



**ANDHRA PRADESH STATE COUNCIL OF HIGHER
EDUCATION**

Model Syllabus for Zoology (Minor) in consonance with Curriculum framework

w.e.f. AY 2025-26

COURSE STRUCTURE

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
II	III	1	Animal Diversity-I Biology of Non-Chordates	3	3
			Animal Diversity-I Biology of Non-Chordates-Practical	2	1
	IV	2	Animal Diversity-II Biology of Chordates	3	3
			Animal Diversity-II Biology of Chordates-Practical	2	1
III	V	3	Cell & Molecular Biology	3	3
			Cell & Molecular Biology-Practical	2	1
	VI	4	Genetics	3	3
			Genetics-Practical	2	1
	V	5	Animal Physiology: Life Sustaining Systems	3	3
			Animal Physiology: Life Sustaining Systems-Practical	2	1
		6	Evolution and Zoogeography	3	3
		Evolution and Zoogeography-Practical	2	1	

SEMESTER-III

COURSE 1: ANIMAL DIVERSITY-I BIOLOGY OF NON-CHORDATES

Theory	Credits: 3	3 hrs/week
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COURSE OBJECTIVES:

- To understand the taxonomic position of protozoa to helminthes.
- To understand the general characteristics of animals belonging to Protozoa to Hemichordate.
- To understand the structural organization of animals phylum from protozoa to Hemi chordata.
- To understand the origin and evolutionary relationship of different phyla from Protozoa to Hemi chordata.
- To understand the origin and evolutionary relationship of different phylum from annelids to hemichordates.

LEARNING OUTCOMES:

By the completion of the course the graduate should able to –

- Describe concept of animal kingdom classification and general characters of Protozoa
- Classify Porifera and Coelenterate with taxonomic keys
- Classify Phylum Platy & Nemathelminths using examples, parasitic adaptation
- Describe Phylum Annelida & Arthropoda using examples and economic importance of vermicomposting & economic importance of insects.
- Describe Mollusca, Echinodermata & Hemi chordata with suitable examples in relation to the phylogeny

SYLLABUS:

UNIT-I:

- 1.1 Whittakers five kingdom concept and classification of Animal Kingdom.
- 1.2 Protozoa General Characters and classification up to classes with suitable examples
- 1.3 Protozoa Locomotion & nutrition
- 1.4 Protozoa reproduction

Activity: Assignment /Seminar on the above

Evaluation: Marks to be awarded for written and oral presentations

UNIT -II:

- 2.1 Porifera General characters and classification up to classes with suitable examples
- 2.2 Canal system in sponges
- 2.3 Coelenterata General characters and classification up to classes with suitable examples
- 2.4 Polymorphism in coelenterates & Corals and coral reefs

Activity: Assignment /Seminar /Quiz/Project on the above

Evaluation: Evaluation of Written part Evaluation of oral Presentation, Assessment of students in Quiz participation and Ranking - Evaluation of Project Report and oral presentation

UNIT – III:

- 3.1 Platyhelminthes General characters and classification up to classes with suitable examples
- 3.2 Parasitic Adaptations in helminthes
- 3.3 Nemathelminthes General characters and classification up to classes with suitable examples
- 3.4 Life cycle and pathogenicity of *Ascaris lumbricoides*

Activity: Assignment /Seminar /Quiz/Project/Peer teaching on the above

Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT – IV:

- 4.1 Annelida General characters and classification up to classes with suitable examples
- 4.2 Vermiculture - Scope, significance, earthworm species, processing, Vermicompost, economic importance of vermicompost
- 4.3 Arthropoda General characters and classification up to classes with suitable examples
- 4.4 *Peripatus* - Structure and affinities

Activity: Assignment /Seminar /Quiz/Project/Peer teaching on the above

Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT – V:

- 5.1 Mollusca General characters and classification up to classes with suitable examples
- 5.2 Pearl formation in Pelecypoda
- 5.3 Echinodermata General characters and classification up to classes with suitable examples
Water vascular system in star fish
- 5.4 Hemichordata General characters and classification up to classes with suitable examples
Balanoglossus - Structure and affinities

Activity: Assignment /Seminar /Quiz/Project/Peer teaching on the above

Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

CO-CURRICULAR ACTIVITIES:

