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UNIVERSITY OF MYSORE

Estd. 1916

VishwavidyanilayaKaryasoudha
Crawford Hall, Mysuru- 570 005

No.AC2(S)/55/2024-25

Dated: 20.07.2024

Notification

Sub:- Modification Syllabus and Scheme of Examinations of Zoology (PG) Programme from the Academic year 2024-25.

Ref:-1. Decision of Board of Studies in Zoology (CB) meeting held on 07-06-2024.
2. Decision of the Faculty of Science & Technology meeting held on 19-06-2024.
3. Decision of the Academic Council meeting held on 28-06-2024.

*****

The Board of Studies in Zoology (CB) which met on 07-06-2024 has resolved to recommend & approved the Modification of Syllabus and Scheme of examinations of Zoology (PG) programme with effect from the Academic year 2024-25.

The Faculty of Science & Technology and Academic Council at their meetings held on 19-06-2024 and 28-06-2024 respectively has also approved the above said revised Syllabus and Scheme of examinations hence it is hereby notified.

The Syllabus and Scheme of Examinations content may be downloaded from the University Website i.e., www.uni-mysore.ac.in.

Registrar

Registrar
University of Mysore
Mysore

To;

1. The Registrar (Evaluation), University of Mysore, Mysuru.
2. The Chairman, BOS/DOS in Zoology, Manasagangothri, Mysore.
3. The Dean, Faculty of Science & Technology, DOS in Mathematics, MGM.
4. The Director, Distance Education Programme, Moulya Bhavan, Manasagangothri, Mysore.
5. The Director, PMEB, Manasagangothri, Mysore.
6. Director, College Development Council, Manasagangothri, Mysore.
7. The Deputy Registrar/Assistant Registrar/Superintendent, Administrative Branch and Examination Branch, University of Mysore, Mysuru.
8. The PA to Vice-Chancellor/ Registrar/ Registrar (Evaluation), University of Mysore, Mysuru.
9. Office Copy.

ENCLOSURE - 2

University of Mysore

(Estd.1916)

M.Sc., Zoology

(Revised Syllabus for the academic year 2024-2025)

Choice Based Credit System (CBCS)

UNIVERSITY OF MYSORE

Department of Studies in Zoology
Manasagangotri, Mysuru-570006

Regulations and Syllabus

Master of Zoology (M.Sc.)

(Two-year semester scheme)

M.Sc., Zoology

(Revised Syllabus for the academic year 2024-2025)

Under

Choice Based Credit System (CBCS)

UNIVERSITY OF MYSORE

GUIDELINES AND REGULATIONS LEADING TO MASTER OF ZOOLOGY

(TWO YEARS - SEMESTER SCHEME UNDER CBCS)

PROGRAMME DETAILS

Name of the Department	:	Department of Studies in Zoology
Subject	:	Zoology
Faculty	:	Science and Technology
Name of the Course	:	Master of Zoology (M.Sc.)
Duration of the Course	:	2 years - divided into 4 semesters

Programme Objectives

The main objective of this M.Sc., programme is to provide strong foundation to the students in the subject of Zoology. The programme encompasses various courses spread across the four semesters, which intend to make the students conceptually and practically fit to handle the Classical, Molecular and Cellular aspects of Zoology.

To prepare the students to take up teaching and research careers as

- Faculties in Undergraduate Colleges, Academic Institutions and Universities
- Researchers in reputed Research Institutions, Fishery, Animal husbandry, Forest department, Forensic department
- Entrepreneur to start their own Life Science based company

Programme Specific Outcomes

M.Sc., programme in Zoology is a highly reputed programme among life sciences in the University. On successful completion of this programme each student will:

- Have a strong foundation in understanding the basic s of Animal science both in non - chordate and chordate. Further, the student will be able to learn technology in the field of Genetics, Cell Biology, Molecular Biology, Immunology, Molecular basis of animal development, Environment Biology, Biodiversity and

Wildlife Biology and Evolutionary Biology.

- Be able to learn concepts and technology in the field of Genetics, Cell Biology, Molecular Biology, Immunology, Molecular basis of Animal Development, Environment Biology, Biodiversity and Wildlife Biology Behavioural and Evolutionary Biology.
- Develop practical skills along with their theory components, which will help in their research programme both in academic institutions and in R & D programmes of different national and international institutes.
- Inculcate skills for teaching in academic institutions for undergraduate and postgraduate students.
- Develop confidence in taking competitive examination in the field of life science both in India and abroad so that they can pursue higher education.

Programme Specific Pedagogies

Pedagogies employed in the M.Sc. Zoology programme

- Class room teaching will be using black board and chalk, power point presentation andinformation and communications technology.
- Individual student is made to study the chromosomes, cells and tissue details usingMicroscopy and perform Biochemical, Molecular Biology, Physiology and Genetic experiments as per the protocol in practical classes.
- Student seminar presentations will be conducted and one on one interaction with small student numbers will be held during tutorial classes in each semester.
- Project work on a small research problem will be done to give a pilot exposure to thestudent about planning, initiating and carrying out a research project.
- Field trip, visit to Aquaculture and Fisheries departments are a part of curriculum forstudents to get direct exposure to the methodologies employed.
- Regular visits to Wildlife Sanctuaries, National Parks, Zoological Gardens to observe and study animalsin their natural habitats.
- Students will be tested for their writing abilities to answer precise and essay typequestions during C1 and C2 assessments.
- Every semester the students will be subjected to viva voce in practical classes and inexams by external examiners.
- Invited talks from eminent scientists.
- Extension programs to interact and express the subject and significance to Schoolchildren/public

OVERVIEW OF COURSES OFFERED FOR M.SC. ZOOLOGY PROGRAM w.e.f. 2024-25 ACADEMIC SESSIONS

I SEMESTER

Sl. No.	Title of the Paper	Credits			Total Credits
		L	T	P	
1.	Non-Chordata - Hard Core- 1	3	0	1	4
2.	Transmission Genetics - Hard Core - 2	3	0	0	3
3.	Cell Biology - Hard Core - 3	3	0	0	3
4.	Animal Physiology - Hard Core - 4	2	0	2	4
5.	Vectors & Communicable Diseases - Soft Core-1	4	0	0	4
	Minimum credits to be offered:				**18**

II SEMESTER

Sl. No.	Title of the Paper	Credits			Total Credits
		L	T	P	
1.	Chordata - Hard Core - 5	3	0	1	4
2.	Reproductive Biology -Hard Core - 6	3	0	0	3
3.	Practical Reproductive Biology & Histology -Hard Core - 7	0	0	2	2
4.	Molecular Biology- Hard Core- 8	3	0	1	4
5.	Histology and Histopathology - Soft Core - 2	4	0	0	4
6.	Principles of Animal Science – Open Elective - 1	4	0	0	4
	Minimum credits to be offered				**17**

III SEMESTER

Sl. No.	Title of the Paper	Credits			Total Credits
		L	T	P	
1.	Ethology & Evolutionary Biology - Hard Core - 9	4	0	0	4
2.	Applied Zoology- Hard Core - 10	3	0	1	4
3.	Advanced Developmental Biology - Hard Core - 11	3	0	1	4
4.	Molecular Endocrinology - Hard Core-12	3	0	0	3
5.	Genetic Engineering & Biotechnology - Soft Core - 3	4	0	0	4
6.	Reproductive Health-Open Elective - 2	4	0	0	4
	Minimum credits to be offered				**19**

IV SEMESTER

Sl. No.	Title of the Paper	Credit pattern in			Credit value
		L	T	P	
1.	Environmental Biology - Hard Core - 13	3	0	1	4
2.	Practical Cytogenetics – Hard Core -14	0	0	2	2
3.	Advanced Cell Biology - Hard Core - 15	4	0	0	4
4.	Major Project - Soft Core - 4	0	2	6	8
5.	Research Methodology - Soft Core - 5	4	0	0	4
6.	Biodiversity & Wildlife Management – Soft Core - 6	4	0	0	4
7.	Economic Zoology –Open Elective -3	4	0	0	4
	Minimum credits to be offered				**18**

Total Credits Offered: Hard Core – 52 (Minimum requirement:52)

Soft Core - 28 (Minimum requirement: 16)

Open Elective - 12 (Minimum requirement: 4)

Total credits required for completing M.Sc., Program: 72 credits (including 52 credits from hard core; 16 credits from soft cores and minimum 4 credits of open elective from other subjects).

Maximum credits per semester = 18; minimum credits per semester =17.

**

SEMESTER: I

Paper: Non – Chordata (Hard Core-1)

Credits: 4
Teaching Pattern: 3 Theory + 1Particals (4 hours duration)
Teaching Hours: 48 hours
Examination: C1 + C2 (Internal Assessment) + C3 (Main Examination) = 15 + 15 + 70 = 100 Marks

Pedagogy:

Objectives

- To study the structure and functional anatomy of invertebrates.
- To study the taxonomy and systematics of invertebrate groups.

Course outcome

- Understand the comparative aspects of diversity and classification of Non-Chordata.
- Understand the external as well as internal features with their functional Significance in nonchordates.
- Understand the economical ecological and evolutionary significance of invertebrates.

Course Content

Units	Existing Syllabus	Revised Syllabus	Remarks
Unit – I **(12 hrs)**	**Animal Taxonomy and Systematics** Introduction to taxonomy – Principles, stages, importance and rise of taxonomy. a. Taxonomic Procedures – Traditional or evolutionary method, Phonetic and Cladistic methods. b. Taxonomic collections, identification and description; taxonomical hierarchy (Linnean hierarchy); Vertical and Horizontal Classification; Concepts of Tacon, holotype, paratype, topotype ect. c. ICZN regulations and regulations and Zoological Nomenclature including use of suffixes 'i', 'orum', 'ae', 'arum', 'ensis' and 'iensis'. oidea, idea, inae,; Tautonyms, Synonyms and Homonyms. d. Concept of species- Different Species concepts, sub-species and other intra-specific categories. e. New trends in taxonomy: Ecological, Ethological, Cytological and Biochemical approaches and Numerical Taxonomy. f. Molecular basis of animal taxonomy- DNA	**Animal Taxonomy and Systematics** Introduction to taxonomy – Principles, stages, importance and rise of taxonomy. a. Taxonomic Procedures – Traditional or evolutionary method, Phonetic and Cladistic methods. b. Taxonomic collections, identification and description; taxonomical hierarchy (Linnean hierarchy); Vertical and Horizontal Classification; Concepts of Tacon, holotype, paratype, topotype ect. c. ICZN regulations and regulations and Zoological Nomenclature including use of suffixes 'i', 'orum', 'ae', 'arum', 'ensis' and 'iensis'. oidea, idea, inae,; Tautonyms, Synonyms and Homonyms. d. Concept of species- Different Species concepts, sub-species and other intra-specific categories. e. New trends in taxonomy: Ecological, Ethological, Cytological and Biochemical approaches and Numerical Taxonomy. f. Molecular basis of animal taxonomy- DNA	**No Changes**

	hybridization, Restriction analysis and sequencing of nucleotides.	hybridization, Restriction analysis and sequencing of nucleotides.	
Unit – II **(12 hrs)**	**Coelom, Nutrition and Locomotion.** a. Origin and importance of Coelom: Acoelomates and Pseudocoelomates; Coelomates -Prostomia and Deuterostomia. b. Locomotion - Flagella and ciliary movement in Protozoa. Hydrostatic movement in Coelenterata, Annelida and Echinodermata. c. Patterns of feeding and digestion in lower metazoa; Filter feeding in Polychaeta, Mollusca and Echinodermata.	**Coelom, Nutrition and Locomotion.** a. Origin and importance of Coelom: Acoelomates and Pseudocoelomates; Coelomates - Prostomia and Deuterostomia. b. Locomotion - Flagella and ciliary movement in Protozoa. Hydrostatic movement in Coelenterata, Annelida and Echinodermata. c. Patterns of feeding and digestion in lower metazoa; Filter feeding in Polychaeta, Mollusca and Echinodermata.	**No Changes**
Unit – III **(12 hrs)**	**Respiration, Excretion and Nervous system.** a. An overview of patterns of respiration in invertebrates; Emphasis to be given to organs of respiration like Gills, Book-lungs and trachea and Respiratory pigments in invertebrates. b. An overview of patterns of excretion in invertebrates; Emphasis to be given to organs of excretion: Coelomoducts, Nephridia and Malphigiantubules, Cocal glands. c. Primitive nervous system: Coelenterata and Echinodermata; Advanced nervous system: Annelida, Crustacea and Insecta) and Cephalopoda, Trends in neural evolution.	**Respiration, Excretion and Nervous system.** a. An overview of patterns of respiration in invertebrates; Emphasis to be given to organs of respiration like Gills, Book-lungs and trachea and Respiratory pigments in invertebrates. b. An overview of patterns of excretion in invertebrates; Emphasis to be given to organs of excretion: Coelomoducts, Nephridia and Malphigiantubules, Cocal glands. **c.** Primitive nervous system: Coelenterata and Echinodermata; Advanced nervous system: Annelida, Crustacea and Insecta) and Cephalopoda, Trends in neural evolution.	**No Changes**
Unit – IV **(12 hrs)**	**Development and Paleontology** An overview of patterns of reproduction in Invertebrates; Direct and Indirect developments; Larval forms of free living and Parasitic invertebrates, Strategies and Evolutionary significance of larval forms; Fossils: Formation, Types and importance of fossils and an overview of Geological Time Scale.	**Development and Paleontology** An overview of patterns of reproduction in Invertebrates; Direct and Indirect developments; Larval forms of free living and Parasitic invertebrates, Strategies and Evolutionary significance of larval forms; Fossils: Formation, Types and importance of fossils and an overview of Geological Time Scale.	**No Changes**
Practical **(16X2=32 Hrs)**	**1.** Study of Nervous system: Crab, Sepia / Loligo. **2.** Study of mounting of Nephridium and Spermatotheca in Earthworm. **3.** Study of Respiratory system: Mounting of Gills, Trachea and Booklunge. **4.** Protozoa: Gregarines, Monocystis, Ceratium, Euplotes, Didinum, Noctiluca, Radiolaria, Stentor and Opalina. **5.** Porifera: Sectonal view of *Sycon* (T.S., L.S.) Grantia (T.S.). **6.** Cridaria: Obelia polyp and medusa, Pennaria, *Aurelia*–Tentaculocysts Virgularia, Spongodus, Zoanthus and Favia. **7.** Helminthes – Slides of Temnocephala, *Ascaris lumbricoides, Taenia solium,Planaria.* **8.** Annelida: Slides of Ozobranchus, Glossiphonia, Eunice, *Chloieaflava*, Polynoe,	**1.** Study of Nervous system : Crab, Sepia / Loligo **2.** Study of mounting of Nephridium and Spermatotheca in Earthworm **3.** Study of Respiratory system: Mounting of Gills, Trachea and Booklungs **4.** Protozoa: Didinum, Noctiluca, Radiolaria,Stentor and Opalina **5.** Porifera: Sycon, Sectonal view of *Sycon* (L.S.), Grantia, Horny sponge, Antler Sponge **6.** Cridaria: Obelia polyp and medusa, *Aurelia* species, *Aurelia* – Tentaculocysts, Pennaria,Virgularia, Spongodus, Zoanthus, Gogonia and Favia **7.** Helminthes – Slides of *Ascaris lumbricoides* (Male and Female), *Taenia solium, Planaria.* **8.** Annelida: Slides of Ozobranchus,	**In Practical few specimens were removed as they were not available. In the same group few**

	Terrebella, Eurythoe and Chaetopterus. **9.** Arthropoda – Balanus, Lepas. Palinurus, Uca, Pycna, Hippa, Gongylus. Belostoma Limulus, Squilla and Eupagurus. **10.** Mollusca – Museum specimens of Dolobella, Pteria, Nerita, Sanguinolaria And Lambis. **11.** Mollusca - Tridacna, Onchidium, Oliva, Murex, Turritella, Bulla, Cardium and Arca. **12.** Echinodermata – Echinodiscus, Holothuria and Antedon. **13.** Visit to campus – to study invertebrates in their natural forms. **14.** Visit to Earth Science Department – to study different fossils and GTS.	Glossiphonia, Eunice, *Chloieaflava*, Polynoe, Eurythoe. **9.** Arthropoda – Balanus. Palinurus, Uca, Hippa, Gongylus. Belostoma Limulus, Squilla and Eupagurus. **10.** Mollusca – Museum specimens of Dolobella, Pteria, Nerita, Sanguinolaria and Lambis **11.** Mollusca - Tridacna, Onchidium, Oliva, Murex, Turritella, Bulla, Cardium and Arca. **12.** Echinodermata – Echinodiscus, Holothuria and Antedon, Asterias (star fish), Echinus (sea Urchin), Regalaria, Linckia, Salmacas. **13.** Visit to campus – to study invertebrates in their natural forms **14.** Visit to Earth Science Department – to study different fossils and GTS.	**available specimens were included.**

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10. Young, J.Z. Life of Vertebrates, Clarendon Press, Oxford, United Kingdom.

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Paper: Transmission Genetics (Hard Core-2)

Credits: 3
Teaching Pattern: 3 Theory
Teaching Hours: 48 hours
Examination: C1 + C2 (Internal Assessment) + C3 (Main Examination) = 15 + 15 + 70 = 100 Marks

Pedagogy:

Objectives

- To understand the Genetic basis and the patterns of inheritance of characters of an organism.
- To study Mendel's principles of inheritance and extension of Mendel's laws.
- To study gene fine structure and functions both in prokaryotes and eukaryotes.

Course outcome

- Understanding of Mendel's principles, its extension and chromosomal basis.
- Understand fine structure of gene (rII locus), one gene one enzyme concept and inheritance of sex-linked, sex-limited traits. Inheritance of haploid organisms.
- Understand chromosomal and genetic basis of linkage and crossing over with suitable examples.
- Understanding of microbial genetics: Transduction, Conjugation, Transformation in bacteria.

