Willey Sons, New York.
6. Soulsby, E.J.L., 1969. Helminths, Arthropods & Protozoa of Domesticated Animals, ELBS Publication London Ed.

M.Sc., ZOOLOGY – SEMESTER - IV
CBCS: 2019-2020 - ELECTIVE COURSE - III
EC- III a: ECOLOGY AND ECOTOXICOLOGY

Course Code:

Hours/Week: 6 (Total 90 hours)

Credit: 5

Max Marks: 100

Internal Marks: 25

External Marks: 75

Course objectives:

- Apply and integrate knowledge of species' biology, interactions among species, and environmental variation to predict the structure and functioning of ecosystems.
- Based on ecological theory, predict the potential consequences of specific human activities including harvesting, pollution, and climate change on species' abundances and distributions, and ecosystem processes.
- Apply foundational knowledge in ecology to understand and predict the consequences for humans of changes in ecological communities.
- To make the students to understand about the toxicological effects of heavy metals, pesticides, and their biotransformation and also to know about toxicity testing techniques.
- The students should learn about the strategies of toxicity and their impact on the environment, exposure of toxicants, management strategies, biomagnifications and toxicity testing.

ECOLOGY:

21 hours

UNIT I: Abiotic factors: Water, soil, light. Biotic factors; Intra (Aggregation, colony formation, social organization) and inter specific associations (Neutralism, symbiosis and antagonism). Structure and function of pond ecosystem: - Autotrophic and heterotrophic producer, consumer - pyramids - primary productivity - methods of measurements - different trophic level - energy flow in an ecosystem - food chain - food web - characteristics of different biomes - adaptations of animals living in deserts and caves - Population ecology and biological control.

18 hours

UNIT II: Environmental Pollution: Effects and control measures of Air, Water, Soil, Marine pollution. Acid rain, Ozone layer depletion. Bio accumulation – Bio magnification, BOD, COD, TDS, TSS. EIA – Steps in EIA – Methods of EIA. Natural resources - sustainable development – survey. Energy resources - environmental quality standards – soil conservation.

15 hours

UNIT III: Remote sensing and instrumentation: Remote sensing, Satellite image – Aerial photography – Thermal and infra red images, radar in ecological applications. Instrumentation – GPS, radio telemetry and satellite telemetry techniques used in ecological research. GIS techniques in ecological research.

ECOTOXICOLOGY

21 hours

UNIT IV: General Introduction: Definition: Toxicology, Toxicants, Toxicity and Toxicity test. Food contaminants; Toxicants present in atmosphere and hydrosphere; Sources and environmental levels. **Heavy Metals and Pesticide Toxicology:** Heavy metal toxicity: Mercury, Lead and Cadmium; Chemical pesticides (Organo - chlorines, Organo - Phosphorous and Carbamates); Impact of pesticides on environment.

15 hours

UNIT V: Toxicity Testing: Types of toxicity test: based on exposure duration - acute toxicity test- bioassay test - calculation of LC₅₀ extrapolation - chronic toxicity test- pathological techniques - autopsy and Histology - histopathology - histochemistry.

Course outcome:

- To know about environment and its role in various aspects.
- Explain in detail the importance an conservation of natural resources.
- Write the causes and effects of pollution and their control measures.
- Discuss the role of individual in conservation of environment.
- To know various toxicants which affect the environment and its remedial process make the students to create employment opportunities.

TEXT BOOKS:

1. Ahmad, Y.J and Sammy, G.K. 1985. Guidelines to Environment Impact Assessment in developing countries. Hodder and Stoughton Ltd., London.
2. Asthana, D.K and Asthana, M. 2001. Environment problems and solutions. S. Chand and Co., New Delhi.
3. Chapman, B.C and Reigs. M.J. 1997. Ecology principles and application. Cambridge University Press, U.K.
4. Clark, G.C. 1963. Elements of ecology. John Wiley and Sons Inc., New York.
5. Odum, E.P. 1996. Fundamentals of Ecology (III Ed.). Nataraj Publishers, Dehradun. P 574.
6. Trivedi, P.R and Gurdeepraj, K. 1992. Environmental biology. Akashdeep Publishing House, New Delhi.
7. Omkar. 1994. Concepts of Toxicology, Chand and Co. Jalandhar.
8. Saxena, P. 2013. Toxicology. Mohit Books International. New Delhi.