- Preparation of chart/model of phylogenetic tree of life, 5-kingdom classification
- Visit to Zoology Museum or Coral Island as part of Zoological tour
- Charts on polymorphism
- Clay models of canal system in sponges
- Plaster-of-paris model of *Peripatus*
- Construction of a vermicompost in each college, manufacture of manure by students and donating to local farmers
- Chart on pearl forming layers using clay
- Visit to a pearl culture rearing industry/institute
- Live model of water vascular system
- Observation of *Balanoglossus* for its tubicolous habit

REFERENCE BOOKS:

- L.H. Hyman „*The Invertebrates' Vol I, II and V.* – M.C. Graw Hill Company Ltd.
- Kotpal, R.L. 1988 - 1992 Protozoa, Porifera, Coelenterata, Helminthes, Arthropoda, Mollusca, Echinodermata. Rastogi Publications, Meerut.
- E.L. Jordan and P.S. Verma „*Invertebrate Zoology*’ S. Chand and Company.
- R.D. Barnes „*Invertebrate Zoology*’ by: W.B. Saunders CO., 1986.
- Barrington. E.J.W., „*Invertebrate structure and Function*’ by ELBS.
- P.S. Dhami and J.K. Dhami. Invertebrate Zoology. S. Chand and Co. New Delhi.
- Parker, T.J. and Haswell “*A text book of Zoology*’ by, W.A., Mac Millan Co. London.
- Barnes, R.D. (1982). *Invertebrate Zoology*, V Edition”

SEMESTER-III

COURSE 1: ANIMAL DIVERSITY-I BIOLOGY OF NON-CHORDATES

Practical	Credits: 1	2 hrs/week
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COURSE OBJECTIVES

- To understand the importance of preservation of museum specimens
- To identify animals based on special identifying characters
- To understand different organ systems through demo or virtual dissections
- To maintain a neat, labelled record of identified museum specimens

SYLLABUS:

- Study of museum slides / specimens / models (Classification of animals up to orders)
- Protozoa: Amoeba, *Paramoecium*, *Paramoecium Binary fission and Conjugation*, *Vorticella*, *Entamoeba histolytica*, *Plasmodium vivax*
- Porifera: *Sycon*, *Spongilla*, *Euspongia*, *Sycon*- T.S & L.S, Spicules, Gemmule
- Coelenterata: *Obelia* – Colony & Medusa, *Aurelia*, *Physalia*, *Velella*, *Corallium*, *Gorgonia*, *Pennatula*
- Platyhelminthes: *Planaria*, *Fasciola hepatica*, *Fasciola* larval forms – *Miracidium*, *Redia*, *Cercaria*, *Echinococcus granulosus*, *Taenia solium*, *Schistosoma haematobium*
- Nemathelminths: *Ascaris* (Male & Female), *Drancunculus*, *Ancylostoma*, *Wuchereria*
- Annelida: *Nereis*, *Aphrodite*, *Chaetopterus*, *Hirudinaria*, Trochophore larva
- Arthropoda: Cancer, *Palaemon*, Scorpion, *Scolopendra*, *Sacculina*, *Limulus*, *Peripatus*,
- Larvae - Nauplius, Mysis, Zoea, Mouth parts of male &female *Anopheles* and *Culex*, Mouthparts of Housefly and Butterfly.
- Mollusca: *Chiton*, *Pila*, *Unio*, *Pteredo*, *Murex*, *Sepia*, *Loligo*, *Octopus*, *Nautilus*, Glochidium larva
- Echinodermata: *Asterias*, *Ophiothrix*, *Echinus*, *Clypeaster*, *Cucumaria*, *Antedon*, Bipinnaria larva
- Hemichordata: *Balanoglossus*, Tornaria larva

Dissections:

Computer - aided techniques should be adopted or show virtual dissections Dissection of edible (Prawn/Pila) invertebrate as per UGC guidelines

An “Animal album” containing photographs, cut outs, with appropriate write up about the above-mentioned taxa. Different taxa/ topics may be given to different sets of students for this purpose

REFERENCE WEB LINKS:

- <https://virtualmicroscopy.peabody.yale.edu/>
- <https://tnhm.in/category/assorted-gallery-for-vertebrates-and-invertebrates/invertebrates/>
- <http://www.nhc.ed.ac.uk/index.php?page=24.25.312>
- <https://biologyjunction.com/invertebrate-notes/>
- <https://lanwebs.lander.edu/faculty/rsfox/invertebrates/>
- <https://www.zoologyresources.com/uploadfiles/books/dc64b77d8769325515d17c945e461b45.pdf>

SEMESTER-IV

COURSE 2: ANIMAL DIVERSITY-II BIOLOGY OF CHORDATES

Theory	Credits: 3	3 hrs/week
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COURSE OBJECTIVES:

- To understand the animal kingdom.
- To understand the taxonomic position of Protochordata to Mammalia.
- To understand the general characteristics of animals belonging to Fishes to Reptilians.
- To understand the body organization of Chordata.
- To understand the taxonomic position of Proterian mammals.