Course Content

Units	Existing Syllabus	Revised Syllabus	Remarks
Unit – I **(12 hrs)**	**Mendel's principles of inheritance:** a. The principles of dominance, segregation and independent assortment. b. Extensions of Mendelian principles: Allelic variations-a diagnostic test for allels: Dominance: incomplete dominance, codominance, over dominace, pseudo alleles, multiple alleles, lethal alleles, penetrance and expressivity, pleiotropy; interaction of genes: Epistasis, Supressors; Polygenic inheritance; Phenocopy.	**Mendel's principles of inheritance:** a. The principles of dominance, segregation and independent assortment. b. Extensions of Mendelian principles: Allelic variations-a diagnostic test for allels: Dominance: incomplete dominance, codominance, over dominace, pseudo alleles, multiple alleles, lethal alleles, penetrance and expressivity, pleiotropy; interaction of genes: Epistasis, Supressors; Polygenic inheritance; Phenocopy. c. Study of inheritance in haploid organisms - Neurospora, cross (tetrad analysis); Mitotic .	-
Unit – II **(12 hrs)**	**Fine structure of gene:** a. Beadle and Tatum's One gene one enzyme concept, one gene one polypeptide concept, Complementation test, Intragenic complementation, Cistron, Recon and Muton. Eg. lz gene in *Drosophila* (Lozenge gene), rII locus in T4 phage. b. Sex-linked inheritance: In *Drosophila* and Humans, Inheritance of sex limited and sex influenced traits. c. Study of inheritance in haploid organisms - Neurospora, cross (tetrad analysis); Mitotic.	**Fine structure of gene:** a. Beadle and Tatum's One gene one enzyme concept, one gene one polypeptide concept, Complementation test, Intragenic complementation, Cistron, Recon and Muton. Eg. lz gene in *Drosophila* (Lozenge gene), rII locus in T4 phage. b. Sex-linked inheritance: In *Drosophila* and Humans, Inheritance of sex limited and sex influenced traits. c. Extranuclear inheritance: i) Organelle heredity-Chloroplast-Variegation in 4'o clock plant; Mitochondria- Petite in Saccharomyces. ii) Maternal effect- Shell coiling in Limnaea. iii) Cytoplasmic Inheritance - Paramecium (Kappa Particle), iv) Infectious heredity – Sigma virus and *Wolbachia* bacterium in *Drosophila.*	-

Unit – III **(12 hrs)**	**a. Linkage and crossing over:** Chromosomal theory of inheritance; Concept of linkage- Experiments of Bateson and Punned, Morgan's experiment; Genetic recombination and construction of linkage maps in *Drosophila* ; Interference and coincidence. **b. Extranuclear inheritance:** i) Organelle heredity-Chloroplast-Variegation in 4'o clock plant; Mitochondria- Petite in Saccharomyces. ii) Maternal effect-Shell coiling in Limnaea. iii) Cytoplasmic Inheritance - Paramecium (Kappa Particle), iv) Infectious heredity – Sigma virus and *Wolbachia* bacterium in *Drosophila.*	**Microbial Genetics:** i) Conjugation: Discovery, nature of donor strains and compatibility, molecular mechanism of conjugation, Hfr, F. ii) Transformation: Discovery, Natural transformation systems, development of competence, Events involved in transformation. iii) **Linkage and crossing over:** Chromosomal theory of inheritance; Concept of linkage- Experiments of Bateson and Punned, Morgan's experiment; Genetic recombination and construction of linkage maps in *Drosophila* ; Interference and coincidence iv) Transduction: Discovery, generalized and specialized transduction, mechanism of generalized transduction, abortive transduction, mechanism of specialized transduction, sexduction.	**Unit III was redistributes to other Units I, II, IV. A total of three Units were made and each with 16hrs.**
Unit – IV **(12 hrs)**	**Microbial Genetics:** Conjugation: Discovery, nature of donor strains and compatibility, molecular mechanism of conjugation, Hfr, F. i) Transformation: Discovery, Natural transformation systems, development of competence, Events involved in transformation. ii) Transduction: Discovery, generalized and specialized transduction, mechanism of generalized transduction, abortive transduction, mechanism of specialized transduction, sexduction.	-	-

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Paper: Cell Biology (Hard Core -3)

Credits: 3
Teaching Pattern: 3 Theory
Teaching Hours: 48 hours
Examination: C1 + C2 (Internal Assessment) + C3 (Main Examination) = 15 + 15 + 70 = 100 Marks

Pedagogy:

Objectives

- To study, cellular architecture in detail at ultra structural level in prokaryotic and eukaryotic organisms.
- Structural and functional understanding of cell organelles.
- To study cell division-meiotic and mitotic and the cellular dynamics at different stages of division and the possible abnormalities.

Course outcome

- Understand the differences between eukaryotic and prokaryotic cells along with function.
- Ultra structural organization of different cell organelles with their function and molecules involved in building the tissues.
- Understand types of cell division and its regulation, dynamics during cells division and consequences of its misregulation.
- Get an elaborate picture of the ultra structural organization of chromosomes, the giant chromosomes and structural anomalies of the chromosomes.

Course Content

Units		Revised Syllabus	Remarks
Unit – I **(16 hrs)**	**a. Overview of cells and their functional specializations** i. Prokaryotic cells: Bacteria, Mycoplasma. ii. Eukaryotic specialized cells: RBC, muscle cells, neurons, Osteoblast. **b. Molecular architecture of eukaryotic cells** i. Biomembranes – composition, structure, fluid mosaic model. ii. Basic functions of biomembrane: permeability, osmotic principles, carrier proteins, channel proteins, passive transport, active transport, membrane pumps, multidrug resistance transport protein, pinocytosis, phagocytosis, receptor mediated endocytosis, transcytosis, electrical properties of membranes. iii. Integrating cells in to tissues: Cell junctions: occluding junctions, Anchoring junctions and communicating junctions, (Tight junctions, Desmosomes, Gap junctions), Cell adheshion:NCAM, Cadherins, fibronectins and integrins. iv. Endoplasmic Reticulum (ER): Protein secretion, targeting proteins into ER, insertion of proteins in to ER membrane, export of proteins and lipids from the ER, fate of misfolded proteins.	**a. Overview of cells and their functional specializations** a. Prokaryotic cells: Bacteria, Mycoplasma. ii. Eukaryotic specialized cells: RBC, muscle cells, neurons, Osteoblast. **b.Molecular architecture of eukaryotic cells** a. Biomembranes – composition, structure, fluid mosaic model. ii. Basic functions of biomembrane: permeability, osmotic principles, carrier proteins, channel proteins, membrane pumps, multidrug resistance transport protein, pinocytosis, phagocytosis, receptor mediated endocytosis, transcytosis, electrical properties of membranes. iii. Integrating cells in to tissues: Cell junctions: occluding junctions, Anchoring junctions and communicating junctions, (Tight junctions, Desmosomes, Gap junctions), Cell adheshion:NCAM, Cadherins, fibronectins and integrins. iv. Endoplasmic Reticulum (ER): Protein secretion, targeting proteins into ER, insertion of proteins in to ER membrane, export of proteins and lipids from the ER, fate of misfolded proteins.	**Unit-I passive transport, active transport is deleted**
Unit – II **(16 hrs)**	**Cellularorganelles and their function** **a.** Mitochondria: Ultra structure, inner membrane, transport proteins, synthesis and targeting mitochondrial proteins, biological energy transducers. **b.** Lysosomes:Lysosomal acid hydrolases, mechanism of membrane resistance to lysosomal enzymes, pathways and mechanisms of intracellular digestion, lysosomal secretion/defecation, lysosomal storage diseases. **c.** Golgi complex: Ultrastructural organization, protein glycosylation within Golgi, lipid and polysaccharide metabolism in Golgi, protein sorting and export from the Golgi. microbodies (Peroxisomes). **d.** Nucleus: Nuclear envelope, nuclear pore complex, import and export between nucleus and cytoplasm, NLS, structure and function of Nucleolus (Ribosome factory).	**Cellularorganelles and their function** a. Mitochondria: Ultra structure, inner membrane, transport proteins, synthesis and targeting mitochondrial proteins, biological energy transducers. b. Lysosomes:Lysosomal acid hydrolases, mechanism of membrane resistance to lysosomal enzymes, pathways and mechanisms of intracellular digestion, lysosomal secretion/defecation, lysosomal storage diseases. c. Golgi complex: Ultrastructural organization, protein glycosylation within Golgi, lipid and polysaccharide metabolism in Golgi, protein sorting and export from the Golgi. microbodies (Peroxisomes). d. Nucleus: Nuclear envelope, nuclear pore complex, import and export between nucleus and cytoplasm, NLS, structure and function of Nucleolus (Ribosome factory).	**No Changes**

Unit – III **(16 hrs)**	**Cell division and chromosomes** **a. Molecular mechanism of cell division**: i) Amitosis, Endomitosis and Mitosis ii) Ultra structure and organization of centrosome, centromere, Kinetochore, iii) Microtubules and their dynamic instability, Microtubule associated proteins, Anaphasic movements, Cytokinesis. **b. Chromatin organization**: (i) Molecular organization of Eukaryotic chromosome - Nucleosomes, Telomeres, Histone and Non-Histone proteins. ii) Chromosome Banding, Karyotyping and its importance. **c. Heterochromatin:** Constitutive and facultative heterochromatin- Properties and functions, Gene silencing by heterochromatinization (Telomeric effect). **d. Special chromosomes**: (i) Polytene chromosomes: Structural organization and significance. (ii) Lampbrush chromsomes: Structural organization and significance. **e. Chromosomal rearrangement**: i) Structural rearrangements in chromosomes: (i) Deletions, Evolution by gene duplications, I heterozygosity. Ex. Oenothera, Centric fusion and Centric fission (ii) Practical applications of rearrangements- Balancers, Ring chromosomes, Attached X-chromosome in Drosophila. ii) Numerical variations in chromosomes: (i) Aneuploidy – causes and consequences with examples from Man (Trisomy 21 and sex chromosomal) (ii) Polyploidy – causes and consequences. Ex. Raphanobrassica, Wheat.	**Cell division and chromosomes** **a. Molecular mechanism of cell division**: i) Amitosis, Endomitosis and Mitosis ii) Ultra structure and organization of centrosome, centromere, Kinetochore, iii) Microtubules and their dynamic instability, Microtubule associated proteins, Anaphasic movements, Cytokinesis. **b. Chromatin organization**: (i) Molecular organization of Eukaryotic chromosome - Nucleosomes, Telomeres, Histone and Non-Histone proteins. ii) Chromosome Banding, Karyotyping and its importance. **c. Heterochromatin:** Constitutive and facultative heterochromatin- Properties and functions, Gene silencing by heterochromatinization (Telomeric effect). **d. Special chromosomes**: (i) Polytene chromosomes: Structural organization and significance. (ii) Lampbrush chromsomes: Structural organization and significance. **e. Chromosomal rearrangement**: i) Structural rearrangements in chromosomes: (i) Deletions, Evolution by gene duplications, Inversion heterozygosity. Ex. Oenothera, Centric fusion and Centric fission (ii) Practical applications of rearrangements- Balancers, Ring chromosomes, Attached X-chromosome in Drosophila. ii) Numerical variations in chromosomes: (i) Aneuploidy – causes and consequences with examples from Man (Trisomy 21 and sex chromosomal) (ii) Polyploidy – causes and consequences. Ex. Raphanobrassica, Wheat.	**No Changes**

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Paper: Animal Physiology (Hard Core-4)

Credits: 4
Teaching Pattern: 2 Theory + 2Particals (4 hours duration)
Teaching Hours: 32 hours
Examination: C1 + C2 (Internal Assessment) + C3 (Main Examination) = 15 + 15 + 70 = 100 Marks
Pedagogy:

Objectives

- The major aims of this course are to provide students with a basic understanding of the fundamental processes and mechanisms that serve and control the various functions of the body.
- To understand how these principles are incorporated into the adaptations of different animalgroups.
- The discipline covers key homeostatic processes, such as the regulation of temperature, blood flow, Cellular Respiration, Bioenergetics, Circulation, Excretion and Neurophysiology.

Course outcome

- Understand the mechanisms that work to keep the animal body alive and functioning, through scientific enquiry into the nature of mechanical, physical, and biochemical functions of animals, their organs and the cells of which they are composed.
- Have an enhanced knowledge and appreciation of mammalian physiology.
- Understand the functions of important physiological systems including the Cardio-respiratory, Neurophysiology and metabolic systems.
- Understand how these separate systems interact to yield integrated physiological responses to challenges such as exercise, jumping, swimming and flight.
- Be able to perform, analyze and report on experiments and observations in physiology.
- Be able to recognize and identify principal tissue structures.

Course Content

Units	Existing Syllabus	Revised Syllabus	Remarks
Unit – I **(08 hrs)**	**Transport across the membrane, Cellular Respiration & Bioenergetics.** • Molecular mechanisms of passive and active transport. b. Energy – Concept, laws of thermodynamics ii) Redox potential. iii) Stepwise release of energy through cytochromes, production of ATP, uncoupling of oxidative phosphorylation, inhibitors. iv)Anaerobic and aerobic breakdown of glucose, alternate pathway – HMP shunt and glucoronic acid pathway. v) Citric acid cycle as common metabolic pathway.	**Transport across the membrane, Cellular Respiration & Bioenergetics.** • Molecular mechanisms of passive and active transport. a. Energy – Concept, laws of thermodynamics ii) Redox potential. iii) Stepwise release of energy through cytochromes, production of ATP, uncoupling of oxidative phosphorylation, inhibitors. iv)Anaerobic and aerobic breakdown of glucose, alternate pathway – HMP shunt and glucoronic acid pathway. v) Citric acid cycle as common metabolic pathway.	**No Changes**
Unit – II	**Circulation and Excretion** i) Major types of body fluids and their composition,	**Circulation and Excretion** i) Major types of body fluids and their composition,	

(08 hrs)	ii) Neurogenic and myogenic hearts iii) Mammalian heart – cardiac cycle, ECG. **ii)** Nitrogenous waste products in animals ii) Formation of ammonia, urea and uric acid. iii) Nitrogen excretion in relation to water economy. iv) Overview of urine formation in mammals with emphasis on regulation of fluid volume, blood pressure, sodium levels and acid-base balance.	ii) Neurogenic and myogenic hearts iii) Mammalian heart – cardiac cycle, ECG. **ii)** Nitrogenous waste products in animals ii) Formation of ammonia, urea and uric acid. iii) Nitrogen excretion in relation to water economy. iv) Overview of urine formation in mammals with emphasis on regulation of fluid volume, blood pressure, sodium levels and acid-base balance.	
Unit – III **(08 hrs)**	**Muscle and Neurophysiology** a. i) Molecular organization of sarcomere. ii) Mechanism of contraction with emphasis on sliding filament and Davies models, regeneration of storage phosphate. iii) Physiological adaptations of muscles for jumping, swimming and flight. i) Electrochemical gradients – Nernst and Goldman equations. ii) Axonal and synaptic transmission of nerve impulses. iii) Synaptic integrity, synaptic plasticity. iv) Molecular mechanism of sensory transduction and neural output in receptor cells.	**Muscle and Neurophysiology** a. i) Molecular organization of sarcomere. ii) Mechanism of contraction with emphasis on sliding filament and Davies models, regeneration of storage phosphate. iii) Physiological adaptations of muscles for jumping, swimming and flight. i) Electrochemical gradients – Nernst and Goldman equations. ii) Axonal and synaptic transmission of nerve impulses. iii) Synaptic integrity, synaptic plasticity. iv) Molecular mechanism of sensory transduction and neural output in receptor cells.	-
Unit – IV **(08 hrs)**	**Environmental Physiology** Concept of homeostasis, Regulators and conformers. ii) Tolerance, resistance acclimation and acclimatization. iii) Overview of thermal homeostasis in homeotherms, CNS regulation of body temperature maintenance. iv) Temperature compensation in poikilotherms. a. Overview of osmoregulation in aquatic and terrestrial animals. b. Stress: Metabolic and immunological responses.	**Environmental Physiology** Concept of homeostasis, Regulators and conformers. ii) Tolerance, resistance acclimation and acclimatization. iii) Overview of thermal homeostasis in homeotherms, CNS regulation of body temperature maintenance. iv) Temperature compensation in poikilotherms. a. Overview of osmoregulation in aquatic and terrestrial animals. b. Stress: Metabolic and immunological responses.	-
Practical **4x16 = 64 Hrs**	**ANIMAL PHYSIOLOGY** 1. Estimation of blood glucose content. 2. Estimation of glycogen in liver. 3. Determination of Blood cholesterol content. 4. Determination of Iodine number of fats to evaluate the biological value. 5. Total count of RBC and WBC. 6. Differential count of WBC. 7. Determination of serum phosphatase activity. 8. Estimation of blood urea content. 9. Determination of serum acetylcholine esterase activity. 10. Estimation of RNA concentration by Diphenylamine method. 11. Estimation of serum LDH activity.	ANIMAL PHYSIOLOGY Estimation of blood glucose content. Estimation of glycogen in liver. Determination of Blood cholesterol content. Determination of Iodine number of fats to evaluate the biological value. Total count of RBC and WBC. Differential count of WBC. Determination of serum phosphatase activity. Estimation of blood urea content. Determination of serum acetylcholine esterase activity. Estimation of RNA concentration by Diphenylamine method. Estimation of serum LDH activity.	

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Paper: Vectors and Communicable Diseases (Soft Core-1)

Credits: 4
Teaching Pattern: 4 Theory
Teaching Hours: 64 hours
Examination: C1 + C2 (Internal Assessment) + C3 (Main Examination) = 15 + 15 + 70 = 100 Marks

Pedagogy:

Objectives

- Aim is to give an introduction to Vector Biology.
- Create a framework for to improve surveillance and monitoring of emerging vector-borne zoonotic diseases of viral origin.
- To learn the control methods for vectors and vector borne diseases.
- To create an awareness and to know the importance of educating people and communityparticipation.

Course outcome

- Understand the importance of vectors from its historic background to current drug discovery.
- Know the epidemiology and symptoms of malaria, filariasis, yellow fewer, leishmaniasis, anthrax, dengue, chikungunya, Japanese encephalitis, schistosomiasis and plague.
- Gaining a basic knowledge regarding cultural control methods, chemical methods, genetic and environmental methods, biological methods using microbes and predators.
- Able to spread an awareness of the added value of integrated surveillance, risk assessment and early warning to prevent and control epidemics and epizootics in the society.