REFERENCE BOOKS:

1. Kumar, H.D. 1997. Modern concepts of ecology. Modern Printers, New Delhi. P 478.
2. Sharma, P.D. 1996 Environmental Biology and Toxicology. Rastrogi Publication, Meerut, India.
3. Bhattacharya. 2011. Environmental Toxicology. Books and Allied (P) Ltd. Kolkata.
4. Panday, K. and Shukla, J.P. 2010. Elements of Toxicology. Wisdom Press. New Delhi.

**M.Sc., ZOOLOGY – SEMESTER - IV
CBCS: 2019-2020 - ELECTIVE COURSE - III**

EC- III b: NANOBIO TECHNOLOGY

Course Code:

Hours/Week: 6 (Total 90 hours)

Credits: 5

Max Marks: 100

Internal Marks: 25

External Marks: 75

Course Objectives:

- To give information about the techniques of nanobiotechnology among students.
- To encourage the students to take nanobiotechnology as their career as it provides ample scope for bright future.
- The contents are more informative and essential for student's lab and research work such as synthesis of nonmaterial in different ways.

18 Hours

UNIT I: Fundamentals and overview of Nanoscience: History of nanotechnology - Definitions and scaling. Properties at nanoscale (optical, electronic and magnetic). Metal and Semiconductor Nanomaterials, Quantum Dots, Wells and Wires, Bucky balls and Carbon Nanotubes.

18 Hours

UNIT II: Nanomaterials: Introduction-Biocompatibility – anti bacterial activity – principles involved – Biomaterial nanocircuitry; Neurons for network formation. DNA nanostructures for mechanics and computing

18 Hours

UNIT III: Biomedical Applications: Nanoparticles in Drug delivery - Nanotechnology in Diagnostics applications: Biochipsanalytical devices, Biosensors- Natural nanocomposite systems as spider silk, bones, shells; nanomaterials in cancer treatment.

18 Hours

UNIT IV: Nanobiotechnology and Environment: Application of nanotechnology in Green energy, sustaining Natural resources, Global climate changes. Nanotechnology and energy production: Fuel Cells — applications in power and transportation.

18 Hours

UNIT V: Nano Toxicology: Nanomaterials in Environment - Toxicology of Airborne and Manufactured nanomaterials in the environment - Nanoparticles and Living

Organisms: Portals of entry and target tissues- Mechanisms and Health Effects - Risk assessment – Ethical – Legal and Social Implications.

Course Outcomes:

- Discuss the most significant discoveries and their impacts on the development of nanbiootechnology .
- Explain the fundamental structure, properties and processes in which the nanoparticles play a part in different fields.
- This field would help the students for drug discovery along with several plant extracts.
- Independently execute a laboratory experiment using the standard methods and techniques in nanbiootechnology, with the appropriate analysis and interpretation of results obtained.
- Process the results obtained in the conducted experiments using computer processing, and display the results in the form of a written report.

TEXT BOOKS:

1. Nanotechnology by Mark Ratner and Daniel Ratner, Pearson Education.
2. Nanomaterials by A.K. Bandyopadhyay; New Age International Publishers
3. Hari Singh Nalwa. 2002. “*Nanostructured Materials and Nanotechnology*”, Academic Press.
4. Yuliang Zhao and Hari Singh Nalwa. 2007. *Nanotoxicology: Interactions of Nanomaterials with Biological Systems*, American Scientific Publishers.

REFERENCE BOOKS:

1. *Nanotoxicology - Interactions of Nanomaterials with Biological Systems*", Ed Yuliang Zhao and Hari Singh Nalwa, June 2006
2. Springer handbook of nanotechnology by Bharat Bhushan
3. MEMS and nanotechnology – Based sensors and devices communication, Medical and Aerospace applications - A.R.Jha.

**M.Sc., ZOOLOGY – SEMESTER - IV
CBCS: 2019-2020 - ELECTIVE COURSE – IV**

EC- IV a: CANCER AND STEM CELL BIOLOGY

Course Code:

Hours/Week: 6 (Total 90 hours)

Credits: 5

Max Marks: 100

Internal Marks: 25

External Marks: 75

Course Objectives:

- To motivate students to learn the fundamentals of cancer.
- To enable the students to know how the stem cells are functioning.
- To get knowledge about different types of molecular techniques.