LEARNING OUTCOMES:

By the completion of the course the graduate should be able to –

- Describe general taxonomic rules on animal classification of chordates
- Classify Protochordata to Mammalia with taxonomic keys
- Understand Mammals with specific structural adaptations
- Understand the significance of dentition and evolutionary significance
- Understand the origin and evolutionary relationship of different phyla from Prochordata to Mammalia.

SYLLABUS:

UNIT – I:

- 1.1 General characters and classification of Chordata up to classes
- 1.2 Salient features of Cephalochordata, Salient features of Urochordata
- 1.3 Structure and life history of *Herdmania*, Retrogressive metamorphosis –Process and Significance
- 1.4 Cyclostomata, General characters, Comparison of Petromyzon and Myxine

Activity: *Model preparation /Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above*

Evaluation: *Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity*

UNIT – II:

- 2.1 General characters of Fishes, Salient features Diploï
- 2.2 *Scoliodon*: External features, Digestive system, Respiratory system
- 2.3 *Scoliodon* Structure and function of Heart, Structure and functions of the Brain.
- 2.4 Migration in Fishes, Types of Scales

Activity: *Model preparation /Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above*

Evaluation: *Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity*

UNIT – III:

- 3.1 General characters of Amphibia, General characters of Reptilia
- 3.2 *Rana hexadactyla*: External features, Respiratory system, Structure and function of Heart
- 3.3 *Rana hexadactyla* structure and functions of the Brain
- 3.4 *Calotes*: External features, Digestive system, structure and function of Brain
- 3.5 Identification of Poisonous snakes

Activity: *Model preparation /Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above*

Evaluation: *Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity*

UNIT – IV:

- 4.1 General characters of Aves
- 4.2 *Columba livia*: External features, Digestive system, Respiratory system
- 4.3 *Columba livia*: Structure and function of Heart, structure and function of Brain
- 4.4 Migration in Birds, Flight adaptation in birds

Activity: *Model preparation/Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above*

Evaluation: *Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity*

UNIT – V:

- 5.1 General characters of Mammalia
- 5.2 Classification of Mammalia up to sub - classes with examples
- 5.3 Comparison of Prototherians, Metatherians and Eutherians
- 5.4 Dentition in mammals, Aquatic mammals Adaptations

Activity: *Model preparation/Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above*

Evaluation: *Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity*

CO-CURRICULAR ACTIVITIES:

- Preparation of charts on Chordate classification (with representative animal photos) and retrogressive metamorphosis
- Clay models of Herdmania and Amphioxus
- Visit to local fish market and identification of local cartilaginous and bony fishes
- Maintaining of aquarium by students
- Model of fish heart and brain
- Preparation of slides of scales of fishes
- Visit to local/nearby river to identify migratory fishes and prepare study notes
- Preparation of Charts on above topics by students (Eg: comparative account of vertebrate heart/brain/lungs, identification of snakes etc.)

- Collecting and preparation of Museum specimens with dead frogs/snakes/lizards etc., and/or their skeletons
- Additional input on types of snake poisons and their antidotes (student activity).
- Collection of bird feathers and submission of report on Plumology
- Taxidermic preparation of dead birds for Zoology Museum
- Map pointing of prototherian and metatherian mammals
- Chart preparation for dentition in mammals

REFERENCE BOOKS:

- J.Z. Young, 2006. The life of vertebrates. (The Oxford University Press, New Delhi). 646 pages.
- Arumugam, N. Chordate Zoology, Vol. 2. Saras Publication. 278 pages. 200 figs.
- A.J. Marshall, 1995. Textbook of zoology, Vertebrates. (The McMillan Press Ltd., UK). 852 pages. (Revised edition of Parker & Haswell, 1961).
- M. Ekambaranatha Ayyar, 1973. A manual of zoology. Part II. (S. Viswanathan Pvt. Ltd., Madras).
- P.S. Dhami & J.K. Dhami, 1981. Chordate zoology. (R. Chand & Co.). 550 pages.
- Gurdarshan Singh & H. Bhaskar, 2002. Advanced Chordate Zoology. Campus Books, 6 Vols., 1573 pp., tables, figs.
- A.K. Sinha, S. Adhikari & B.B. Ganguly, 1978. Biology of animals. Vol. II. Chordates. (New Central Book Agency, Calcutta). 560 pages.
- R.L. Kotpal, 2022. Modern textbook of zoology, Vertebrates. (Rastogi Publ., Meerut). 632 pages.
- E.L. Jordan & P.S. Verma, 1998. Chordate zoology. (S. Chand & Co.). 1092 pages.
- G.S. Sandhu, 2005. Objective Chordate Zoology. Campus Books, vii, 169 pp.
- Sandhu, G.S. & H. Bhaskar, H. 2004. Textbook of Chordate Zoology. Campus Books, 2 vols., xx, 964 p., figs.
- Veena, 2008. Lower Chordata. (Sonali Publ.), 374 p., tables, 117 figs.

SEMESTER-IV

COURSE 2: ANIMAL DIVERSITY-II BIOLOGY OF CHORDATES

Practical	Credits: 1	2 hrs/week
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COURSE OBJECTIVES:

- To understand the importance of preservation of museum specimens
- To identify animals based on special identifying characters
- To understand different organ systems through demo or virtual dissections
- To maintain a neat, labeled record of identified museum specimens

SYLLABUS:

1. Protochordata: *Herdmania, Amphioxus, Amphioxus* T.S through pharynx.
2. Cyclostomes: *Petromyzon and Myxine*.
3. Pisces: *Pristis, Torpedo, Hippocampus, Exocoetus, Echeneis, Labeo, Catla, Clarius, Channa, Anguilla*.
4. Amphibia: *Ichthyophis, Ambystoma, Axolotl larva, Hyla*,
5. Reptilia: *Draco, Chamaeleon, Uromastyx, Testudo, Trionyx, Russel viper, Naja, Krait, Hydrophis, Crocodile*.
6. Aves: *Psittacula, Eudynamis, Bubo, Alcedo*.
7. Mammalia: *Ornithorhynchus, Pteropus, Funambulus*.
8. **Dissections**-As per UGC guidelines *Scoliodon IX and X, Cranial nerves Scoliodon Brain Mounting of fish scales*

Note: 1. Dissections are to be demonstrated only by the faculty or virtual.
2. Laboratory Record work shall be submitted at the time of practical examination.

REFERENCE WEB LINKS:

- <https://nt7-mhe-complex-assets.mheducation.com/nt7-mhe-complex-assets/Upload-20190715/InspireScience6-8CA/LS15/index.html>
- <https://themammallab.com/>
- <http://abacus.bates.edu/acad/depts/biobook/LabConCh.htm>
- <https://virtualzoology.wordpress.com/scoliodon/>
- <https://www.zoologyresources.com/uploadfiles/books/dc64b77d8769325515d17c945e461b45.pdf>

SEMESTER-V

COURSE 3: CELL & MOLECULAR BIOLOGY

Theory	Credits: 3	3 hrs/week
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COURSE OBJECTIVES:

- To understand the cell and distinguish between prokaryotic and eukaryotic cell
- To understand the role of different cell organelles in maintenance of life activities
- To acquaint the students with the concepts of cell division and cell cycle
- To acquaint student with basic concepts of molecular biology as to how characters are expressed with a coordinated functioning of replication, transcription and translation in all living beings
- To acquaint the students on the biological importance of biomolecules.

LEARNING OUTCOMES:

The overall course outcome is that the student shall develop deeper understanding of what life is and how it functions at cellular level. This course will provide students with a deep knowledge in Cell and molecular biology by the completion of the course the graduate shall be able to –

- Understand the basic unit of the living organisms and to differentiate the organisms by their cell structure.
- Describe fine structure and function of plasma membrane and different cell organelles of eukaryotic cell.
- Explain the cell cycle and bioenergetics of the cell
- Understand the central dogma of molecular biology and flow of genetic information from DNA to proteins
- Understand the gene expression phenomenon and biological importance of biomolecules

SYLLABUS:

UNIT – I: Cell Biology-I

- 1.1 Definition, history, prokaryotic and eukaryotic cells, virus, viroids, mycoplasma
- 1.2 Electron microscopic structure of animal cell.
- 1.3 Plasma membrane –Models and Fluid mosaic model
- 1.4 Transport functions of plasma membrane-Active – passive- facilitated.