Course Content

Units	Existing Syllabus	Revised Syllabus
Unit – I **(16 hrs)**	**Introduction to Vector Biology** a. Scope and importance of vectors. b. Historical perspective – epidemics, scientists involved in the discovery of vectors and pathogens of communicable diseases. o-ecology and life cycle of vectors. d. Vector-parasite interaction; host-pathogen interaction, insect transmitting bacteria and viruses.	**Introduction to Vector Biology** a. Vector Biology: Definition, scope and importance. b. Historical account on the incidences of vector borne communicable diseases in the world and in India. c. Important discoverers involved in the discovery of vectors, pathogens and communicable diseases. d. Vector-parasite interaction; host-pathogen interaction, insect transmitting bacteria and viruses including corona virus.
Unit – II **(16 hrs)**	**Biological vectors and communicable diseases** a. Epidemiology and biology of vectors and pathogens. b. Transmission cycles and symptoms of malaria, filariasis, yellow fewer leishmaniasis, anthrax, dengue, chikungunya, Japanese encephalitis, schistosomiasis and plague.	**Biological vectors and their communicable diseases** a. Biological vectors: Life cycle of Mosquito species. b. Epidemiology, transmission cycle, symptoms and control measures of biological vector borne diseases. c. **Protozoan diseases:** Malaria and Leishmaniasis. **d. Bacterial diseases:** Anthrax and Plague **e. Viral diseases:** Yellow Fewer, dengue, chikungunya, Japanese encephalitis.
Unit – III **(16 hrs)**	**Mechanical vectors** a. House flies, cockroaches and bed bugs – Transmission of dysentery, diarrhea, typhoid cholera, epidemic conjunctivitis and skin infections. b. Nematodes: Ancylostoma, Ascaris, Enterobius & Wuchereria. c. Tikes: Morphology and life history of Argas and Haemaphysalis.	**Mechanical vectors and their communicable diseases** a. Mechanical vectors: House fly, Cockroach, bed bug, tick, mites and their life cycle. b. Epidemiology, transmission cycle, symptoms and control measures of mechanical vectors borne diseases. c. Dysentery, Diarrhea, Typhoid Cholera, Epidemic conjunctivitis. d. Helminthes:Schistosoma,filarial worm, Ancylostoma, Ascaris, Enterobius & Wuchereria. **e.** Tikes & Mites: Morphology and life history of Argas and Haemaphysalis.
Unit –	**Control of vectors and vector borne diseases** a. Cultural control methods, chemical	**Management of vector borne diseases.** a. Importance of education, awareness and

IV **(16 hrs)**	methods, genetic and environmental methods, biological methods using microbes and predators. Integrated Vector Control and Management (IVCM). b. Insecticide resistance in vectors, Drug resistance in pathogens. **c.** Importance of education, awareness and community participation.	community participation. b. Insecticide resistance in vectors, Drug resistance in pathogens. c. Integrated Vector Control and Management (IVCM): Cultural, chemical, genetic and environmental methods. d. Biological methods using microbes and predators.

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Websites

www.Corona viral disease and Covid – 19 pandemic.

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SEMESTER II

Paper: Chordata (Hard Core – 5)

Credits: 4
Teaching Pattern: 3 Theory + 1Particals (4 hours duration)
Teaching Hours: 48 hours
Examination: C1 + C2 (Internal Assessment) + C3 (Main Examination) = 15 + 15 + 70 = 100 Marks
Pedagogy:

Objectives

To study the structure and functional anatomy of Chordates.

- To study the taxonomy and systematics of vertebrate groups.
- Identify the major groups within the Phylum Chordata.
- To understand the level of organization in chordate subphylum.
- Study of museum specimens and slides with emphasis on evolutionary and adaptivesignificance.
- To understand the origin and evolutionary relationship in different subphylum of chordates.

Course outcome

- Able to describe the unique characters and classification of Protochordata. Phylogenetic interrelationship between Protochordates and Chordates.
- Explain the mechanisms of respiration, circulation and locomotion among the vertebrates.
- Understand the details of vertebrate integument, excretory system, nervous system andSense organs among the chordates.
- Understand the structural and morphological basis of diversity in chordates.

Course Content

Units	Existing Syllabus	Revised Syllabus	Remarks
Unit – I **(12 hrs)**	**Origin and interrelationships** **a.** General characters and outlines of classification of Chordata - the construction and interpretation of classifications. Origin of chordates in the light of recent theories. **b.** Fine structure and role of notochord and endostyle in Amphioxus and Ascidia with their evolutionary significance. **c.** General characters and classification of Protochordata. Phylogenetic interrelationship between Protochordates and Chordates. **d.** Reproduction in Tunicates and significance of retrogressive matamorphosis. **e.** The Nature of Vertebrate Morphology–	**Origin and interrelationships** a. General characters and outlines of classification of Chordata - the construction and interpretation of classifications. Origin of chordates in the light of recent theories. b. Fine structure and role of notochord and endostyle in Amphioxus and Ascidia with their evolutionary significance. c. General characters and classification of Protochordata. Phylogenetic interrelationship between Protochordates and Chordates. d. Reproduction in Tunicates and significance of retrogressive matamorphosis.	**In Theory paper: Unit -I: The 'f' section was removed due to repetition.**

	Definition, Scope and Relation to other disciplines; Importance of the study of vertebrate morphology. **f.** Some principles and considerations. Origin and Classification of Vertebrates.	e. The Nature of Vertebrate Morphology– Definition, Scope and Relation to other disciplines; Importance of the study of vertebrate morphology.	
Unit – II **(12 hrs)**	**Vertebrate Integument, Excretory system, Nervous system and Sense organs** a. Development and general structure of skin and its functions; Integument of fishes with emphasis on dermal derivatives; Integument of Tetrapods with emphasis on epidermal derivatives - glands, scales, horns, claws, nails, hoofs, feathers and hairs. b. Excretion-Evolution of urogenital system in Vertebrates; Comparative account of kidney in Verebrates. c. Nervous system: Development of spinal cord and peripheral nervous system; Evolution of spinal nerves, cranial nerves and autonomic nervous system; Development and organization of the brain; Comparative account of brain in Vertebrates. d. Sense organs: Types of receptors; Organs of olfaction and taste- Vomero-nasal/Jacobson's organ in reptiles; lateral line system; electroreception in fish; ear and eyes in Vertebrates.	**Vertebrate Integument, Excretory system, Nervous system and Sense organs** e. Development and general structure of skin and its functions; Integument of fishes with emphasis on dermal derivatives; Integument of Tetrapods with emphasis on epidermal derivatives - glands, scales, horns, claws, nails, hoofs, feathers and hairs. f. Excretion-Evolution of urogenital system in Vertebrates; Comparative account of kidney in Verebrates. g. Nervous system: Development of spinal cord and peripheral nervous system; Evolution of spinal nerves, cranial nerves and autonomic nervous system; Development and organization of the brain; Comparative account of brain in Vertebrates. h. Sense organs: Types of receptors; Organs of olfaction and taste- Vomero-nasal/Jacobson's organ in reptiles; lateral line system; electroreception in fish; ear and eyes in Vertebrates.	**No Changes**
Unit – III **(12 hrs)**	**Respiration, Circulation and Locomotion:** a. Structure and mechanism of cutaneous, bronchial and pulmonary respirations. b. Outline of origin and evolution of cardiovascular system in Vertebrates. c. Form, function, size and skeletal and muscular elements of the body –appendicular skeleton – origin of tetrapod limbs and their modifications. appendicular musculature of tetrapodes. d. Axial skeletons- Overview of Skull Morphology, Skull Function and Design. Originof Jaw and modification of Jaw bones and types. Functional and evolutionary significance of Jaw suspension in Vertebrates. Origin and evolution of Web barian ossicles in fish and ear ossicles in mammals. e. Types of vertebrae of Procoelus, Opisthocoelus, Amphicoelus, Amphiplatins, Heterocoelus, Axis and atlas vertebrae. f. Types of Vertebrate musculature. Flight muscles of Birds; Skeletal and muscular elements in Running and jumping; Digging and crawling without appendages; Climbing;	**Respiration, Circulation and Locomotion:** a. Structure and mechanism of cutaneous, bronchial and pulmonary respirations. b. Outline of origin and evolution of cardiovascular system in vertebrates. c. Form, function, size and skeletal and muscular elements of the body –appendicular skeleton – origin of tetrapod limbs and their modifications. appendicular musculature of tetrapodes. d. Axial skeletons- Overview of Skull Morphology, Skull Function and Design. Origin, types and modification of Jaw bones. Functional and evolutionary significance of Jaw suspension in Vertebrates. e. Types of vertebrae of Procoelus, Opisthocoelus, Amphicoelus, Amphiplatins, Heterocoelus, Axis and atlas vertebrae. f. Types of Vertebrate musculature. Skeletal and muscular elements in	**In Unit-III: The 'd' section due to repetition the word 'of Jaw' and ' types' , 'origin and evolution of webbarian ossicles in fish and ear ossicles in animals.**

	Swimming, Diving, Flying and Gliding.	Running and jumping; Digging and crawling without appendages; Climbing; Swimming, Diving, Flying and Gliding.	
Unit – IV **(12 hrs)**	**Adaptive radiation in Vertebrates** a. Origin b. Evolution and c. Adaptive radiation in fishes, amphibians, reptiles, birds andmammals.	**Adaptive radiation in Vertebrates** a. Introduction to Adaptive radiation and its significance. b. Structural, Morphological and Physiological adaptation in fishes. c. Structural, Morphological and Physiological adaptation in Amphibians. d. Structural, Morphological and Physiological adaptation in Reptiles. e. Structural, Morphological and Physiological adaptation in Birds. f. Structural, Morphological and Physiological adaptation in Mammals.	**In Unit-IV has been re organized and to be subsection. All these changes have been incorporates in the revised syllabus.**
Practical **(16X2=32 Hrs)**	1. Study of Digestive, Reproductive, Respiratory, Arterial and Venous systems in differentvertebrates**.** 2. Study of museum specimens and slides with emphasis on evolutionary and adaptive Significance. 3. Protochordates – Salpa-sexual, Salpa-asexual, Botryllus, Herdmania. 4. Fishes– Rhinobatus, Chimera, Acipenser, Actinopterygii: Polypterus, Lepidosteus, Muraena, Mystus, Catla. Hippocampus, Syngnathus, Anabas, Diodon, Tetradon and Echeneis. 5. Amphibians– Icthyophis, Geganophis, Rhachophorus, Ranatigrina, Amblystoma, Uraeotyphlus, Necturus, Amphiuma, Ambystomaand its Axolotllarva. Triton, Salamandra, Hyla and Rhacophorus. 6. Reptiles– Sitana, Chameleon, Phyrnosoma, Chelonemydas, Hemidactylus, Calotes, Draco, Varanus, Phrynosoma. Typhlops, Python, Eryx, Ptyas, Bungarus, Naja, Hydrus, Vipera, Crocodilus, Gavialis, Chelone and Testudo. 7. Birds – Indian Oriole, Indian koel - male & female, Indian tailor bird, kite, jungle fowl. 8. Mammals – Indian otter, Marmoset, Loris Bat –Megadermalyra, Pangolin. 9. Osteology - Skull and lower jaw of Chelonia, Crocodile, Bird, Carnivore mammal (Dog), Herbivore mammal (Horse);Types of vertebrae of Procoelus, Opisthocoelus, Amphicoelus, Amphiplatin, Heterocoelus, Axis and Atlas vertebrae.	1. Study of Digestive, Reproductive, Respiratory, Arterial and Venous systems in differentvertebrates**.** 2. Study of museum specimens and slides with emphasis on evolutionary and adaptive Significance. 3. Protochordates – Salpa-sexual, Salpa-asexual, Botryllus, Herdmania. 4. Fishes– Rhinobatus, Chimera, Acipenser, Actinopterygii: Polypterus, Lepidosteus, Muraena, Mystus, Catla. Hippocampus, Syngnathus, Anabas, Diodon, Tetradon and Echeneis. 5. Amphibians– Icthyophis, Geganophis, Rhachophorus, Ranatigrina, Amblystoma, Uraeotyphlus, Necturus, Amphiuma, Ambystomaand its Axolotllarva. Triton, Salamandra, Hyla and Rhacophorus. 6. Reptiles– Sitana, Chameleon, Phyrnosoma, Chelonemydas, Hemidactylus, Calotes, Draco, Varanus, Phrynosoma. Typhlops, Python, Eryx, Ptyas, Bungarus, Naja, Hydrus, Vipera, Crocodilus, Gavialis, Chelone and Testudo. 7. Birds – Indian Oriole, Indian koel - male & female, kite, jungle fowl, water fowl, wood pecker, Mespps orientalis and sky lark. 8. Mammals – Indian otter, Marmoset, Loris Bat – Megaderma lyra, Pangolin, Squirrel and Rabbit. 9. Osteology - Skull and lower jaw of Chelonia, Crocodile, Bird, Carnivore mammal (Dog), Herbivore mammal (Horse);Types of vertebrae of Procoelus, Opisthocoelus, Amphicoelus, Amphiplatin, Heterocoelus, Axis and Atlas vertebrae.	**In Practical in Unit few specimens of fishes have been removed due to non availability. In Sl. No. 7 the Indain tail and bird has been removed. Few available birds have been included.** **All these changes have been incorporated in the revised syllabus.**

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Paper: Reproductive Biology (Hard Core -6)

Credits: 3
Teaching Pattern: 3 Theory
Teaching Hours: 48 hours
Examination: C1 + C2 (Internal Assessment) + C3 (Main Examination) = 15 + 15 + 70 = 100 Marks
Pedagogy:

Objectives

- The major objective of this course is to provide students with a sound coverage of mammalian reproductive biology within the framework of Human Biology.
- This is achieved by first covering fundamentals of the structure and function of the male and female reproductive tracts, game to genesis, fertilization, early embryogenesis, fetal development and preparation for birth, and maternal adaptations to pregnancy.
- Particular emphasis is placed on the hormonal control of reproduction.
- Provides an important foundation to consider sexual differentiation and development, contraception, infertility and current reproductive technologies.

Course outcome

- Understand the basics of Sex differentiation and Female reproductive organs understand the details of female and male reproductive physiology.
- Relate the structural characteristics to the function of each part of the tract.
- Describe the major changes that occur in the female reproductive tract over themenstrual cycle.
- Describe the hormonal control of ovarian and testicular function.
- Describe the embryonic development of the male reproductive system and the roleof hormones in its control.
- Describe the major treatments available for infertility and the social and ethicalissues associated with these treatments.

Course Content

Units	Existing Syllabus	Revised Syllabus	Remarks
Unit – I **(12 hrs)**	**Sex differentiation and Female reproductive organs** **a.** Origin and migration of primordial germ cells; genetic and hormonal control of differentiation of gonads and gonadal ducts in mammals. **b.** Female Reproductive System-Functional morphology of mammalian ovary, Fallopian tube and uterus. **c.** Hormonal control of follicular development – Recruitment and selection of follicles, Follicular dominance, Oocyte maturation, Ovulation, Atresia and Regulation of corpus luteum.	**Sex differentiation and Female reproductive organs** **a.** Origin and migration of primordial germ cells; genetic and hormonal control of differentiation of gonads and gonadal ducts in mammals. **b.** Female Reproductive System-Functional morphology of mammalian ovary, Fallopian tube and uterus. **c.** Hormonal control of follicular development – Recruitment and selection of follicles,Follicular dominance, Oocyte maturation, Ovulation, Atresia and Regulation ofcorpus luteum.	**No Changes**
Unit – II **(12 hrs)**	**Female reproductive physiology** a. Onset of puberty in human, factors affecting onset of puberty. b. Estrous cycle and it's hormonal regulation. c. Menstrual cycle and it's hormonal regulation. d. Fertilization – Molecular Events of fertilization. e. Implantation – Process, Types and hormonal control. f. Pregnancy – length of gestation, hormonal control. g. Parturition – Process of birth and influence of hormones. h. Lactation – Hormonal control of mammary gland development and lactogenesis	**Female reproductive physiology** a. Onset of puberty in human, factors affecting onset of puberty. b. Estrous cycle and it's hormonal regulation. c. Menstrual cycle and it's hormonal regulation. d. Fertilization – Molecular Events of fertilization. e. Implantation – Process, Types and hormonal control. f. Pregnancy – length of gestation, hormonal control. g. Parturition – Process of birth and influence of hormones. h. Lactation – Hormonal control of mammary gland development and lactogenesis	**No Changes**
Unit – III **(12 hrs)**	**Male Reproductive Physiology** a.Functional morphology of mammalian testis. b. Brief description of histomorphology and hormonal control of male accessory organs *viz*., epididymis, vas deferens, seminal vesicles, ventral prostate, bulbourethral gland and preputial gland. c. Sperm maturation – morphological and biochemical events, influence of accessoryorgan secretions, capacitation. d. Biochemistry of semen.	**Male Reproductive Physiology** a.Functional morphology of mammalian testis. b.Brief description of histomorphology and hormonal control of male accessory organs *viz*., epididymis, vas deferens, seminal vesicles, ventral prostate, bulbourethral gland and preputial gland. c. Sperm maturation – morphological and biochemical events, influence of accessory organ secretions,	**No Changes**

	e. Kinetics of spermatogenesis – wave and cycle, Stem cell renewal. f. Hormonal control of spermatogenesis. g. Ultra structure of spermatozoa. h. Abnormalities of sperm.	capacitation. d. Biochemistry of semen. e. Kinetics of spermatogenesis – wave and cycle, Stem cell renewal. f. Hormonal control of spermatogenesis. g. Ultra structure of spermatozoa. h. Abnormalities of sperm.	
Unit – IV **(12 hrs)**	**Fertility control and assisted reproduction (ART)** a. Fertility control: Need, principles, practice and efficacy of different male and female temporary and permanent contraceptive methods- hormonal and barrier methods, intrauterine devices and sterilization. b. Assisted Reproduction: Ovulation induction, Sperm bank, Artificial insemination, different methods of assisted reproduction – In vitro fertilization (IVF), gamete intra fallopian transfer (GIFT), Zygote intrafallopian transfer (ZIFT), intra cytoplasmic sperm injection (ICSI), pre-implantation genetic diagnosis (PGD), Surrogacy. Ethical and legal considerations of ART and PGD.	**Fertility control and assisted reproduction (ART)** a. Fertility control: Need, principles, practice and efficacy of different male and female temporary and permanent contraceptive methods- hormonal and barrier methods, intrauterine devices and sterilization. b. Assisted Reproduction: Ovulation induction, Sperm bank, Artificial insemination, different methods of assisted reproduction – In vitro fertilization (IVF), gamete intra fallopian transfer (GIFT), Zygote intrafallopian transfer (ZIFT), intra cytoplasmic sperm injection (ICSI), pre-implantation genetic diagnosis (PGD), Surrogacy. Ethical and legal considerations of ART and PGD.	**No Changes**

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Paper: Practical Reproductive Biology & Histology (Hard Core – 7)

Credits: 2
Teaching Pattern: 2Particals (4 hours duration)
Teaching Hours: 64 hours
Examination: C1 + C2 (Internal Assessment) + C3 (Main Examination) = 15 + 15 + 70 = 100 Marks
Pedagogy:

Objectives

- The Use of Histological Techniques to study the Reproductive Biology.
- To understand the morphology of ovary and testis in vertebrates.
- To learn the basics of histopathology and histo-chemistry.
- To study different contraceptive devices.