18 Hours

UNIT I: Regulation of the Eukaryotic cell cycle, Cancer biomarkers, Primary and established cell lines, Kinetics of Cancer cell growth, Genetics of cancer biology. Cancer stem cell culture and their applications. Cell culture-based vaccines. Cancer proteomics at a glance.

18 Hours

UNIT II: Cell Signaling in Cancer Cells and Signaling at the cell surface level, Types of signaling pathways that control gene activity in normal and cancer cells, endocytotic and exocytotic proteins in membranes and organelles, Vascular traffic, Metabolism and movement of lipids.

18 Hours

UNIT III: Etiology, epidemiology, diagnosis and treatment of Breast, Lung, and colorectal, cancers. Current scenario of micro-RNA technology in cancer medicine. Role of DNA vaccination in cancer treatment.

18 Hours

UNIT IV: Introduction to Stem cells– Stem cell definition, origin and hierarchy; stem cell properties, Identification and Characterization- potency and differentiation; niche of stem cell; overview of different stem cell types (embryonic stem cell, adult stem cell and induced pluripotent stem cells)

18 Hours

UNIT V: Characterization and properties of ES cells -pluripotency and self-renewal of ES; molecular mechanisms regulating pluripotency Mesenchymal stem cell (MSC) Haematopoietic stem cell (HSC) pluripotent stem cell (iPSC), Gene therapy - Therapeutic cloning. Ethical and Social consideration of Stem cell research.

Course Outcomes:

- This course work provides chance to work in stem cells and cancer stem cells.
- There is a chance for the students to enter into the modern cancer and stem cell laboratories as scientist.

TEXT BOOKS:

1. Turksen, K. 2002. Embryonic Stem Cells Method and Protocols. Humana press.
2. Korobkin, R and Munzer, S.R. 2007. Stem Cell Century, Law and Policy for a Breakthrough Technology, Yale University Press.
3. Lanza, R. 2004. Hand Book of Stem Cells Volume 1and2, Elsevier press.
4. Committee, R. 2004. Stem Cells and the Future of Regenerative Medicine by on the Biological and Biomedical Application of Stem Cell Research.
5. Robertis, E.D.P and De Robertis, E.M.F. 2005. Cell and Molecular Biology, (8th edn), De, B.I.Waverly Pvt. Ltd., New Delhi.

REFERENCE BOOKS:

1. Lodish H, Kaiser, C.A, Brasher A, Amon A, Berk A, Kreger M, Ploegh, H and Scott M.P. 2012. Molecular Cell Biology, 7th edition, Garland Publishing, Inc. New York.
2. Kiessling, A.A. 2006. Human Embryonic Stem Cells (Second Ed.) Jones & Barlett Publishers.
3. Lanza, R. 2005. Essentials of Stem Cell Biology. Academic Press.

**M.Sc., ZOOLOGY – SEMESTER –IV
CBCS: 2019-2020 - ELECTIVE COURSE – IV**

EC-IV b: ENDOCRINOLOGY

Course Code:
Hours/Week: 6 (Total 90 hours)
Credit: 5

Max Marks: 100
Internal Marks: 25
External Marks: 75

Course objectives:

- This paper provides knowledge about whole body control mechanism by hormones.
- This Paper also provides diseases caused due to hypo and hyper secretion of hormones and treatment options for imbalanced hormonal functions.
- Able to identify and distinguish between the different tissues of the body and organs at the microscopical level.

18 hours

UNIT I: Definition and scope of Endocrinology - Historical and anatomical aspects of mammalian endocrine system. Definition of a hormone- chemical nature of mammalian hormones- types of hormone receptors- secondary messenger system general mechanism of peptide and non- peptide hormones action. Feed-back regulation of Endocrine System.

18 hours

UNIT II: The Endocrines of Hypothalamus - Hypo-Physiotropic hormones- Neurovascular hypothesis. Pituitary gland hormones- chemistry and biochemical functions. Pineal gland hormones- chemistry- biochemical functions- mechanism of action. Thyroid gland hormones- chemistry- biochemical functions- mechanism of action. Parathyroid glands- biochemical functions.

18 hours

UNIT III: Adrenal gland: Hormones of adrenal gland- chemistry- mechanism of action/biochemical functions. Pancreas- Insulin/glucagon: chemistry- biochemical functions- mechanism of action. Somatostatin. Hormones involving in calcium metabolism- chemistry- mechanism of action. Neuro-hormones- the brain- reninangiotensin, Urotensin- neuropeptides.