Activity: *Model preparation of cell/Assignment /Students Seminar /Quiz/Project/Peer teaching on the above*

Evaluation: *Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity*

UNIT – II : Cell Biology-II

- 2.1 Structure and functions of Golgi complex & Endoplasmic Reticulum
- 2.2 Structure and functions of Lysosomes & Ribosomes
- 2.3 Structure and functions of Mitochondria & Centriole
- 2.4 Structure and functions of Nucleus & Chromosomes

Activity: *Model preparation of cell organelles/Assignment /Students Seminar /Quiz/Project/Peer teaching on the above*

Evaluation: *Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity*

UNIT – III :Cell Biology-III

- 3.1 Cell Division- mitosis, meiosis
- 3.2 Cell cycle – stages- check points- regulation
- 3.3 Abnormal cell growth- cancer- apoptosis
- 3.4 Bio energetics- Glycolysis-Krebs cycle-ETS

Activity: *Model preparation cell division /Assignment /Students Seminar /Quiz/Project/Peer teaching/Report writing after watching any video on the above*

Evaluation: *Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity*

UNIT IV: Molecular Biology-I

- 4.1 Central Dogma of Molecular Biology
- 4.2 Basic concepts of - DNA replication – Overview (Semi-conservative mechanism, Semi- discontinuous mode, Origin & Propagation of replication fork)
- 4.3 Transcription in prokaryotes – Initiation, Elongation and Termination, Post- transcriptional modifications (basics)
- 4.4 Translation – Initiation, Elongation and Termination

Activity: *Model preparation of DNA/Assignment /Students Seminar /Quiz/Project/Peer teaching/Report writing after watching any video on the above*

Evaluation: *Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity*

UNIT V: Molecular Biology-II

- 5.1 Gene Expression in prokaryotes (Lac Operon); Gene Expression in eukaryotes
- 5.2 Biomolecules- Carbohydrates (Glucose- structure-properties- biological importance only)
- 5.3 Biomolecules- Protein (Amino acid- structure- properties- biological importance only)
- 5.4 Biomolecules- Lipids (Fatty acid- structure - properties- biological importance only)

Activity: *Assignment / Students Seminar /Quiz/Project/Peer teaching/Report writing after watching any video on the above*

Evaluation: *Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity*

CO-CURRICULAR ACTIVITIES :

- Model of animal cell
- Working model of mitochondria to encourage creativity among students
- Photo album of scientists of cell biology
- Charts on plasma membrane models/cell organelles
- Charts on central dogma/lac operon/genetic code
- Model of semi-conservative model of DNA replication
- Power point presentation of any of the above topics by students

REFERENCES BOOK:

- Lodish, Berk, Zipursky, Matsudaria, Baltimore, Darnell „Molecular Cell Biology“ W.H. Freeman and company New York.
- Cell Biology by De Robertis
- Bruce Alberts, Molecular Biology of the Cell
- Rastogi, Cytology
- Varma & Aggarwal, Cell Biology
- C.B. Pawar, Cell Biology
- Molecular Biology by Frei fielder
- Instant Notes in Molecular Biology by Bios scientific publishers and Viva Books Private Limited
- James D. Watson, Nancy H. Hopkins „Molecular Biology of the Gene“

SEMESTER-V

COURSE 3: CELL & MOLECULAR BIOLOGY

Practical

Credits: 1

2 hrs/week

COURSE OBJECTIVES:

- Acquainting and skill enhancement in the usage of laboratory microscope
- Hands-on experience of different phases of cell division by experimentation
- Develop skills on human karyotyping and identification of chromosomal disorders
- To apply the basic concept of inheritance for applied research
- To get familiar with phylogeny and geological history of origin & evolution of animals

SYLLABUS:

1. Preparation of temporary slides of Mitotic divisions with onion root tips
2. Observation of various stages of Mitosis with prepared slides
3. Observation of various stages of Meiosis with prepared slides
4. Mounting of salivary gland chromosomes of Chironomus
5. Test for carbohydrate in given biological sample (Benedict's test)
6. Test for Protein in given biological sample (Nitric acid test -white ring)
7. Test for lipid in the given biological sample (Saponification test)

REFERENCE WEB LINKS:

- <https://cbi-au.vlabs.ac.in/>
- <https://www.youtube.com/watch?v=xhnUZAyNdQk>
- https://www.youtube.com/watch?v=l8LXQq5_VL0
- <https://www.labster.com/simulations>
- <https://www.sciencecourseware.org/BiologyLabsOnline/protected/TranslationLab/index.php>
- <https://virtual-labs.github.io/exp-analysis-of-carbohydrates-au/procedure.html>
- https://www.labxchange.org/library/items/lb:LabXchange:f10fd7ad:lx_simulation:1
- <http://www.zoologyresources.com/uploadfiles/books/dc64b77d8769325515d17c945e461b45.pdf>

SEMESTER-V

COURSE 4: GENETICS

Theory

Credits: 3

3 hrs/week

COURSE OBJECTIVES:

- To provide the background knowledge on the history of genetics and the importance of Mendelian principles.
- To provide the required knowledge on the gene interactions
- To acquaint the students, distinguish between polygenic, sex-linked, and multiple allelic modes of inheritance and extrachromosomal inheritance.
- To understand the principles of sex determination in animals with a reference to human being, and sex-linked inheritance
- To understand the human karyotyping and the concept of pedigree analysis basics.

LEARNING OUTCOMES:

By the completion of the course the graduate should able to –

- To understand the history of genetics, gain knowledge basic terminology of genetics
- To acquire knowledge on interaction of genes, various types of inheritance patterns existing in animals with reference to non-Mendelian inheritance.
- To acquire knowledge on chromosomal inheritance
- Acquiring in-depth knowledge on various of aspects of genetics involved in sex determination,
- Acquiring in-depth knowledge on human karyotyping, pedigree analysis and chromosomal disorders concepts of proteomics and genomics

SYLLABUS:

UNIT-I:

- 1.1 History of Genetics- Concepts of Phenotype, Genotype, Heredity, Variation, Pure lines and Inbreed Lines
- 1.2 Mendelian Principles on Monohybrid cross, back cross and Test cross
- 1.3 Mendelian Principles on Dihybrid cross

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above/Problem solving on Mendelian principles

Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-II:

- 2.1 Linkage - Definition, Types of linkage-complete linkage and incomplete linkage, Significance of linkage.
- 2.2 Crossing over - definition; Mechanism of crossing over: Chiasma Interference and coincidence
- 2.4 Gene Interactions: Incomplete dominance, codominance, Pleiotropy
- 2.5 Gene Interactions: Lethal alleles, Epistasis, Non- Epistasis

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above/Model preparation of linkage/crossing over

Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-III:

- 3.1 Polygenes (General Characteristics & examples)
- 3.2 Multiple Alleles (General Characteristics and Blood group inheritance)
- 3.3 Rh inheritance erythroblastosis foetalis
- 3.4 Extra chromosomal inheritance- Kappa particles in Paramecium and Shell coiling in snails

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above/Case study on Rh/Erythroblastosis foetalis

Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-IV:

- 4.1 Sex determination- Chromosomal theory and Genic Balance theory
- 4.2 Sex determination- Hormonal, Environmental and Haplo-diploidy types
- 4.3 Sex linked inheritance: X-linked inheritance
- 4.4 Sex linked inheritance: Y-linked & XY-linked inheritance

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above/ Preparation of animated model /chart on sex determination methods

Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-V:

- 5.1 Human karyotyping, Pedigree Analysis(basics)
- 5.2 Autosomal Recessive disorder-Sickle cell anaemia – causes, treatment, inheritance pattern, modes of testing and prevention
- 5.3 Autosomal Dominant disorder- Huntington disease
- 5.4 Basics on Genomics and Proteomic

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above/ Case study of a family for pedigree analysis

Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

CO-CURRICULAR ACTIVITIES (SUGGESTED)

- Observation of Mendelian / Non-Mendelian inheritance in the plants of college botanical garden or local village as a student study project activity
- Observation of blood group inheritance in students, from their parents and grandparents
- Karyotyping and preparation of pedigree charts for identifying diseases in family history
- Charts on chromosomal disorders

REFERENCE BOOKS:

- Harper, P. (2010). Practical genetic counselling. CRC Press.
- Kessler, S. (Ed.). (2013). Genetic counselling: psychological dimensions. Academic Press.
- Stevenson, A. C., & Davison, B. C. (2016). Genetic counselling. Elsevier.
- Evans, C. (2006). Genetic counselling: a psychological approach. Cambridge University Press.
- Atlas of Inherited Metabolic Diseases, MMendelian Inheritance in Man: A Catalog of Human Genes and Genetic Disorders, Victor A.McKusick, Vol I & II
- Stacy L Blachford (Editor) 2001. The Gale Encyclopedia of Genetic Disorders. Gale Group Publishers, Vol.1 (A-L), Vol.II (M-Z). Limoine, W.R. and Cooper, D.NB. 1996: Gene Trophy, Bios Scientific Pub.Oxford.
- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. VIII Edition. Wiley India
- Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition.
- Benjamin Cummings. Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin
- Cummings. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. Introduction to Genetic Analysis. IX Edition. W. H. Freeman and Co.
- James D. Watson, Nancy H. Hopkins 'Molecular Biology of the Gene'
- Gupta P.K., 'Genetics