Course outcome

- Understand the estrous cycle in rat using vaginal smear.
- Able to stain the vaginal smear in laboratory rat.
- Able to identify sperm abnormalities in semen samples.
- Understand the pathology of Gastric ulcers, Cirrhosis of liver, Breast tumors, Cyctic follicles of ovary, Pancreas in diabetes, Cryptorchid Testis and Leukemia.

Course Content

Units	Existing Syllabus	Revised Syllabus	Remarks
Unit-I Practical **8x4=32 hrs**	**I. Reproductive Biology** **a.** Study of estrous cycle in rat using vaginal smear. **b.** Staining of vaginal smear in laboratory rat. **c.** Sperm count and study of sperm abnormalities in semen samples collected fromvolunteers / clinical samples. **d.** Study of different contraceptive devices. **f.** Observation of permanent slides. **i.** Comparative morphology of ovary in vertebrates. **ii.** Comparative morphology of testis in vertebrates.	**II. Reproductive Biology** **a.** Study of estrous cycle in rat using vaginal smear. **b.** Staining of vaginal smear in laboratory rat. **c.** Sperm count and study of sperm abnormalities in semen samples collected fromvolunteers / clinical samples. **d.** Study of different contraceptive devices. **i.** Observation of permanent slides of mammalian (rat) reproductive organs: Testis, epididymis, vas deferens, seminal vesicle, ventral prostate, ovary, Fallopian tube, uterus.	
Unit-I Practical 8x4=32 hrs	**III. Histology** **a.** Microtomy and staining: Hematoxylin-eosin – Demonstration. **b.** Functional histology: Observations of permanent histology slides of mammalian organs: stomach, intestine, spleen, liver, kidney, lungs, thymus, blood vessel, lymph vessel, brain, bone and bone marrow. **c.** Histopathology: Study of histopathological changes (permanent slides): Gastric ulcers, Cirrhosis of liver, Breast tumors, Cyctic follicles of ovary, Pancreas in diabetes, Cryptorchid testis and Leukemia. **d.** Histochemistry: Localization of proteins and (Bromophenol blue method) and PAS reaction.	**IV. Histology** **a.** Microtomy and staining: Hematoxylin-eosin – Demonstration. **b.** Functional histology: Observations of permanent histology slides of mammalian organs: stomach, intestine, spleen, liver, kidney, lungs, thymus, blood vessel, lymph vessel, brain, bone and bone marrow. **c.** Histopathology: Study of histopathological changes (permanent slides): Gastric ulcers, Cirrhosis of liver, Breast tumors, Cyctic follicles of ovary, Pancreas in diabetes, Cryptorchid testis and Leukemia. **d.** Histochemistry: Localization of proteins and (Bromophenol blue method) and PAS reaction.	**No Changes**

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Paper: Molecular Biology (Hard Core – 8)

Credits: 4
Teaching Pattern: 3 Theory + 1Particals (4 hours duration)
Teaching Hours: 48 hours
Examination: C1 + C2 (Internal Assessment) + C3 (Main Examination) = 15 + 15 + 70 = 100 Marks
Pedagogy:

Objectives

- To understand the chemical and molecular processes that occurs to maintain andtransfer the Genetic information of cells.
- To learn in depth structure of DNA and the process of its replication.
- To gain a detailed understanding of process that comprises the central dogma ofmolecular biology.
- To gain insight into the gene regulatory mechanisms employed in prokaryotes andeukaryotes.

Course outcome

- Understand the detailed mechanism, enzymatic components and fidelity measures involved in DNA replication.
- Understand the molecular basis of DNA repair and recombination.
- Able to discuss the detailed process of information transfer through replication,transcription and translation.
- Understand the simple and complex mechanisms and the components ofregulation of Gene expression in prokaryotes and eukaryotes.
- Able to practically extract and estimate DNA from tissues.
- Able to explain the principle behind and methodology of PCR.
- Can construct and identify a karyotype.
- Learn the technique to prepare mitotic chromosomes and few concepts of Evolution.

Course Content

Units	Existing Syllabus	Revised Syllabus	Remarks
Unit – I **(08 hrs)**	**a. Introduction to Nucleic acids:** a) Nucleic acids store and convey genetic information, Information transfer– Central Dogma – b) Overview of structure of: DNA: The double helix Complementarity of bases. **b. Replication of DNA**: 1. Enzyme and non enzyme components of replication machinery. 2. Replication process: i) Initiation of replication: Origin of replication, DnaA, Regulation of initiation in relation to cell division. ii) Elongation: coordinated synthesis of Leading and Lagging strands. iii) Termination: End replication problem-telomerase in	**a.Introduction to Nucleic acids:** a) Nucleic acids store and convey genetic information, Information transfer– Central Dogma – b) Overview of structure of: DNA: The double helix Complementarity of bases. **b. Replication of DNA**: 1. Enzyme and non enzyme components of replication machinery. 2. Replication process: i) Initiation of replication: Origin of replication, DnaA. ii) Elongation: coordinated synthesis of Leading and Lagging strands.	

	eukaryotes **3.** Fidelity in replication: Selection, proof reading, mismatch repair**.**	iii) Termination: End replication problem-telomerase in eukaryotes	
Unit – II **(08 hrs)**	**a. DNA Repair** i) Direct reversal of DNA damages: Photo reactivation, Alkyl transferases (ii) Excision repair: Nucleotide excision-Uvr ABC system, Base excision and AP nuclease pathway (iii) Transcription coupled repair (iv) SOS repair (v) Translesion synthesis. **b. Recombination**: Homologous recombination: (i) Models of Recombination - Holliday model, Double strand break model, Genetic consequence of homologous recombination**.** (ii) Protein Machinery and mechanism of homologous recombination.	**a. D** **DNA Repair** i) Direct reversal of DNA damages: Photo reactivation, Alkyl transferases (ii) Excision repair: Nucleotide excision-Uvr ABC system, Base excision and AP nuclease pathway (iii) Transcription coupled repair (iv) SOS repair (v) Translesion synthesis. **b. Recombination**: Homologous recombination: (i) Models of Recombination - Holliday model, Double strand break model, Genetic consequence of homologous recombination**.**	
Unit – III **(08 hrs)**	**Transcription:** a. Cis components Template, promoter, (b) RNA polymerases (c) Transcription mechanism-Initiation, Elongation and Termination in Prokaryotes and Eukaryotes (d) Post transcriptional modifications of transcripts (i) Prokaryotes: mRNA, rRNA, tRNA. (ii) Eukaryotes: mRNA (G-cap, Poly-A tail, Splicing).	**Transcription** Cis components Template, promoter, (b) RNA polymerases (c) Transcription mechanism-Initiation, Elongation and Termination in Prokaryotes and Eukaryotes (d) Post transcriptional modifications of transcripts (i) Prokaryotes: mRNA, rRNA, tRNA. (ii) Eukaryotes: mRNA (G-cap, Poly-A tail, Splicing).	
Unit – IV **(08 hrs)**	**Translation** (i) Genetic code: genetic and biochemical analysis of genetic code, features of Genetic code. (ii) Enzymes of translation: Amino Acyl tRNA synthetase, Peptidyl transferase. (iii) Translation process and factors: initiation, elongation (selection against incorrect Amino Acyl tRNA), and termination.	**Translation** (iii) Genetic code: genetic and biochemical analysis of genetic code, features of Genetic code. (iv) Enzymes of translation: Amino Acyl tRNA synthetase, Peptidyl transferase. (iii) Translation process and factors: initiation, elongation (selection against incorrect Amino Acyl tRNA), and termination.	
Unit – V **(08 hrs)**	**Gene Regulation in Prokaryotes** **a. Transcriptional Regulation: i)** Cis acting elements: Operator, enhancers, Silencers, Trans factors - Activators, Repressors, DNA binding motifs, helix turn helix, Zinc finger, Leucine Zipper ii)The Operons - Lactose operon (Allosteric, positive, negative control), iii)Regulation in Lambda Phage - Lytic and lysogenic cycle (Logic of lambda). **b. Regulation beyond transcription initiation**, i) premature termination of transcription - Tryptophan operon (*trp* attenuator) ii) Ribosomal proteins as	**Gene Regulation in Prokaryotes** **a. Transcriptional Regulation: i)** Cis acting elements: Operator, enhancers, Silencers, Trans factors - Activators, Repressors, DNA binding motifs, helix turn helix, Zinc finger, Leucine Zipper ii)The Operons - Lactose operon (Allosteric, positive, negative control), iii)Regulation in Lambda Phage - Lytic and lysogenic cycle (Logic of lambda). **b. Regulation beyond transcription initiation**, i) premature termination of transcription - Tryptophan operon (*trp* attenuator) ii) Ribosomal proteins as translational repressors (iii) Riboswitches (B12).	

	translational repressors (iii) Riboswitches (B12).		
Unit – VI **(08 hrs)**	**Gene Regulation in Eukaryotes** a. **Transcriptional Regulation i)** Basic considerations, Britten and Davidsons model ii) Transcriptional activators: Recruit transcription machinery proteins and nucleosome modifiers (HATs & DMTs), Example: Yeast Mating type switching iii}Transcriptional repression : Mechanism - Competition, inhibition, direct repression, indirect repression. b. **Regulation after transcription initiation:** i) Alternative mRNA splicing (Reliable recognition of splice sites, ESE & ESS sequences, SR proteins), Mechanisms (Exon skipping etc) and significance examples sxl ,tra *and* dsx in flies ii) Translational control as in Ferritin and transferrin mRNA, iii)RNA interference miRNA and siRNA with examples.	**Gene Regulation in Eukaryotes** **a. Transcriptional Regulation i)** Basic considerations, Britten and Davidsons model ii) Transcriptional activators: Recruit transcription machinery proteins and nucleosome modifiers (HATs & DMTs), Example: Yeast Mating type switching iii}Transcriptional repression : Mechanism - Competition, inhibition, direct repression, indirect repression. **b. Regulation after transcription initiation:** i) Alternative mRNA splicing (Reliable recognition of splice sites, ESE & ESS sequences, SR proteins), Mechanisms (Exon skipping etc) and significance examples sxl ,tra *and* dsx in flies ii) Translational control as in Ferritin and transferrin mRNA, iii)RNA interference miRNA and siRNA with examples.	
Practical **(08X04= 32 Hrs)**	**MOLECULAR BIOLOGY AND EVOLUTION** 1. DNA isolation by rapid method. 2. Estimation of DNA concentration by Diphenylamine method. 3. Demonstration of PCR. 4. Karyotyping. 5. Study of mitotic chromosomes of *D.* melanogaster. 6. Study of sympatric species- D. melanogaster and D. anannassae. 7. Study of few examples of homologous and analogous organs. 8. Experiment to demonstrate Genetic drift and Natural Selection.	**MOLECULAR BIOLOGY AND EVOLUTION** 1. DNA isolation by rapid method. 2. Estimation of DNA concentration by Diphenylamine method. 3. Demonstration of PCR. 4. Karyotyping. 5. Study of mitotic chromosomes of *D.* melanogaster. 6. Study of sympatric species- D. melanogaster and D. anannassae. 7. Study of few examples of homologous and analogous organs. 8. Experiment to demonstrate Genetic drift and Natural Selection.	

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Paper: HISTOLOGY AND HISTOPATHOLOGY (Soft Core – 2)

Credits: 4
Teaching Pattern: 3 Theory + 1Tutorials
Teaching Hours: 48 hours
Examination: C1 + C2 (Internal Assessment) + C3 (Main Examination) = 15 + 15 + 70 = 100 Marks
Pedagogy:

Objectives

- To acquire a basic background in histology and to understand the properties of cells and their interactions with one another as components of tissues and organs.
- To understand how structure and function correlate at the microscopic level.
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Course outcome

- The student will be able to identify the basic structure of cells, tissues and organs and describe their contribution to normal function.
- The student will be able to explain the relationship between histology and thepathogenesis of disease.
- Understand the Principles and methods of immune-histo-chemistry techniques.
- Able to describe the normal structure and function of various cell types, tissues, and organs, and to differentiate their histological structures from each other through examination.

Course Content

Units	Existing Syllabus	Revised Syllabus	Remarks
Unit – I (12 hrs)	**Tissue fixation and staining** a. Histology, Histochemistry and Histopathology: Meaning, objectives and applications. b. Tissue fixation: Objectives, methods, chemical fixatives-types and chemistry of fixation; Physical methods - freezing and microwave fixation; choice of fixatives, factors affecting fixation, fixation artifacts. c. Dyes – Classification, Natural and Synthetic.	**Tissue fixation and staining** i. Histology, Histochemistry and Histopathology: Meaning, objectives and applications. j. Tissue fixation: Objectives, methods, chemical fixatives-types and chemistry of fixation; Physical methods - freezing and microwave fixation; choice of fixatives, factors affecting fixation, fixation artifacts. k. Dyes – Classification, Natural and Synthetic.	**No Changes**
Unit – II (12 hrs)	**Histology** a. Epithelium: Types and modifications – cilia, microvilli, stereocilia, flagella, junctional complexes. b. Functional Morphology (Mammalian): lungs, kidney, spleen, thymus, brain, bone and bone marrow, blood and lymph vessels.	**Histology** a. Epithelium: Types and modifications – cilia, microvilli, stereocilia, flagella, junctional complexes. **b.** Functional Morphology (Mammalian): lungs, kidney, spleen, thymus, brain, bone and bone marrow, blood and lymph vessels.	
Unit – III (12 hrs)	**Histochemistry** a. Classical Histochemistry: Principles and methods of application and utility of classical histochemical techniques : Examples: Localization of glycoproteins (PAS), nucleic acids (Feulgen) and	**Histochemistry** a. Classical Histochemistry: Principles and methods of application and utility of classical histochemical techniques : Examples: Localization of glycoproteins (PAS), nucleic acids (Feulgen)	

	steroid dehydrogenase activity. b. Immunohistochemistry: Principles and methods of application of Imunohistochemistry and immunofluorescence techniques. Examples: Localization of proteins in endocrine cells (Pituitary cell types orislet of Langherhans); *In situ* hybridization of nucleic acids.	and steroid dehydrogenase activity. **b.** Immunohistochemistry: Principles and methods of application of Imunohistochemistry and immunofluorescence techniques. Examples: Localization of proteins in endocrine cells (Pituitary cell types or islet of Langherhans); *In situ* hybridization of nucleic acids.	
Unit – IV **(12 hrs)**	**Histopathology** a. Morphological alterations in cells due to disease, types of degeneration-clouding, hyaline, hydrophic and fatty degeneration. b. Etiology, pathogenesis and histopathology of Liver cirrhosis and atherosclerosis, Neuropathology of alcoholism and methanol poisoning. c. Tumors- malignant and non-malignant, types of carcinoma, histopathology of breast and prostate tumors.	**Histopathology** a. Morphological alterations in cells due to disease, types of degeneration-clouding,hyaline, hydrophic and fatty degeneration. b. Etiology, pathogenesis and histopathology of Liver cirrhosis and atherosclerosis, Neuropathology of alcoholism and methanol poisoning. **c.** Tumors- malignant and non-malignant, types of carcinoma, histopathology of breast and prostate tumors.	

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Paper: Principles of Animal Sciences (Open Elective – 1)

Credits: 4
Teaching Pattern: 4 Theory
Teaching Hours: 64 hours
Examination: C1 + C2 (Internal Assessment) + C3 (Main Examination) = 15 + 15 + 70 = 100 Marks

Pedagogy:

Objectives

- This open elective paper mainly helps the students from non-zoology background to gain a basic knowledge about the characteristics of animals, branches of animal science and the Uniqueness of Indian wildlife
- Another aim of the paper is to understand the fundamentals of biomolecules, cells, tissues and organ systems.
- To discuss the principles of animal science with presentations and tutorials.

Course outcome

- Understand the chemical composition of carbohydrates, lipids, proteins and nucleic acids.
- Able to describe the basic structure of a cell and its organelles in a detailed manner.
- Understand the theories behind cell division, functional diversity and structure and function of different organ systems.

- Understand the fundamentals of ecology and environmental biology.
- Able to discuss the theory of inheritance and evolutionary theory.