18 hours

UNIT IV: Hormones of female and male reproductive system: Ovarian steroid hormones chemistry- biosynthesis and transport; Synthesis, chemistry and metabolism of

androgens- dynamics of steroid hormone production and metabolism mechanisms of action of sex steroid hormones. Testicular and ovarian determining genes – Mullerian-inhibiting substance genes- molecular basis of male and female contraception.

18 hours

UNIT V: Endocrinopathies: Hypo-physeal, Thyroid, parathyroid, adrenal and pancreas. Disorders of pituitary hormone axis- thyrotoxicosis- hypothyroidism- Hashimoto's thyroiditis- metabolic bone diseases- Cushing syndrome- Addison's diseases Diabetes mellitus- androgen deficiency syndromes- Testicular neoplasm Klinefelter's syndrome and Turner's syndrome. Clinical evaluation of endocrine functions-overview.

Course outcomes:

- Able to describe the organisation and structure of the endocrine systems and their relation to other organ systems.
- Able to explain the endocrine systems general regulation at normal function and at deranged homeostasis.
- Able to explain for how various types of hormones seems and the principles behind the function of hormone receptors.
- Able to describe at a general level pharmacological treatment that includes the endocrine organs.
- Able to explain the blood glucose raising and- reducing metabolic processes search after information in scientific databases.

TEXT BOOKS:

1. Henry M. Kronenberg, Shlomo Melmed, Kenneth S. Polonsky, P. Reed Larsen. William.
2. Saunders Elsevier. 2008. Textbook of Endocrinology, 11th ed.
3. Bolander, F. F. 2004. Molecular Endocrinology, III ed. Academic Press.
4. Vasantharaj David, B and T. Kumaraswami. 1996. Elements of economic entomology. Popular Book Depot Publishers. P 536.
5. Barrinton, E.J.W. 1968. An introduction to general and comparative endocrinology. Academic press, New Delhi.
6. Turner, C.D. 1966. General Endocrinology. W.B. Saunders Co., London.

REFERENCE BOOKS:

1. Nelson Cox. 2000. Lehninger's Principle of Biochemistry, 3rd ed. MacMillian Worth Publ.
2. Mac E. Hadely. 2000. Endocrinology, 5th ed. Pearson Education.
3. Barrinton, E.J.W. 1968. An introduction to general and comparative endocrinology. Academic press, New Delhi.
4. Bantley, P.J. 1985. Comparative vertebrate endocrinology. S.Chand and Co., New Delhi.
5. Michael, P. 1968. Endocrinology and human behavior. Oxford University press, New Delhi.

BLUE PRINT OF THEORY QUESTION PAPER

Question Paper Pattern

External: Total 75 Marks

Theory Paper

Section A : 10 Questions x 2 Marks = 20 Marks (Two Questions from each unit will be taken) Answer all the questions. Define each question in four or six sentences.	20
Section B: 05 Questions x 5 Marks = 25 Marks (Either or type and one set of questions from each unit will be taken) Answer all the questions in 500 -700 words, draw diagram wherever necessary.	25
Section C: 03 Questions x 10 Marks = 30 Marks (5 questions will be asked and one question from each unit will be taken) (Answer any THREE questions only) Write the answer in 1500 words, draw diagram wherever necessary.	30
Total	75

Internal: Total 25 Marks

- Assignment I (from first 2½ units) }
 Assignment II (from remaining 2½ units) } = 05 Marks (or seminar)
- *Mid Semester Exam (from first 2 units) = 10 Marks
 *End Semester Exam (from remaining 3 units) = 10 Marks
- * Question must be prepared same that of Autonomous exam pattern.

BLUE PRINT OF PRACTICAL QUESTION PAPER

External: 60 marks

- | | | |
|-----------------------------------|------------|-------------|
| 1. Major Dissection or Experiment | (1x15=15) | = 15 marks. |
| 2. Minor practical | (2x10= 20) | = 20 marks |
| 3. Spotters | (4x5=20) | = 20 marks |
| 4. Record | | = 05 marks |
| | | ----- |
| | | 60 marks |
| | | ----- |

Internal: 40 marks (as model practical examination)

Question must be prepared same that of Autonomous exam pattern.