SEMESTER-V
COURSE 4: GENETICS

Practical	Credits: 1	2 hrs/week
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COURSE OBJECTIVES:

- To acquire practical knowledge on the importance of Mendelian principles by solving the problems.
- To provide the required knowledge on the gene interactions
- To acquaint the students on Human karyotype & pedigree analysis basics
- To understand the various genetic concepts through Virtual labs

SYLLABUS:

1. Study of Mendelian inheritance using suitable examples/Problems
2. Study of linkage recombination, gene mapping using the data
3. Study of human karyotypes
4. Blood grouping and Rh in humans
5. Demonstration of prenatal diagnosis (Virtual lab).
6. Amniocentesis demo or virtual lab
7. Demonstration of Ultrasonography (Virtual lab).
8. Scoring dysmorphic features in syndromic patients
9. Genetic Counselling methods based on case history
10. Construction and analysis of Pedigree

REFERENCE WEB LINKS:

- <https://www.iitg.ac.in/cseweb/vlab/anthropology/Experiments/Mendels%20law/index.html>
- <https://learn.genetics.utah.edu/content/labs/>
- https://virtuallabs.merlot.org/vl_biology.html
- <https://blog.praxilabs.com/2020/06/30/dna-extraction-virtual-lab/>
- <https://jru.edu.in/studentcorner/lab-manual/agriculture/Fundamentals%20of%20Genetics.pdf>
- https://academicworks.cuny.edu/cgi/viewcontent.cgi?article=1008&context=ny_oers
- <https://sjce.ac.in/wp-content/uploads/2018/04/Cell-Biology-Genetics-Laboratory-Manual-17-18.pdf>
- <https://www.rlbcau.ac.in/pdf/Agriculture/AGP%20113%20Fundamentals%20of%20Genetics.pdf>
- https://coabnau.in/uploads/1610707528_GPB3.2PracticalManual-Final.pdf

SEMESTER-VI

COURSE 5: ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS

Theory	Credits: 3	3 hrs/week
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COURSE OBJECTIVES:

- To acquire knowledge of organ systems function.
- To develop the ability to integrate physiology from the cellular and molecular level to the organ system and organismic level of organization.
- To Effectively read, evaluate and communicate scientific information related to physiological processes in the body.
- To gain a deep knowledge of current topics in physiology.

LEARNING OUTCOMES:

The overall course outcome is that the student shall develop deeper understanding of concepts of Physiology. This course will provide students with a deep knowledge in physiology by the completion of the course the graduate shall able to –

- Understand the physiology of digestion and hormonal control of digestion
- Develop a comprehensive picture of respiratory physiology
- Acquire knowledge on the Renal physiology
- Understand the physiology of Nerve and muscle
- Understand the physiology of heart

SYLLABUS:

UNIT-I: Physiology of Digestion

- 1.1 Structural organization and functions of gastrointestinal tract and associated glands;
- 1.2 Vitamins & Mineral composition of food & Mechanical and chemical digestion of food;
- 1.3 Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins;
- 1.4 Hormonal control of secretion of enzymes in Gastrointestinal tract.

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above /Chart preparation on the hormonal control of secretion of enzymes

Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-II: Physiology of Respiration

- 2.1 Structural organization of Respiratory system, Mechanism of respiration, Control of respiration
- 2.2 Pulmonary ventilation; Respiratory volumes and capacities;
- 2.3 Transport of oxygen in blood and dissociation curves and the factors influencing it
- 2.4 Transport of Carbon dioxide in blood; dissociation curves and the factors influencing it, Carbon monoxide poisoning

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above /Group discussion on the CO poisoning/Debate on the dissociation curves
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-III: Renal Physiology

- 3.1 Structure of kidney and its functional unit
- 3.2 Mechanism of urine formation
- 3.3 Regulation of water balance
- 3.4 Regulation of acid-base balance

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above /Group discussion on the Urine formation/Working model of Kidney
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-IV: Physiology of exciting tissues