Course Content

Unit	Existing Syllabus	Revised Syllabus
Unit – I	**UNIT I. Introduction and Animal Taxonomy** a. Characteristics of animals. b. Branches of animal science. c. Uniqueness of Indian wildlife. d. Animals as natural resource and their conservation. e. Animals and human welfare. f. Variety of life (different Kingdoms). g. Carl Linnaeus – Taxonomic hierarchy, binomial nomenclature. h. Major and minor phyla – diagnostic features with example for each phylum.	**Introduction and Animal Taxonomy (10 hrs)** a. Characteristics of animals. b. Branches of animal science c. Carl Linnaeus – Taxonomic hierarchy, binomial nomenclature. d. Major and minor phyla – diagnostic features with example for each phylum.
Unit – II	**UNIT II. Biomolecules, Animal cells and Tissues** a. Chemical composition. b. Examples and importance of carbohydrates, lipids, proteins, nucleic acids, enzymes and hormones. c. Sources and function of vitamins. d. Cell theory. e. Brief description of animal cell (light and ultra structure). f. Functions of cell organelles. g. Structure and functional diversity in animal cell. Cell division. **i.** Structure and functions of basic tissues.	**Biomolecules, Animal cells and Tissues (10 hrs)** a. Carbohydrates, lipids, proteins, enzymes, vitamins and their importance. b. Cell theory - brief description of animal cell, cell organelles and their functions. c. Cell division: Mitosis and Meiosis. d. Structure and functions of basic tissues. imple and Complex tissues
Unit – III	**UNIT III. Organ systems: Structure and functions** a. Nutrition: Feeding mechanisms in animals – filter feeding, biting and chewing, piercing and sucking, detritus feeding. Human alimentary canal and outlines of digestion and absorption. b. Respiration : Respiratory devices in different habitat, human respiration – exchange of gases, cellular respiration, and ATP synthesis. c. Circulation : Blood vessels and capillaries, composition of blood, blood coagulation, immunity. d. Excretion : Nitrogenous waste productions, excretory organs in animals, mammalian kidney and urine formation. e. Movement : Locomotion in vertebrates	**Organ systems: Structure and functions (20 hrs)** a. **Nutrition:** Feeding mechanisms in animals (Ex. Filter feeding, biting, chewing, piercing and sucking types). Human alimentary canal and outlines of digestion and absorption. b. **Respiration**: Different types of respiration in animals. Human respiration – exchange ofgases and cellular respiration. c. **Circulation**: Blood vessels and capillaries, heart, composition of blood and its functions. c. **Excretion:** Different types of excretion, nitrogenous waste

	– Swimming, walking running, flying skeletalmuscle contraction. f. Co-ordination: Neural and chemical co-ordination, parts of nervous system and their functions, endocrine system and hormones as chemical messengers. **g.** Reproduction: Asexual and sexual reproduction, significance of sexual reproduction, outlines of human reproduction and fertility control.	products, excretory organs in animals, mammalian kidney and urine formation. d. **Movement**: Locomotion in vertebrates (Ex. Swimming, walking running, flying). e. **Co-ordination**: Endocrine system and hormones as chemical messengers. **f. Reproduction:** Asexual and sexual reproduction, significance of sexual reproduction.
Unit-IV	**UNIT IV. Ecology and Environmental Biology** **a)** Abiotic and Biotic factors b) Population ecology c) Environment and Micro organisms (microbial ecology) d) Environmental Pollution – brief account of Air, Water, Noise, Pesticide, Metal, sound and soil pollution.	**Ecology and Environmental Biology (8hrs)** **a.** Abiotic and Biotic factors **b.** Environmental Pollution – brief account of Air, Water, Noise, Pesticide, Metal and Soil pollution and their impact on man.
Unit-V	**UNIT V. Heredity and Evolution** a) Continuity of life – Mendel's laws b) Structure of chromosomes and genes c) DNA andRNA d) Central dogma in molecular biology e) Evolution: Major theories and Evidences.	**Heredity and Evolution (8hrs)** a. Mendel's laws b. Structure of chromosomes and genes c. DNA andRNA d. Evolution of man.
Unit-VI	**UNIT VI. Applied Zoology** a. Brief description, and economic importance of Vermiculture, Apiculture, Sericulture, Fishery, Poultry, Piggery and Diary. b. Vectors and human parasites.	**Animals and human welfare (8 hrs)** a. Brief description and economic importance of Vermiculture, Apiculture, Sericulture, Laculture, Fishery, Poultry, Piggery and Diary. b. Parasites and vectors

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SEMESTER III

Paper: Ethology and Evolutionary Biology (Hard Core – 9)

Credits: 4
Teaching Pattern: 4 Theory
Teaching Hours: 64 hours
Examination: C1 + C2 (Internal Assessment) + C3 (Main Examination) = 15 + 15 + 70 = 100 Marks
Pedagogy:

Objectives

- To explain both phylogenetically and physiologically the functional relationships of all factors involved in behavior.
- To study the animal behaviour basically with a focus on behaviour under natural conditions, and viewing behaviours as an evolutionarily adaptive trait.
- To understand the theories of evolution and to understand the forces of evolutionthat affect the allelic frequencies.

Course outcome

- Get a better understanding about the reflexes and complex behavior, innate and learned behavior and different kinds of biological communications.
- Get an ideain approaching to study the genetics of behavior.
- Gain a better understanding of the theories of evolution and the details of humanevolutionary theories.
- Understand ideas and evidence that supports how life might have changed throughtime through speciation and molecular evolution.

Course Content

PART–A: ETHOLOGY			
Unit	**Existing Syllabus**	**Revised Syllabus**	**Remarks**
Unit – I **(16 hrs)**	**Study of animal behavior** a. Descriptive versus experimental approaches. b. Reflexes and complex behaviour- Latency, after discharge, summation, warm up, fatigueinhibition and feedback control. c. Instinctive Behaviour - Fixed action pattern, types of sign stimuli and releasers as triggers ;Genetic basis of instinctive behavior. d. Learning- Classical conditioning experiment, latent and insight learning Social learning;Altruism. e. Anti predator behavior - avoiding detection through colour and markings (Mullerian mimicry), Warning coloration. Batesian mimicry. f. Biological Communication: Forms of	**Study of animal behavior** a. Descriptive versus experimental approaches. b. Reflexes and complex behaviour- Latency, after discharge, summation, warm up, fatigueinhibition and feedback control. c. Instinctive Behaviour - Fixed action pattern, types of sign stimuli and releasers as triggers ;Genetic basis of instinctive behavior. d. Learning- Classical conditioning experiment, latent and insight learning Social learning;Altruism. e. Anti predator behavior - avoiding detection through colour and markings (Mullerian mimicry), Warning coloration. Batesian mimicry.	**No changes**

	signals, vision, audition and chemicals; Role of pheromone-Insects social organization; pheromone effects in mammals- Lee Boot, Whitten, Bruce, Collidge and Castro-Vandenberg effect/s.	f. Biological Communication: Forms of signals, vision, audition and chemicals; Role of pheromone-Insects social organization; pheromone effects in mammals- Lee Boot, Whitten, Bruce, Collidge and Castro-Vandenberg effect/s.	
Unit – II **(16 hrs)**	**Approaches for studying the genetics of behavior** a. Low tech' approaches. b. Quantitative genetic approaches. b. Candidate gene approaches. c. *G*enomic. d. Quantitative trait locus mapping. e. Microarray approaches. f. Other whole-genome approaches. Behavioural Genetics: a) Inheritance of behavioral traits b) Nest cleaning behavior in honey bees d) Circadian rhythm in Drosophila c) Genetic dissection of behavior using mutations inDrosophila.	**Approaches for studying the genetics of behavior** a. Low tech' approaches. c. Quantitative genetic approaches. b. Candidate gene approaches. c. *G*enomic. d. Quantitative trait locus mapping. e. Microarray approaches. f. Other whole-genome approaches. Behavioural Genetics: a) Inheritance of behavioral traits b) Nest cleaning behavior in honey bees d) Circadian rhythm in Drosophila c) Genetic dissection of behavior using mutations inDrosophila.	**No changes**
PART B: EVOLUTIONARY BIOLOGY			
Unit – III **(16 hrs)**	**ories of Evolution:** a. Overview of Lamarckism, Darwinism; Development of Neo-Darwinism-Mendelian Population; Gene pool, Allele and Genotype frequencies; Hardy-Weinberg genetic equilibrium. b**. Forces of Evolution that affect the allelic frequencies**: Mutation, Migration, Selection- Stabilizing selection, Directional selection, Disruptive selection, Balancing selection, Frequency dependent selection, Density dependent selection, Group and kin selection; Selection coefficient; Selective value; Genetic drift; Nonrandom mating. **Iuman evolution:** Hominid evolution: Anatomical, Geographical, Cultural; Molecular phylogenetics of *Homo sapiens*; Phyletic gradualism and punctuated equilibrium.	**ories of Evolution:** b. Overview of Lamarckism, Darwinism; Development of Neo-Darwinism-Mendelian Population; Gene pool, Allele and Genotype frequencies; Hardy-Weinberg genetic equilibrium. b**. Forces of Evolution that affect the allelic frequencies**: Mutation, Migration, Selection- Stabilizing selection, Directional selection, Disruptive selection, Balancing selection, Frequency dependent selection, Density dependent selection, Group and kin selection; Selection coefficient; Selective value; Genetic drift; Nonrandom mating. c. **Human evolution:** Hominid evolution: Anatomical, Geographical, Cultural; Molecular phylogenetics of *Homo sapiens*; Phyletic gradualism and punctuated equilibrium.	**No changes**
Unit – IV **(16 hrs)**	a. **Isolating mechanisms and speciation:** Concepts of species; Isolating mechanisms - Geographic, Reproductive isolation - Premating isolation- Climatic, Seasonal, Habitat, temporal, Ethological; Post mating isolation- gametic mortality, zygotic mortality, Hybrid inviability, Hybrid sterility, Hybrid breakdown; Origin of reproduction isolation- Muller's view,	a. **Isolating mechanisms and speciation:** Concepts of species; Isolating mechanisms - Geographic, Reproductive isolation - Premating isolation- Climatic, Seasonal, Habitat, temporal, Ethological; Post mating isolation- gametic mortality, zygotic mortality, Hybrid inviability, Hybrid sterility, Hybrid breakdown; Origin of reproduction isolation- Muller's view,	**No changes**

	Dobzhansky's view; Models of speciation - sympatric, allopatric, stasipatric; speciation by hybridization. **b. Molecular Evolution:** Molecular clock - Conversion of genetic distance into divergence time, Neutral theory of molecular evolution, Emergence of Non-Darwinism, Kinds of molecular data used in phylogenetic analysis, Phylogenetic considerations based on nucleotide and amino acid data.	Dobzhansky's view; Models of speciation - sympatric, allopatric, stasipatric; speciation by hybridization. b. **Molecular Evolution:** Molecular clock - Conversion of genetic distance into divergence time, Neutral theory of molecular evolution, Emergence of Non-Darwinism, Kinds of molecular data used in phylogenetic analysis, Phylogenetic considerations based on nucleotide and amino acid data.	

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Paper: Applied Zoology (Hard Core – 10)

Credits: 4
Teaching Pattern: 3 Theory + 1Practical (4 hours duration)
Teaching Hours: 48 hours
Examination: C1 + C2 (Internal Assessment) + C3 (Main Examination) = 15 + 15 + 70 = 100 Marks

Pedagogy:

Objectives

- To provide a strong foundation and motivation for applying fundamental concepts of **applied zoology** in basic research to meet global challenges.
- It provides the knowledge of medicine, dentistry, veterinary medicine, medicaltechnology, animal farming and fisheries.
- To learn about the life cycle of pests and harmful insects.

Course outcome

- Will gain a better knowledge about apiculture, lac culture and sericulture.
- Understand the ethology and life cycle of venomous insects and chemicalcomposition of venom and its applications.
- Understand the advantages and limitations behind the animal farming and fisheries -get a better understanding about the aquaculture with field visits.

Course Content

Units	Existing Syllabus	Revised Syllabus
Unit I **(12 Hours)**	**I. Beneficial insects** a. Meaning and scope of Applied Zoology. b.Apiculture: Honeybee species, Bee forage, Pollen calendar, Beekeeping, bee hive products, honeybee diseases and management. d. Lac culture: Lac insects, host plants, Lac culture and by products. e. Sericulture: Silkworm races, Life cycle of *Bombyx mori*, silkworm rearing, Grainage activity, Seed area, Silkworm diseases and their control. Pests and predators of silkworms. **f.** Insects as tools in Forensic Science.	**I. Beneficial insects (12 hrs)** a. Meaning and scope of Applied Zoology. b. Apiculture: Honeybee species, Bee forage, Pollen calendar, Beekeeping and its hive products, honeybee diseases and management. c. Lac culture: Lac insects, host plants, Lac culture and by products. d. Sericulture: Silkworm races, Life cycle of *Bombyx mori*, silkworm rearing, Grainage activity, Seed area, Silkworm diseases, pests, predators and their control. e. Insects of Forensic importance.

Unit II **(12 Hours)**	**Harmful insects** **a.** Plant insect interactions: Origin of insect pests, pest control and IPM. **b.** Pests of cereals and pulses: Rice, Wheat, Jowar and Zeyamays, Green gram, Bengal gram (one pest from each category). **c.** Pests of millets and commercial crops: Finger millet, Pearl millet, Cotton, Coffee, Tea(one pest from each category). **d.** Venomous insects and chemical composition of venom and its applications.	**Harmful insects (12 hrs)** **a.** Origin of insect pests. **b.** Pests of cereals and pulses: Rice, Wheat, Jowar and Zeyamays, Green gram, Bengal gram(one pest from each category with pest control measures). **c.** Pests of millets and commercial crops: Finger millet, Pearl millet, Cotton, Coffee, Tea(one pest from each category with pest control measures). **d.** Venomous insects, chemical composition of venom and its applications.
Unit III **(12 Hours)**	**Animal Farming** a. Poultry: Poultry breeds, hatcheries, rearing, poultry diseases and their management and poultry by products. b. Dairy: Dairy breeds, dairy farming, Dairy management and by products of dairy. c. Laboratory animal science: General principle of breeding and maintenance of small laboratory animals – Rat, Mouse. CPCSEA Guide lines. **d.** Piggery: Pig species, rearing and by products.	**Animal Farming (12 hrs)** a. Poultry: Poultry breeds, hatcheries, broiler and layer farming, bye products, poultry diseases and their management. b. Dairy: Dairy breeds, dairy farming and management, bye products. c. Laboratory Animals: General principle of breeding and maintenance of small laboratory animals (Rat and Mouse) and CCSEA Guide lines. d. Piggery: Pig species, rearing and by products.
Unit IV **(12 Hours)**	**Fisheries** **a.** Fisheries resources of India: coastal, deep sea and inland fisheries. **b.** Fresh water and marine aquaculture; culturable organisms: prawn, pearl and oyster culture. **c.** Intensive freshwater fish culture: carps & cat fishes, integrated fish farming, compositeand polyculture fish farming, fish by products. **d.** Ornamental fish culture and sea weeds.	**Fisheries (12 hrs)** **a.** Fishery (Coastal, Deep Sea and Inland) resources of India. **b.** Fresh water and marine aquaculture: Prawn, Pearl and Oyster culture. **c.** Inland freshwater fish culture: Carps & Cat fishes, integrated fish farming and fish by products. **d.** Ornamental fishes, sea weeds and their uses.
	Practical (Existing)	**Practical (Revised)**
4 x 12= 48 Hours	**PRACTICAL: APPLIED ZOOLOGY** **Apiculture** **1.** Study of honeybee species and honey bee colony members (queen, drone & worker honeybee)**.** Mounting of mouth parts, sting apparatus and appendages from moribund honeybee worker. Analysis of honey quality: Physical and biochemical parameters. **Sericulture** **2.** Silkworm egg (DFL), silkworm larva, pupa and adult moths, bivoltine and multivoltine cocoons, non-mulberry silkworm cocoons,	**PRACTICAL: APPLIED ZOOLOGY** **Apiculture** 1. Study of honeybee species, honey bee colony members (queen, drone & worker honeybee)**.** 2. Mounting of mouth parts, sting apparatus and appendages frommoribund honeybee worker. 3. Honeybee foraging plants. **Sericulture** 4. Silkworm egg (DFL), silkworm larva, pupa and adult moths, 5. Bivoltine and multivoltine silkworm cocoons, non-mulberry silkworm cocoons, silkworm pest - Uzi fly.

	silkworm pests. Uzi fly and Dermested beetles. **3.** Insect pests: Rice, wheat, Jowar, vegetables, coffee, cotton, milletand Pulses pests. **4.** Venomous insects and insects of Forensic Science importance. **Poultry & Dairy** **5.** Study of Quality parameters of Egg and milk. **Aquaculture** **6.** Commercially important inland and marine fishes, prawn and ornamental Fishes. Fixing and presentation of dead insects by Plastination Technique. **Field Visits:** Fish Farm, Sericulture, Apiculture and Lac culture Farms, Dairy and Poultry Farms and Visit to Animal House.	6. Insect pests: Rice, wheat, vegetables, coffee and Pulses pests. **Venomous and Forensically important insects** 7. Venomous insects and insects of Forensic importance (Two specimens each). **Poultry & Dairy** 8. Study of egg quality parameters. 9. Analysis of lactose in milk and milk test. **Aquaculture** 10. Study of commercially important inland and marine edible fishes, prawns 11. Plastination Technique using dead insects. **Field Visits** 12.Visiting to local fish farm, Sericulture farm, Apiculture center Lac culture farms, Dairy and Poultry farms and Central Animal Facility.

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Paper: ADVANCED DEVELOPMENTAL BIOLOGY (Hard Core – 11)

Credits: 4
Teaching Pattern: 3 Theory + 1 Praticals (4 hours duration)
Teaching Hours: 48 hours
Examination: C1 + C2 (Internal Assessment) + C3 (Main Examination) = 15 + 15 + 70 = 100 Marks
Pedagogy:

Objectives

- This course is structured with an intension of giving a contemporary Genetic and

Molecular perspective to the classical Developmental Biology, which the students have learnt during their UG classes. It opens up the students to a new branch – The Developmental Genetics, a synthesis which enables a genetic basis for understanding of animal development.

- The topics to study are organized in such a way that the student will get to understand the intricate genetic and molecular mechanisms which underlie animal development at all the landmark stages from zygote to adult in a systematic order.

Course outcome

- Understand the molecular basis of cell autonomous and conditional developmental decisionsmade during development.
- Learn about the molecular cross talks and genetic pathway that work in setting up the basic body plan through specification of body axis in the early developmental stages in Drosophila, amphibians and mammals.
- Learn about the inductive and guiding signals which operate during morphogenesis withexamples from nervous system and heart development.
- Understand the regulation specification, axis formation and the role of cell death during tetrapod limb formation. Study the hormonal and cellular pathways which function during the Post embryonic developmental programes –Metamorphosis and Regeneration.
- Study examples to demonstrate long term impact of developmental mechanisms to bring about'Evolutionary changes'.
- Conduct practical experiments which are used as tools to study gene expression during development and study the impact of mutations which affect developmental regulatory genes.

Course Content

Units	Existing Syllabus	Revised Syllabus	Remarks
Unit – I **(16 hrs)**	a. **Introduction**: i) Issues in developmental Biology ii) Mechanisms regulating developmental process: Autonomous specification - morphogenetic determinants (Yellow Cytoplasm, gcl), Conditional specification - Cell Cell Interaction (Lens induction). b. **Pattern Formation**: Laying down the primary body axis- i) *Drosophila* (Anterior/posterior, terminal group genes, Dorso/ventral axis) ii) Amphibians (Dorso/ventral) iii) Left –right axis in mammals. iv) Segmentation genes: Gap genes, Pairule genes, Segment polarity genes in *Drosophila.* v) Homeotic Selector genes in flies, mammals (Hox code).	**a. Introduction**: i) Issues in developmental Biology ii) Mechanisms regulating developmental process: Autonomous specification - morphogenetic determinants (Yellow Cytoplasm, gcl), Conditional specification - Cell Cell Interaction (Lens induction). **b. Pattern Formation**: Laying down the primary body axis- i) *Drosophila* (Anterior/posterior, terminal group genes, Dorso/ventral axis) ii) Amphibians (Dorso/ventral) iii) Left –right axis in mammals. iv) Segmentation genes: Gap genes, Pairule genes, Segment polarity genesin *Drosophila.* v) Homeotic Selector genes in flies, mammals (Hox code).	**No Changes**

Unit II (16 hrs)	a. **Morphogenesis:a) Gastrulation:** i) Morphogenetic movements and selective affinities of cells (cadherins and differential adhesion) ii) Molecular regulators of mesodermal migration (fibronectin, lamin, integrin). b. **Neurogenesis** i). Neuronal specification -Notch signaling- a skin/nerve regulatory switch in flies. ii). Axonal path finding: Attractants and repulsive signals – (long range and short range- Lamin, Netrins, Semaphorins, Neurotrophins), Target selection and forming the synapse. Example:Retinal axon pathfinding. **c. Mesoderm**-Vertebrate heart development (heart field specification, migration, differentiation, looping and chamber formation)	**a. Morphogenesis:a) Gastrulation:** i) Morphogenetic movements and selective affinities of cells (cadherins and differential adhesion) ii) Molecular regulators of mesodermal migration (fibronectin, lamin, integrin). **b. Neurogenesis** i). Neuronal specification -Notch signaling- a skin/nerve regulatory switch in flies. ii). Axonal path finding: Attractants and repulsive signals – (long range and short range- Lamin, Netrins, Semaphorins, Neurotrophins), Target selection and forming the synapse. Example:Retinal axon pathfinding. **c. Mesoderm**-Vertebrate heart development (heart field specification, migration, differentiation, looping and chamber formation)	**No Changes**
Unit III (16 hrs)	**Limb development:** i) Limb bud formation & specification (FGF, Hox, Tbx, genes, retinoic acid) ii) Digit formation- A/P axis specification and ZPA, Cell death in digit formation. a. **Metamorphosis and Regeneration**: i) Molecular mechanism of ecdysone action-cellular choice between apoptosis and differentiation. ii) Molecular responses to thyroid hormone during metamorphosis (Amphibians). iii) Blastema formation and differentiation during regeneration. (Morphollaxis in Hydra and Epimorphosis in Salamander). **b. Developmental mechanisms of evolutionary changes** i) Genetic mechanisms- Heterotopy (loss of limbs in snakes, Turtle shell), Heterochrony (Dolphin flippers) , Heterometry (Darwin's Finches), Heterotypy (Why insects have six legs) ii) Homologous genetic pathways of development –Deep homology.	**Limb development:** i) Limb bud formation & specification (FGF, Hox, Tbx, genes, retinoic acid) ii) Digit formation- A/P axis specification and ZPA, Cell death in digit formation. **a. Metamorphosis and Regeneration**: i) Molecular mechanism of ecdysone action-cellular choice between apoptosis and differentiation. ii) Molecular responses to thyroid hormone during metamorphosis (Amphibians). iii) Blastema formation and differentiation during regeneration. (Morphollaxis in Hydra and Epimorphosis in Salamander). **b. Developmental mechanisms of evolutionary changes** i) Genetic mechanisms- Heterotopy (loss of limbs in snakes, Turtle shell), Heterochrony (Dolphin flippers) , Heterometry (Darwin's Finches), Heterotypy (Why insects have six legs) ii) Homologous genetic pathways of development –Deep homology.	**No Changes**
PRACTICALS: 8X4=32	**ADVANCED DEVELOPMENTAL BIOLOGY** 1. Live observation of *Drosophila* embryogenesis. *2.* Dissection and mounting of Imaginal discs of *Drosophila.* 3. Study of gene expression during development with lac-Z reporter gene in Embryos. (Demonstration). 4. Reporter gene Lac-Z expression in imaginal discs. 5. Study of homeotic and maternal effect mutations. Observation of GFP tagged reporter expression in embryos, imaginal disc and others. **6.** Chick embryo mounting and study.	**ADVANCED DEVELOPMENTAL BIOLOGY** 1. Live observation of *Drosophila* embryogenesis. *2.* Dissection and mounting of Imaginal discs of *Drosophila.* 3. Study of gene expression during development with lac-Z reporter gene in Embryos. (Demonstration). 4. Reporter gene Lac-Z expression in imaginal discs. 5. Study of homeotic and maternal effect mutations. Observation of GFP tagged reporter expression in embryos, imaginal disc and others. **6.** Chick embryo mounting and study.	**No Changes**

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Paper: GENERAL MOLECULAR ENDOCRINOLOGY (Hard Core – 12)

Credits: 3
Teaching Pattern: 3 Theory (3 hours duration)
Teaching Hours: 48 hours
Examination: C1 + C2 (Internal Assessment) + C3 (Main Examination) = 15 + 15 + 70 = 100 Marks
Pedagogy:

Objectives

- To understand the molecular structure and function of Endocrine, Paracrine and autocrine secretions, Local hormones, Neuroendocrine secretions and Neurotransmitters.
- To understand the genetic control of harmone synthesis.

Course outcome

- Understand the basics of endocrine system.
- Able to discuss the mechanism of hormone action.
- Het a better understanding of Hypothalamo-Hypophyseal system.
- Able to explain the Morphology and physiological actions of melatonin.
- Able to explain the Bio-chemistry of synthesis, secretion and metabolism of thyroidhormones and Parathormone.

Course Content

Units	Existing Syllabus	Revised Syllabus	Remarks
Unit – I **(12 hrs)**	**Hormones** i) History, ii). Endocrine, Paracrine and autocrine secretions, Local hormones, Neuroendocrine secretions and Neurotransmitters iii) An over view of Mammalian endocrine system, iv) An overview of general classes of chemical messengers-Peptide, Amino acid derivatives and Steroid hormones; v) Neurotransmitters-Neuropeptides, vi). Growth stimulating factors, Chalones, Eicosanoids and Pheromones. (3 hrs). **b. Hormones and Homeostatsis :**	**Hormones** i) History, ii). Endocrine, Paracrine and autocrine secretions, Local hormones, Neuroendocrine secretions and Neurotransmitters iii) An over view of Mammalian endocrine system, iv) An overview of general classes of chemical messengers-Peptide, Amino acid derivatives and Steroid hormones; v) Neurotransmitters-Neuropeptides, vi). Growth stimulating factors, Chalones, Eicosanoids and Pheromones. (3 hrs).	**No Changes**

	i) Glucose, Calcium and Sodium Homeostasis, ii). Neuro-endocrine integration: milk ejection reflex and water balance. (4 hrs) **c. Endocrine Methodologies :** **i)** Histological-Cytological, ii). Surgical and Hormone replacement Therapy, iii). Bioassay, iv). RIA, v). ELISA, vi). Recombinant DNA techniques, vii). Gene knockout animal models. (5 hrs)	**b. Hormones and Homeostatsis :** i) Glucose, Calcium and Sodium Homeostasis, ii). Neuro-endocrine integration: milk ejection reflex and water balance. (4 hrs) **c.Endocrine Methodologies :** i) Histological-Cytological, ii). Surgical and Hormone replacement Therapy, iii). Bioassay, iv). RIA, v). ELISA, vi). Recombinant DNA techniques, vii). Gene knockout animal models. (5 hrs)	
Unit – II **(12hrs)**	**a. Genetic control of hormone synthesis:** i) Structure and expression of protein hormone encoding gene- Post translational modification, molecular aspects of peptide hormone secretion and delivery, ii). Transport and peripheral activation of hormones. (5 hrs) **b. Mechanism of hormone action :** i) Membrane bound, cytoplasmic and nuclear hormone receptors, ii). Regulation of receptor number, iii). Non-genomic mechanism of hormone action, Signal transduction:secondary messengers - cyclic AMP, prostaglandins, DAG and calmodulin, iv). Genomic mechanism of hormone action-Steroid and thyroid hormones - regulation of gene expression v). Termination of hormone action and metabolism of hormones. (5 hrs) **c. Invertebrate Endocrinology:** Structure, functions and molecular actions of insect and crustacean hormones with special reference to reproduction. (2 hrs).	**a. Genetic control of hormone synthesis:** i) Structure and expression of protein hormone encoding gene- Post translational modification, molecular aspects of peptide hormone secretion and delivery, ii). Transport and peripheral activation of hormones. (5 hrs) **b. Mechanism of hormone action :** ii) Membrane bound, cytoplasmic and nuclear hormone receptors, ii). Regulation of receptor number, iii). Non-genomic mechanism of hormone action, Signal transduction:secondary messengers - cyclic AMP, prostaglandins, DAG and calmodulin, iv). Genomic mechanism of hormone action-Steroid and thyroid hormones - regulation of gene expression v). Termination of hormone action and metabolism of hormones. (5 hrs) c. **Invertebrate Endocrinology:** Structure, functions and molecular actions of insect and crustacean hormones with special reference to reproduction. (2 hrs).	**No Changes**
UNIT III (12 hrs)	**a. Hypothalamo-Hypophyseal system :** i). Endocrine Hypothalamus : Structure, Chemical nature and control of secretion of hypothalamic hormones-TRH, GHRH, GnRH, CRH, Somatostatin and dopamine, Control of release of these hormones and their action on target cells, ii). Pituitary- Location, Development, structure and functional cell types, Hypothalomo-hypophysial portal system, Pituitary hormone and their physiological actions with emphasis on molecular mechanisms-GH and Prolactin, FSH, LH and FSH (Glycoprotein Hormones), Pro-opiomelanocortin and Neurohypophysial Hormones, iii). Control of Hypophysial Hormones, secretion and Feed back regulation, iv). Pituitary patho-physiology. :Hyperprolactinaemia, Pituitary dwarfish, Gigantism and Acromegaly. (7 hrs) **b.Pineal gland :** Morphology and physiological actions of melatonin (1 hr)	**a. Hypothalamo-Hypophyseal system :** i). Endocrine Hypothalamus : Structure, Chemical nature and control of secretion of hypothalamic hormones-TRH, GHRH, GnRH, CRH, Somatostatin and dopamine, Control of release of these hormones and their action on target cells, ii). Pituitary- Location, Development, structure and functional cell types, Hypothalomo-hypophysial portal system, Pituitary hormone and their physiological actions with emphasis on molecular mechanisms-GH and Prolactin, FSH, LH and FSH (Glycoprotein Hormones), Pro- opiomelanocortin and Neurohypophysial Hormones, iii). Control of Hypophysial Hormones, secretion and Feed back regulation, iv). Pituitary patho-physiology. :Hyperprolactinaemia, Pituitary dwarfish, Gigantism and Acromegaly. (7 hrs) **b.Pineal gland :** Morphology and physiological actions of melatonin (1 hr) **c. Endocrine Pancreas :**	**No Changes**

	a. **Endocrine Pancreas :** i). Structure and cell types of Islets of Langerhans, ii). Secretion and metabolism of Insulin, Glucagon and other pancreatic hormones, iii). Cellular and molecular actions of Insulin and Glucagon, iv). Insulin and Non Insulin Dependent Diabetes Mellitus, v). Islet cell tumor. (4 hrs)	i). Structure and cell types of Islets of Langerhans, ii). Secretion and metabolism of Insulin, Glucagon and other pancreatic hormones, iii). Cellular and molecular actions of Insulin and Glucagon, iv). Insulin and Non Insulin Dependent Diabetes Mellitus, v). Islet cell tumor. (4 hrs)	
Unit IV (12 hrs)	**a. Thyroid and Parathyroid Glands:** i). Position and Morphology, ii). Bio-chemistry of synthesis, secretion and metabolism of thyroid hormones and Parathormone, iii). Actions with emphasis on molecular mechanisms, iv). Patho-physiology-Goiter, Grave's disease and Cretinism. (5 hrs) **b. Adrenal Gland.** i). Anatomy, embryology and histology, ii). Control of synthesis, secretion and physiological roles of cortical hormones with emphasis on molecular actions, iii). Adrenal chromaffin tissue: Synthesis, and actions of catecholamines, iv). Addison's disease and Cushing's syndrome. (5 hrs) **c. Gastro-Intestinal Hormones :**Endocrine cells, Gastrin, CCK and Secretin(2 hrs)	**a. Thyroid and Parathyroid Glands:** i). Position and Morphology, ii). Bio-chemistry of synthesis, secretion and metabolism of thyroid hormones and Parathormone, iii). Actions with emphasis on molecular mechanisms, iv). Patho-physiology-Goiter, Grave's disease and Cretinism. (5 hrs) b. **Adrenal Gland.** i). Anatomy, embryology and histology, ii). Control of synthesis, secretion and physiological roles of cortical hormones with emphasis on molecular actions, iii). Adrenal chromaffin tissue: Synthesis, and actions of catecholamines, iv). Addison's disease and Cushing's syndrome. (5 hrs) c. **Gastro-Intestinal Hormones :**Endocrine cells, Gastrin, CCK and Secretin(2 hrs)	**No Changes**

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8. Nussey,S.S. and Whitehead,S.A. (2001): Endocrinology, an integrated approach. Taylor Francis Group.

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Paper: GENETIC ENGINEERING & BIOTECHNOLOGY (Soft Core-3)

Credits: 4
Teaching Pattern: 4 Theory
Teaching Hours: 64 hours
Examination: C1 + C2 (Internal Assessment) + C3 (Main Examination) = 15 + 15 + 70 = 100 Marks

Pedagogy:

Objectives

- This course aims to give the student a thorough theoretical and practical input about the standard as well as the modern techniques and tools used in Genetic engineering, gene manipulation and cloning.
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Course outcome

- Study the various enzymes and techniques used to purify and manipulate the DNA of interest in adesired manner.
- Learn about the methods of cloning the DNA of interest into appropriate vectors and its *in vivo* amplification, construction of Genomic and cDNA libraries.
- Learn the Principles, methodology and the an array of applications of PCR technique
- Understand the DNA sequencing technique from its earliest form, to its advancements till themost modern NGS technology.
- Learn the basic lab techniques used in DNA and protein analysis, generating transgenic animals,and gene transfers.
- Practically conduct experiments to use the tools like DNA extraction, electrophoretic analysis,PCR, Restriction digestion, Ligation etc.

Course Content

Units	Existing Syllabus	Revised Syllabus	Remarks
Unit – I **(20 hrs)**	**Principles of Genetic Engineering**: Nucleic acids isolation (Principles of isolation, purification and quantification); DNA modifying enzymes - Restriction and modification enzymes, Other nucleases, Polymerase, Ligase, Kinases and Phosphatases; Cloning vectors - Plasmids, Phages, Cosmids, Artificial chromosomes and Expression vectors; Cloning hosts - *E. coli, Saccharomyces,* Plant and animals cells.; Gene transfer -Physical and vector mediated methods and cloning methods (Directional cloning and TA cloning methods); Constructionof libraries -Genomic library, cDNA library and expression libraries.	**Principles of Genetic Engineering**: Nucleic acids isolation (Principles of isolation, purification and quantification); DNA modifying enzymes - Restriction and modification enzymes, Other nucleases, Polymerase, Ligase, Kinases and Phosphatases; Cloning vectors - Plasmids, Phages, Cosmids, Artificial chromosomes and Expression vectors; Cloning hosts - *E. coli, Saccharomyces,* Plant and animals cells.; Gene transfer -Physical and vector mediated methods and cloning methods (Directional cloning and TA cloning methods); Construction of libraries -Genomic library, cDNA library and expression libraries.	**No Changes**
Unit – II **(20hrs)**	**PCR:** Principle, Methodology, Types - RT-PCR, AFLP, RFLP, inverse PCR and Real time PCR and their applications. DNA finger printing **DNA sequencing** : DNA sequencing methods and their applications- Maxam and Gilbert's method, Sanger's method, Automated sequencing technique and Capillary gel electrophoresis, Next Generation Sequencing (NGS) methods.	**PCR:** Principle, Methodology, Types - RT-PCR, AFLP, RFLP, inverse PCR and Real time PCR and their applications. DNA finger printing **DNA sequencing** : DNA sequencing methods and their applications- Maxam and Gilbert's method, Sanger's method, Automated sequencing technique and Capillary gel electrophoresis, Next Generation Sequencing (NGS) methods.	**No Changes**
Unit – III	**DNA Engineering techniques**: Gel electrophoresis of nucleic acids and proteins (Agarose, Polyacrylamide) ; Blotting of macromolecules and hybridization- Probe	**DNA Engineering techniques**: Gel electrophoresis of nucleic acids and proteins (Agarose, Polyacrylamide) ; Blotting of macromolecules and	**No Cha**

(24 hrs)	Selection and labeling, principles of hybridization; gene screening-colony, plaque, dot, Southern & Northern blot screening, Antibody screening; Oligonucleotide synthesis ; Promoter characterization, Site directed mutagenesis; Generation of transgenic animals (*Drosophila* andMouse).	hybridization- Probe Selection and labeling, principles of hybridization; gene screening-colony, plaque, dot, Southern & Northern blot screening, Antibody screening; Oligonucleotide synthesis ; Promoter characterization, Site directed mutagenesis; Generation of transgenic animals (*Drosophila* and Mouse).	**nges**
Tutorials 8X4=32	**GENETIC ENGINEERING** 1. Demonstration of instruments and calculation for making of stock and working solutions. 2. Isolation of DNA by phenol chloroform method. 3. Analysis of DNA by agarose gel electrophoresis. 4. *In vitro* amplification of DNA by PCR. 5. Restriction digestion of DNA and analysis. 6. Ligation of DNA fragments and analysis. 7. Immunodiffusion.	**GENETIC ENGINEERING** 1. Demonstration of instruments and calculation for making of stock and working solutions. 2. Isolation of DNA by phenol chloroform method. 3. Analysis of DNA by agarose gel electrophoresis. 4. *In vitro* amplification of DNA by PCR. 5. Restriction digestion of DNA and analysis. 6. Ligation of DNA fragments and analysis. 7. Immunodiffusion.	**No Changes**

REFERENCES

1. Brown, T. A. (1995) Gene Cloning: An introduction. Chapman and Hall, London, UK.
2. Brown, T. A. (2015) Gene Cloning: An introduction. 7th edition. Chapman and Hall, London, UK.
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4. Kreuzer, H. and A. Massey. (2001): Recombinant DNA and Biotechnology. ASM Press,Washington DC, USA.
5. Primrose, S. B. and R. M. Twyman. (2006) Principles of gene manipulation and Genomics, Blackwell Publishing MA. USA.

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Paper: REPRODUCTIVE HEALTH (Open Elective – 2)

Credits: 4
Teaching Pattern: 4 Theory
Teaching Hours: 64 hours
Examination: C1 + C2 (Internal Assessment) + C3 (Main Examination) = 15 + 15 + 70 = 100 Marks
Pedagogy:

Objectives

- To learn the structure and functions of male and female reproductive system - particular emphasis is placed on the hormonal control of reproduction.
- Provides an important foundation to consider sexual differentiation and development, contraception, infertility and current reproductive technologies.

Course outcome

- Understand the basics of reproductive health, onset of puberty and harmonal
- functions.
- Get to know the need for male and female temporary and permanent contraceptives -awareness of sexually transmitted diseases.

- Understand the causes, symptoms, diagnosis and treatment of Gonorrhea, Syphilis,Herpes, Chlamydia, genital warts, AIDS, Vaginitis.

Course Content

Units	Existing Syllabus	Revised Syllabus	Remarks
Unit – I **(16 hrs)**	a. Male and Female reproductive system, Structure and functions of Primary and accessory reproductive organs, formation of spermatozoa and egg. b. Onset of puberty and its Hormonal control in male and female, Menstrual cycle and its hormonal control.	a. Male and Female reproductive system, Structure and functions of Primary and accessory reproductive organs, formation of spermatozoa and egg. b. Onset of puberty and its Hormonal control in male and female, Menstrual cycle and its hormonal control.	**No Changes**
Unit – II **(16 hrs)**	a. Events of fertilization. b. Process and hormonal control of pregnancy, parturition and lactation.	a. Events of fertilization. b. Process and hormonal control of pregnancy, parturition and lactation.	**No Changes**
Unit – III **(16 hrs)**	a. Fertility control: Need, Male and female temporary and permanent contraceptives. b. Assisted Reproduction: Causes of infertility in male and female, Sperm bank, Procedure of test tube baby : collection of ova, IVF, surrogate mother, GIFT, ZIFT,ICSI.	a. Fertility control: Need, Male and female temporary and permanent contraceptives. b. Assisted Reproduction: Causes of infertility in male and female, Sperm bank, Procedure of test tube baby : collection of ova, IVF, surrogate mother, GIFT, ZIFT,ICSI.	**No Changes**
Unit – IV **(16hrs)**	a. Sexually transmitted diseases (STD): Meaning, Psychological aspects of STD. b. Incidence, causes, transmission, symptoms, diagnosis and treatment of Gonorrhea, Syphilis, Herpes, Chlamydia, genital warts, AIDS, Vaginitis.	a. Sexually transmitted diseases (STD): Meaning, Psychological aspects of STD. b. Incidence, causes, transmission, symptoms, diagnosis and treatment of Gonorrhea, Syphilis, Herpes, Chlamydia, genital warts, AIDS, Vaginitis.	**No Changes**
TUTORIAL2x16 =32 Hrs	**REPRODUCTIVE HEALTH**: Tutorials to include brain storming sessions, discussions and seminar presentations	**REPRODUCTIVE HEALTH**: Tutorials to include brain storming sessions, discussions and seminar presentations	**No Changes**

REFERENCES

1. Austin, C. R. and R. V. Short (eds) (1972) :Reproduction in mammals. (1) Germ cells and Fertilization, (2) Embryonic and Foetal development, (3) Hormones in Reproduction, (4) Reproduction patterns (5) Artificial control of reproduction, Cambridge University Press, London, UK.
2. Jones, R. E. (1991) :Human Reproductive Biology , Academic Press N.Y, USA.
3. Paul Wassar Man and Jimmy, D. Neill (2005). Knobil and Neill's physiology of reproduction, Volume 1, 2, Raven Press, N. Y, USA.
4. Sasidhara, R (2006). Animal biotechnology recent concepts and development, MJP Publishers, Chennai, India.
5. Sawant, K. C (2001) Human Physiology, Dominant Publishers and Distributors, New Delhi, India.

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SEMESTER - IV

Paper: Environmental Biology (Hard Core – 13)

Credits: 4
Teaching Pattern: 3 Theory + 1Practical (4 hours duration)
Teaching Hours: 48 hours
Examination: C1 + C2 (Internal Assessment) + C3 (Main Examination) = 15 + 15 + 70 = 100 Marks

Pedagogy:

Objectives

- To understand the importance to preserve natural landscapes and biodiversity, protect wildlife populations and reverse ecosystem degradation.
- To understand the concept of habitat and ecological niche.
- To learn the importance of ecology, population ecology Conservation ofNatural Resources.

Course outcome

- Will understand the historical account, scope, basic concepts of environment andecology.
- Will understand the nature of ecological models; goals of model building; basic tools inmodel building.
- Learn about the causes, effects, control measures and monitoring of environmentalpollution.
- Learn the strategies of conservation and management of natural resources.

Course Content

Units	Existing Syllabus	Revised Syllabus
Unit I **(12 Hours)**	**Ecosystem** a. Historical account, scope, basic concepts, components of environment and approaches to thestudy of Environmental Biology. b. Concept of habitat and ecological niche; ecotone and edge effect; food chains, Food-webs and their structure; ecological pyramids in aquatic, terrestrial and parasitic environments. c. Brief description of biogeochemical (N,C,P) cycles. d. Ecological productivity and its measurement.	**Introduction to Environment Biology (12 hrs)** a. Environmental Biology: Definition, scope, concepts, pioneers and their contribution in the field of environmental biology b. Components of environment and approaches to the study of Environmental Biology. c. Concept of habitat and ecological niche; ecotone, edge effect, food chains, food-websand their structure; ecological pyramids in aquatic, terrestrial and parasitic environments. d. Brief description of biogeochemical (N,C,P) cycles.
Unit II **(12 hours)**	**Population Ecology** a. An overview of important population attributes – density, natality, growth rates - growthforms and concept of carrying capacity. b. Mortality - life tables and survivorship curves., c. Sex ratio, age distribution, dispersal and dispersion, aggregation and Allee's principle,	**Population Ecology (12 Hours)** a. An overview of important population attributes: density, natality, growth rates, growth forms and concept of carrying capacity. b. Mortality: Life tables and survivorship curves.

	population fluctuation & cyclic oscillations and Population interactions. d. Ecological model - nature of ecological models; goals of model building; basic tools in modelbuilding. Approaches to development of models with examples (Energy flow models).	c. Sex ratio, age distribution, dispersal and dispersion, aggregation and Allee's principle, population fluctuation and Population interactions. d. Ecological model:Nature of ecological models; goals of model building; basic tools in modelbuilding. Approaches to development of energy models with examples.
Unit III **(12 Hours)**	**Environmental pollution** a. Definition, causes, effects and control measures and monitoring of – Air Pollution - green house effect, global warming, Ozone layer depletion, photochemical smog and acid rain; Water Pollution with reference to major Indian rivers and marine pollution; soil, noise, thermal, and nuclear pollution - with special reference to present scenario in India. b. Pollutants and their impact on flora, fauna and humans; Solids and Biomedical wastes - causes, effects and control measures and their management. c. Microbial Ecology: Indicator Microorganisms. Role of microorganisms in biodegrading and bioremediation of organic and metal pollution. Biodegradation, biotransformation, biomagnifications and bioaccumulation of toxicants. **d.** Role of Central and State Pollution Control Boards.	**Environmental pollution (12 Hours)** a. Definition, pollutants, toxicants, solid wastes, biomedical wastes and their effects and control measures. b. Air Pollution: Sources, Causes, effects, control measures and monitoring. Green house effect, global warming, Ozone layer depletion, photochemical smog and acid rain and their impact on flora, fauna and man. c. Water Pollution: Sources, causes, effects and control measures with reference to major Indian rivers and marine ecosystem. Impact of water pollution on flora, fauna and man. d. Soil, noise, thermal and nuclear pollution with special reference to present scenario in India.
Unit IV **(12 Hours)**	**Conservation of Natural Resources and Natural hazards** a. Conservation and management of natural resources- types, need, strategies of conservation. Significance of non - conventional energy resources: solar, wind, geo-thermal, tidal, nuclear and bio energy. b. Natural hazards - Earthquakes, Cyclones, Volcanoes Tsunami and their causes; Environment and Social issues\ c. Resettlement and rehabilitation of people, Wasteland reclamation and Environmental ethics. Environmental Protection Act -1986 and related Acts.	**Conservation of Natural Resources and Natural hazards (12 Hours)** a. Natural resources: Types, renewable and non-renewable resources, conventional and non-conventional resources, conservation and management. Significance of non - conventional energy resources: solar, wind, geo-thermal, tidal, nuclear and bio energy. b. Natural hazards: Earthquakes, Cyclones, Volcanoes Tsunami and their causes to environment. Environment and Social issues\ c. Resettlement and rehabilitation of people, Wasteland reclamation and Environmental ethics. d. Environmental Protection Act -1986 and related Acts. Role of Central and State Pollution Control Boards.
	PRACTICAL	**PRACTICAL**
	ENVIRONMENTAL BIOLOGY 1. Field visit to sewage pond, natural lake / river: Collection of water samples and study of physico-chemical parameters such as colour, pH, temperature, conductivity, total solids and	

4 x 12=48 Hours	turbidity. 2. Estimation of Carbon di oxide and dissolved oxygen in three natural (Sewage, Pond and Tap) water samples. 3. To study the relationship between Dissolved oxygen and free carbon dioxide, if any, in three natural (Sewage, Pond and Tap) water samples. 4. Determination of COD and BOD in three natural (Sewage, Pond and Tap) water samples. To study the relationship between BOD and COD, if any, in three natural (Sewage, Pond and Tap) water samples. Estimation of primary productivity of water bodies. 5. Population ecology- Population growth in Paramecium/ Drosophila 6. Estimation of Phosphate concentration in three natural (Sewage, Pond and Tap) watersamples. 7. Estimation of Nitrate concentration in three natural (Sewage, Pond and Tap) water samples. 8. Determination of population density in a natural/ hypothetical community by quadrate method and calculation of Ecological indices for the same community 9. Visit to RNHM, Mysore, to study models of freshwater, marine, estuarine and terrestrial habitats. 10. Survey of Animal Population - to visit different habitats, areas in and around Mysore and collect data on some population attributes; application of Bio-statistical tests to the collected data and its interpretation. 11 & 12. C1 and C2 assessment.	**No changes**

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1. APHA. 1992: Standard methods for examination of water and waste water, 18th EdN, usa..
1. Fahey, T.J. and Knapp, A.K. (2007). Principles and Standards for Measuring Primary Production, Oxford University Press, UK.
2. Zuur, A. F., Ieno, E. N. nad Smith, G. M. (2007). Analysizing Ecological data. Springer Science & Business Media.
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4. Trivedi, P.R.and Gurdeepraj, K. 1992. Environmental Biology. Akashdeep Publishing House New Delhi, India.

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Paper: Practical Cytogenetics (Hard Core -14)

Credits: 2
Teaching Pattern: 2 Practical
Teaching Hours: 64 hours
Examination: C1 + C2 (Internal Assessment) + C3 (Main Examination) = 15 + 15 + 70 = 100 Marks
Pedagogy:

Objectives

- To study the chromosomal structure, location and function in cells. It includes the study of chromosome number, appearance and chromosomal behavior in processes such as cell division.
- Gaining expertise in culture and maintenance of *Drosophila melanogaster.*
- To study the morphology, and life cycle of wild type *Drosophila melanogaster* and various types of mutants.
- To understand the Monohybrid, Di hybrid and Sex linked pattern of inheritance of characters by analysis of genetic crosses in *Drosophila.*

Course outcome

- Get practical exposure to conduct and analyse genetic crosses and their pattern of characters
- Understand the details of polytene chromosome and chromosomal anomalies
- Understand different stages of meiosis and chromosomal segregation and anomalies
- Study and observe the Mitochondria and Barr Body

Course Content

Units	Existing Syllabus	Revised Syllabus	Remarks
16x4=64Hrs	**2.** Study of Life cycle, culture and maintenance of *Drosophila melanogaster*. **3.** Study of Morphology (wing, sex comb, genital plate and bristles) of *Drosophila melanogaster*. 3. Study of mutants of *Drosophila melanogaster*– Dominant, Recessive, Autosomal, Sex-linked and Multiple mutations. 4. Genetic crosses and analysis of P1, P2, F1, F2 & test cross progeny in *Drosophila:*(a) Monohybrid (b) Dihybrid (c) Sex-linked inheritance. **6.** Study of Polytene chromosomes of *Drosophilamelanogaster*. Study of inversion heterozygotes in *D.anannassae.* 6. Study of meiotic stages and chromosome anomalies in grass hopper testis. **8.** Study of Barr body using buccal smear of volunteers. **9.** Observation of mitochondria using Janus green stain.	1. Study of Life cycle, culture and maintenance of *Drosophila melanogaster*. **1.** Study of Morphology (wing, sex comb, genital plate and bristles) of *Drosophila melanogaster.* **2.** Study of mutants of *Drosophila melanogaster*– Dominant, Recessive, Autosomal, Sex-linked and Multiple mutations. **3.** Genetic crosses and analysis of P1, P2, F1, F2 & test cross progeny in *Drosophila:*(a) Monohybrid (b) Dihybrid (c) Sex-linked inheritance. **4.** Study of Polytene chromosomes of *Drosophilamelanogaster.* **5.** Study of inversion heterozygotes in *D.anannassae.* **6.** Study of meiotic stages and chromosome anomalies in grass hopper testis. **7.** Study of Barr body using buccal smear of volunteers. **8.** Observation of mitochondria using Janus green stain.	**No Changes**

REFERENCES:

1. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. 7th Edn., Pearson Benjamin Cummings Publishing, San Francisco, USA.
2. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). Molecular Biology of the Cell. 5th Edn., Garland Publishing Inc., New York, USA.
3. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th Edn., ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, Massachusetts, USA.
4. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. 8th Edn., Lippincott Williams and Wilkins, Philadelphia, USA.
5. Karp, G. (2010). Cell and Molecular Biology*:* Concepts and Experiments. 6th Edn., John Wiley and Sons. Inc.

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Paper: Advanced Cell Biology (Hard Core – 15)

Credits: 4
Teaching Pattern: 4 Theory
Teaching Hours: 64 hours
Examination: C1 + C2 (Internal Assessment) + C3 (Main Examination) = 15 + 15 + 70 = 100 Marks
Pedagogy:

Objectives

- This paper is designed to offer the students an in depth molecular and cellular level understanding of the basic cellular processes in the organism – Cell cycle, Programmed Cell death, Signal Transduction, Cell – Cell communication, Immune response and Cancer.
- This understanding will be an extremely useful resource for the student in any of the higher academic careers that would be pursued in any field of Biology or Medicine.

Course outcome

- Understand in detail the Cell intrinsic, core system and the external factors that regulate cell division cycle in an orderly manner. Understand how cell is protected against wrong steps, DNA damage which might occur during cell division, by specific regulatory mechanisms.
- Learn about the Programmed Cell Death which is an essential process of normal development and adult life of an organism. Study the signaling pathways and the enzymes which control Apoptosis.
- Study the key mechanisms of Cell –Cell communications which are brought about through Cell junction complexes, intra and inter cellular signal transduction pathways.
- Learn in detail the cellular, chromosomal and genetic basis of tumor formation and progression. Study the role of tumor suppressor genes, Oncogenes in causing cancers and an over view of Cancer Therapy.
- Get a comprehensive account of the immune system of the body. Cellular components, Immunoglobulins of both innate and adaptive immunity are studied, with understanding of vaccines and other applications of immunology.

Course Content

Units	Existing Syllabus	Revised Syllabus	Remarks
Unit – I **(16 hrs)**	**Eukaryotic cell cycle & its regulation** a. Phases of cell cycle. **b.** Regulation: (i) Cell cycle check points (ii) cell intrinsic core regulators of checkpoints-Cyclins and Cdks, CAKs, CKIs, MPF, APC. and regulation at check points (iii) Cell intrinsic mediators of regulation- activators (myc, Ras), inhibitors (Rb, DNA damage P53 dependent and independent inhibition) (iv) Extracellular signals – growth factors (mitogens) (v) Specific regulators at meiosis, regulation of oocyte meiosis.	**Eukaryotic cell cycle & its regulation** a. Phases of cell cycle. **b.** Regulation: (i) Cell cycle check points (ii) cell intrinsic core regulators of checkpoints-Cyclins and Cdks, CAKs, CKIs, MPF, APC. and regulation at check points (iii) Cell intrinsic mediators of regulation- activators (myc, Ras), inhibitors (Rb, DNA damage P53 dependent and independent inhibition) (iv) Extracellular signals – growth factors (mitogens) (v) Specific regulators at meiosis, regulation of oocyte meiosis.	**No Changes**
Unit – II **(08 hrs)**	**Cell death** **a. Programmed:** (i) Programmed apoptosis v/s necrosis (ii) Discovery of cell death genes in *C.elegans* & homologous pathway in mammals (iii) Caspases – action, inhibition by survival signals (Trophic factors, neurotrophins) and activation by death signals (TNF, Perforin/granzyme pathway, Mitochondrial permeability). **b. Alternative Cell Death Mechanisms:** Autophagic, Necroptosis and their significance.	**Cell death** **a. Programmed:** (i) Programmed apoptosis v/s necrosis (ii) Discovery of cell death genes in *C.elegans* & homologous pathway in mammals (iii) Caspases – action, inhibition by survival signals (Trophic factors, neurotrophins) and activation by death signals (TNF, Perforin/granzyme pathway, Mitochondrial permeability). **b. Alternative Cell Death Mechanisms:** Autophagic, Necroptosis and their significance.	**No Changes**
Unit – III **(08 hrs)**	**Cell signaling** **a.** Endocrine, synaptic, autocrine and Nitric oxide signaling. **b.** Cell Surface receptors: (i) G-protein linked-structure, mechanism, Cyclic AMP mediated (ii) Enzyme linked -Receptor tyrosine kinases (iii) signaling through regulated proteolysis - Wnt-β catenin pathway, calcium signaling (iv) Synaptic signaling - Signaling at neuromuscular junction (transmitter gated ion channels, spatial and temporal summation).	**Cell signaling** a. Endocrine, synaptic, autocrine and Nitric oxide signaling. b. Cell Surface receptors: (i) G-protein linked-structure, mechanism, Cyclic AMP mediated (ii) Enzyme linked -Receptor tyrosine kinases (iii) signaling through regulated proteolysis - Wnt-β catenin pathway, calcium signaling (iv) Synaptic signaling - Signaling at neuromuscular junction (transmitter gated ion channels, spatial and temporal summation).	**No Changes**

Unit IV (16 hrs)	a. **Biology of Neoplasm:** (i) Types of tumors (Benign and Malignant), (ii) Development of cancer, metastasis and properties of cancer cells (iii) transformation of cells in culture, (iv) Causes of cancer- Carcinogens (Physical, Chemical and Biological agents). b. **Genetics of cancer:** (i) Chromosomes and cancer (Philadelphia, Burkitts lymphoma) (ii) Oncogenes: mechanism of transformation of protooncogens (iii) RNA tumor virus (Hepatitis) and DNA Tumor virus (Papilloma virus), Retroviral oncogenes, proto-oncogenes, (iv) Tumor suppressor genes: (Rb, BRCA) (v) Cancer as a multistep process, (vi) Cancer therapy: early detection and prevention, molecular diagnosis, treatment, cancer cell lines.	**a. Biology of Neoplasm:** (i) Types of tumors (Benign and Malignant), (ii) Development of cancer, metastasis and properties of cancer cells (iii) transformation of cells in culture, (iv) Causes of cancer- Carcinogens (Physical, Chemical and Biological agents). **b. Genetics of cancer:** (i) Chromosomes and cancer (Philadelphia, Burkitts lymphoma) (ii) Oncogenes: mechanism of transformation of protooncogens (iii) RNA tumor virus (Hepatitis) and DNA Tumor virus (Papilloma virus), Retroviral oncogenes, proto-oncogenes, (iv) Tumor suppressor genes: (Rb, BRCA) (v) Cancer as a multistep process, (vi) Cancer therapy: early detection and prevention, molecular diagnosis, treatment, cancer cell lines.	**No Changes**
Unit V **(16 hrs)**	**a. Immunology:** (i) Historical account (ii) General properties of immune responses – Innate immunity and its mechanisms – cellular and molecular basis of inflammation and its importance. (ii) Adaptive immunity - active, passive and adoptive types (iv) Humoral and cell mediated immunity. (v) Cells of the immune system: Hematopoesis, functions of NK cells, Dendritic cells, Macrophages, B Lymphocytes, T Lymphocytes (vi) Antigens and antigenicity (Epitopes, Haptene) (vii) Immunoglobulins: Classes of immunoglobulins, structure of IgG (viii) Genetic basis of immunoglobulin diversity (xi) MHC molecules: Types, structure (x) Cytokines (xi) Antigen recognition by cytosolic pathway, endocytic pathway **b. Clinical immunology**: (i) Vaccines – principles of vaccination, Recombinant vaccines. DNA vaccines. (ii) Principles of monoclonal antibody production and its applications (iii) Deficiencies in the immune system – AIDS, autoimmune diseases, Hypersensitivity.	**a. Immunology:** (i) Historical account (ii) General properties of immune responses – Innate immunity and its mechanisms – cellular and molecular basis of inflammation and its importance. (iii) Adaptive immunity - active, passive and adoptive types (iv) Humoral and cell mediated immunity. (v) Cells of the immune system: Hematopoesis, functions of NK cells, Dendritic cells, Macrophages, B Lymphocytes, T Lymphocytes (vi) Antigens and antigenicity (Epitopes, Haptene) (vii) Immunoglobulins: Classes of immunoglobulins, structure of IgG (viii) Genetic basis of immunoglobulin diversity (xi) MHC molecules: Types, structure (x) Cytokines (xi) Antigen recognition by cytosolic pathway, endocytic pathway **b.Clinical immunology:** (i) Vaccines – principles of vaccination, Recombinant vaccines. DNA vaccines. (ii) Principles of monoclonal antibody production and its applications (iii) Deficiencies in the immune system – AIDS, autoimmune diseases, Hypersensitivity.	**No Changes**

REFERENCES:

1. Alberts, B. Jhonson, A. Lewis, J. Raff, M. Roberts, K. and Walter, P. (2008): Molecular Biology of the Cell. 5th Edn. Garland Science, New York, USA.
2. Alberts, B Johnson, J. Lewis, M. Raff, K Roberts and P. Watter. (2014) Molecular Biology of the cell. 6th Edition. Garland Science, New York, USA.
3. Lodish, H., Berk, A. Kaiser, C.A. Scott, M.P. Bretscher, A. Ploegh, H. Matsudaira, P. (2016) 8th Edition, Molecular Cell Biology. W. H. Freeman and Co., N. Y, USA.
4. Brachet, J. (1985) Molecular Cytology, Academic Press, N. Y, USA.
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6. Pollard, T. D. and W. C. Earnshaw.(2002): Cell Biology. Saunders
7. Wolfe, A. (1995): Chromatin: Structure and function. Academic Press, N. Y, USA.

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Paper: Major Research Project (Soft Core- 4)

Credits: 8
Teaching Pattern: 2 Hours Tutorials + 6 Hours Practical / 2 days in a week
Teaching Hours: 24 + 192 =216 hours
Examination: C1 + C2 (Internal Assessment) + C3 (Main Examination) = 15 + 15 + 70 = 100 Marks
Pedagogy:

Objectives

- To insist researching ability, field survey and developing experimental designs to discover answers to questions through the application of scientific procedures.
- Formulating research aim and objectives in an appropriate manner is one of the most important aspects of this paper
- To learn and practice the literature survey aspects of projects
- To understand the importance of Biostatistics and computer applications

Course outcome

- Understand the Purpose and importance of scientific research.
- Understand the basics of biostatistics and various computer applications.
- Understand the importance of significance of disseminating research results, importance of peer review in paper publication and limitations of Plagiarism.

Course Content

Depends on the field of interest of the student in consultation with the research guide.

REFERENCES

- Published papers of the concerned research work
- Web sites an

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Paper: Research Methodology (Soft Core – 5)

Credits: 4
Teaching Pattern: 4 Theory
Teaching Hours: 64 hours
Examination: C1 + C2 (Internal Assessment) + C3 (Main Examination) = 15 + 15 + 70 = 100 Marks
Pedagogy:

Objectives

- To discover answers to questions through the application of scientific procedures.
- Formulating research aim and objectives in an appropriate manner is one of the most important aspects of this paper
- To learn and practice the literature survey aspects of projects
- To understand the importance of Biostatistics and computer applications

Course outcome

- Understand the Purpose and importance of scientific research.
- Understand the basics of biostatistics and various computer applications.
- Understand the importance of Significance of disseminating research results, IPR, Patenting -learn the Importance of peer review in paper publication and limitations of Plagiarism.

Course Content

Units	Existing Syllabus	Revised Syllabus	Remarks
Unit – I **(16 hrs)**	**Introduction to Research** **a.** Purpose and importance of scientific research. **b.** Sampling Techniques: Random and non-random sampling methods. **c.** Survey methods: Line Transect, Variable Width Line Transect, All out Search Methods. **d.** Planning and designing a research study: Literature survey and critical review; Identifying the gaps, defining the problem, statement of objectives, selection of methods to achieve objectives, collection, compilation and presentation of data.	**Introduction to Research** **a.** Purpose and importance of scientific research. **b.** Sampling Techniques: Random and non-random sampling methods. **c.** Survey methods: Line Transect, Variable Width Line Transect, All out Search Methods. **d.** Planning and designing a research study: Literature survey and critical review; Identifying the gaps, defining the problem, statement of objectives, selection of methods to achieve objectives, collection, compilation and presentation of data.	**No Changes**
Unit – II **(16 hrs)**	**Animals models in research and Cell culture** a. Introduction to laboratory animals – Drosophila, rat, mice, guinea pigs, rabbits. Breeding and management of laboratory animals, bioethics. CPCSEA Guide lines, RRR. b. Introduction to cell lines, *in-vitro* cell culture systems, primary and secondary culture systems, applications of cell culture. c. Cryopreservation: Scope, principles, methods and applications, cryoprotectants, cryopreservation of tissue, organs and embryos. d. Good laboratory practices, waste disposal, maintenance of sanitation & hygiene.	**Animals models in research and Cell culture** a. Introduction to laboratory animals – Drosophila, rat, mice, guinea pigs, rabbits. Breeding and management of laboratory animals, bioethics. CPCSEA Guide lines, RRR. b. Introduction to cell lines, *in-vitro* cell culture systems, primary and secondary culture systems, applications of cell culture. c. Cryopreservation: Scope, principles, methods and applications, cryoprotectants, cryopreservation of tissue, organs and embryos. **d.** Good laboratory practices, waste disposal, maintenance of sanitation & hygiene.	**No Changes**
Unit –III **(16 hrs)**	**Biostatistics and computer application** a. Arithmetic mean, mode, median, range, variance, standard deviation and standard error, coefficient of variation. b. Testing of hypothesis: Statement for testing the hypothesis, statistical validation using student's 't' test, 'z' test, chi square test, simple and multiple correlation, regression analysis, ANOVA., Meaning of level of significance. Computer applications: MS word, EXCEL, Power point, SPSS uses.	**Biostatistics and computer application** a. Arithmetic mean, mode, median, range, variance, standard deviation and standard error, coefficient of variation. b. Testing of hypothesis: Statement for testing the hypothesis, statistical validation using student's 't' test, 'z' test, chi square test, simple and multiple correlation, regression analysis, ANOVA., Meaning of level of significance. Computer applications: MS word, EXCEL, Power point, SPSS uses.	**No Changes**
	Preparation of Research paper, Thesis and Research Project Proposal preparation.	**Preparation of Research paper, Thesis and Research Project Proposal preparation.**	**No Cha**

Unit – IV **(16 hrs)**	a. Significance of disseminating research results, IPR, Patenting. b. Research paper: Preparation of research paper, importance of peer review in paper publication. c. Dissertation/thesis: Collection and compilation of data, organizing a thesis, bibliography. d. Research Project Proposal: Indentifying a problem, reviewing national and international status, objectives, methodology, budget. e. Plagiarism.	a. Significance of disseminating research results, IPR, Patenting. b. Research paper: Preparation of research paper, importance of peer review in paper publication. c. Dissertation/thesis: Collection and compilation of data, organizing a thesis, bibliography. d. Research Project Proposal: Indentifying a problem, reviewing national and international status, objectives, methodology, budget. **e.** Plagiarism.	**nges**

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Paper: Biodiversity and Wildlife Biology (Soft Core-6)

Credits: 4
Teaching Pattern: 4 Theory
Teaching Hours: 64 hours
Examination: C1 + C2 (Internal Assessment) + C3 (Main Examination) = 15 + 15 + 70 = 100 Marks

Pedagogy:

Objectives

- **T**o learn the scope of biodiversity
- To understand the importance of conservation of biodiversity -to learn the scope of wildlife biology

Course outcome

- Will learn the Concept of biodiversity, levels of biodiversity and general theoriesof biodiversity.
- Will understand the values of wildlife including endangered, threatened,vulnerable, rare and extinct species.
- Understand the importance of Wildlife Conservation

Course Content

Units	EXISTING SYLLABUS	REVISED SYLLABUS
Unit I **(16 hrs)**	**Scope of Biodiversity** a. Concept of biodiversity, levels of biodiversity: General theories (biotic and abiotic) of biodiversity. b. Biodiversity profile of World, India and Karnataka. c. Biodiversity depletion: threatened biodiversity, impact of development, effect of pollution, global warming and climate change. d. Mega biodiversity centeres in the world, biodiversity hot spots in India and Ramsar wetlands.	**Scope and importance of Biodiversity** a. Biodiversity: Definition, scope, importance, concept of biodiversity, levels of biodiversity: General theories (biotic and abiotic) ofbiodiversity. b. Biodiversity profile of the World, India and Karnataka. c. Biodiversity depletion: Overview on threatened biodiversity, impact of human development, effect of pollution, global warming and climate change. **d.** Mega biodiversity centeres in the world, biodiversity hot spots in India and Ramsar wetlands.
Unit II **(16 hrs)**	**Conservation of Biodiversity** a. Convention on Biological Diversity, Biodiversity Act, 2002, Biodiversity Board. b. Bioethics, IPR, Earth summits, Man and Biosphere Program (MAB). c. Biodiversity mapping, methods of assessment, prospecting, bioremediation, Biodiversity index and techniques. **d.** Management of biodiversity hotspots, biodiversity sustainable development and biodiversity heritage sites in Karnataka.	**Conservation of Biodiversity** a. Convention on Biological Diversity, Biodiversity Act, 2002. b. Bioethics, IPR, Man and Biosphere Programs (MAB's). c. Biodiversity mapping, assessment and prospecting. Biodiversity indices. **d.** Biodiversity hotspots conservation and Management in India andbiodiversity heritage sites in Karnataka.
Unit III **(16 hrs)**	**Scope of Wildlife Biology** a. Values of wildlife, wildlife categories: endangered, threatened, vulnerable, rare and extinct species, Red data book, green data book. b. Causes of wildlife depletion: degradation and destruction of wildlife habitats, exploitation for commercial purposes, deforestation, urbanization and industrialization, hunting, forest fire and agricultural expansion. c. Wildlife corridors, human-wildlife conflicts: Elephant, Tiger, Panther. d. Wildlife and tribal welfare, tribes in India and role of tribes in wildlife management.	**Scope & importance of Wildlife Biology** a. V alues of wildlife, wildlife categories: endangered, threatened, vulnerable, rare and extinct species, Red data book, green data book. b. Causes of wildlife depletion: Wildlife/natural habitat destruction and degradation, hunting, commercial exploitation, deforestation, urbanization, industrialization and forest fire. c. Wildlife corridors, human-wildlife conflicts. **d.** Tribal welfare, tribes in India and role of tribes in wildlife management.
Unit IV **(16 hrs)**	**Wildlife Conservation** a. Wildlife Legislation: IBWL, Wildlife Protection Act, 1972. Wildlife Conservation strategies: NGO's - BNHS, WWF, IUCN; ZSI, BSI. Protected Area Network and Wildlife Projects. b. In-situ conservation: Wildlife sanctuaries, national parks and bioreservers and their management. *Ex-situ* conservation: Zoo garden	**Wildlife Conservation** a. Wildlife Legislation: IBWL, Wildlife Protection Act, 1972. Role of NGO's (e.g. BNHS, WWF, IUCN; ZSI, BSI) in wildlife conservation. Wildlife Projects: Gir, Tiger, Elephant, Antelopes and Crocodiles. b. In-situ conservation: Wildlife sanctuaries, national parks and bioreservers and their management.

	and its management, Zoo Authority of India, captive breeding, artificial insemination, cryopreservation, germplasm banks. c. Wildlife census, techniques and survey methods.	c. *Ex-situ* conservation: Zoo gardens and their management, Zoo Authority of India, captive breeding, artificial insemination, cryopreservation, germplasm banks. **d.** Wildlife census, techniques and survey methods.

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Paper: Economic Zoology (Open Elective – 3)

Credits: 4
Teaching Pattern: 4 Theory
Teaching Hours: 64 hours
Examination: C1 + C2 (Internal Assessment) + C3 (Main Examination) = 15 + 15 + 70 = 100 Marks

Pedagogy:

Objectives

- To understand the Economic importance of Invertebrates andVertebrates
- To learn the Commercial importance of Insects.
- To gain better knowledge regarding Pests, Parasites and Vectors

Course outcome

- Will learn the culture and management of important invertebrates including apiculture,Corals, Lac culture, Mariculture.

- A basic knowledge about invertebrate products and byproducts.
- Understand the usefulness of insects as tools in Forensic Science and in crimedetection.
- A better understanding of Insect culture, collection, preservation and theimportance of Bioethics.

Course Content

Units	EXISTING SYLLABUS	REVISED SYLLABUS
Unit 1 **(16 Hrs)**	**Introduction and scope of Economic Zoology** a. Economic importance of Invertebrates; culture and management of important invertebrates – Apiculture, Corals, Lac culture, Mariculture, Prawn culture, Pearl culture, Sericulture and Vermiculture. b. Invertebrate products and byproducts.	**Introduction to Economic Zoology** a. Economic Zoology: Scope, importance and economically important animal species. b. Invertebrates culture and management: Corals, Apiculture, Lac culture, Sericulture, Prawn and Pearl culture. Mollusks and Echinoderms use for commercial purpose. c. Bye products of invertebrates and their commercial uses. d. Entomophagy: Insect eating, insect species and their usage as food in different parts of the world and their economics.
Unit 2 **(16 Hrs)**	**Economic importance of Vertebrates** a. Rearing and management of important vertebrates – Dairy, Fisher culture, Poultry, Piggery, Pigeonery, Rabbit and snakes. b. Usefulness of vertebrate products and by products: Animal oriented Medicine, leather, wool, fur industry.	**Commercial important invertebrates** a. Forensically important insects used in crime detection. b. Insect pests: Cereals, millets and pulses pests (one example each) and their control. c. Parasitic protozoan's, nematode and their diseases to man d. Vectors: Mosquitoes, ticks, mites and their diseases to man. Venomous insects and their venom applicationto treat various diseases, Apitherapy.
Unit 3 **(16 Hrs)**	**Pests, Parasites and Vectors** a. Insects as pests – on food and vegetable crops. b. Parasitic protozoa, nematodes, helminthes and their human diseases. c. Vectors: Mosquitoes, ticks, mites, cockroaches, rat and their human diseases.	**Vertebrate's culture and management:** a. Culture of Fishes, Amphibians, Crocodiles, Turtles, Snakes, Birds and mammals. b. Rearing and management of vertebrates for food, medicine and other bye products. **c.** Animal oriented Medicine, leather, wool, fur and other vertebrate animals related industries.
Unit 4 **(16 Hrs)**	**Commercial importance of Insects** a. Entomophagy: Entomophagic species and their usage in different parts of the world and economics. b. Insects as tools in Forensic Science, usefulness of insects in crime detection. c. Insect culture, collection, preservation and bioethics. **d.** Insects as biological controlling agents. Venomous insects and their venom application to treat various ailments and diseases, Apitherapy.	**Economic importance of Vertebrates** a. Animal welfare: Government and NGO's involved in animal welfare. b. Rat and Mice culture. Animal house management. Animal ethics and CCSEA Rules and Regulations. c. Domesticated and wild animals trade and its control. Applications of vertebrate poisonous animals (e.g. snake venom) for human welfare.

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