- 4.1 Neuron structure and types
- 4.2 Nerve impulse transmission-(Myelinated, Non-myelinated, synaptic)
- 4.3 Ultra structure of muscle
- 4.4 Molecular and chemical basis of muscle contraction

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above /Group discussion on the impulse transmission/Debate on the dissociation curves

Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT- V: Physiology of Heart

- 5.1 Structure of mammalian heart, Coronary circulation;
- 5.2 Structure and working of conducting myocardial fibers. Origin and conduction of cardiac impulses
- 5.3 Cardiac Cycle-Cardiac output and its regulation
- 5.4 Nervous and chemical regulation of heart rate. Blood pressure and its regulation

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above /Group discussion on the phases of Cardiac output /case study on the Blood Pressure

Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

CO-CURRICULAR ACTIVITIES:

- Chart on cardiac cycle, human lung, kidney/nephron structure etc.
- Working model of human / any mammalian heart.
- Working model of human / any mammalian urine formation
- Chart/model of sarcomere
- Chart/model on nerve impulse transmission

REFERENCES BOOKS:

- Eckert H. *Animal Physiology: Mechanisms and Adaptation*. W.H. Freeman & Company.
- Floray E. *An Introduction to General and Comparative Animal Physiology*. W.B. Saunders Co., Philadelphia.
- Goel KA and Satish KV. 1989. *A Text Book of Animal Physiology*, Rastogi Publications, Meerut, U.P.
- Hoar WS. *General and Comparative Physiology*. Prentice Hall of India, New Delhi.
- Lehninger AL. Nelson and Cox. *Principles of Biochemistry*. Lange Medical Publications, New Delhi.
- Prosser CL and Brown FA. *Comparative Animal Physiology*. W.B. Saunders Company, Philadelphia.

SEMESTER-VI

COURSE 5: COURSE 5: ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS

Practical

Credits: 1

2 hrs/week

COURSE OBJECTIVES:

- To acquire knowledge of anatomy of certain important organs.
- To develop the ability to test the biological sample like saliva and urine.
- To Effectively estimate the blood haemoglobin.
- To Acquire skill to use the sphygmomanometer in recording blood pressure.
- To observe the ECG

SYLLABUS:

1. Examination of sections of mammalian oesophagus, stomach, duodenum, ileum, rectum liver, trachea, lung, kidney
2. Study of activity of Salivary amylase under optimum condition
3. Qualitative tests for identification of Carbohydrates
4. Qualitative tests for identification of Proteins
5. Qualitative tests for identification of Fats
6. Urine test for sugar, albumin
7. Estimation of haemoglobin using Sahli's haemoglobinometer
8. Recording of blood pressure using a sphygmomanometer
9. Recording of frog's heart beat under in situ and perfused conditions
10. ECG observation- Spotting/identification of curves from the given ECG

REFERENCE WEB LINKS:

- <https://www.vlab.co.in/participating-institute-amrita-vishwa-vidyapeetham>
- <https://library.csi.cuny.edu/oer/virtuallabs-simulations#anatomy>
- <https://www.labster.com/simulations?course-packages=animal-physiology>
- <http://www.zoologyresources.com/uploadfiles/books/dc64b77d8769325515d17c945e461b45.pdf>
- [https://physiology.elte.hu/gyakorlat/jegyzet/Physiology_Practical_\(2013\).pdf](https://physiology.elte.hu/gyakorlat/jegyzet/Physiology_Practical_(2013).pdf)

SEMESTER-VI

COURSE 6: EVOLUTION AND ZOOGEOGRAPHY

COURSE OBJECTIVES:

- To provide knowledge on origin of life, theories and forces of evolution
- To explore the evidences of evolution
- To Explain the theories of evolution
- To understand the role of variations and mutations in evolution of organisms
- To understand the zoogeographical distribution of animals

LEARNING OUTCOMES:

The overall course outcome is that the student shall develop deeper understanding of what life is and how it functions at cellular level. This course will provide students with a deep knowledge in Evolution and zoo geography, by the completion of the course the graduate shall able to –

- Understand the principles and forces of evolution of life on earth, the process of evolution of new species and apply the same to develop new and advanced varieties of animals
- Explain the different evidences of evolution
- Understand the theories of evolution
- Explain the various tools for evolution
- Map the distribution of animals according to zoological realms

SYLLABUS:

UNIT-I:

- 1.1 Origin of life: different ancient concepts -Origin of Earth and Solar system: Big Bang theory, Primitive atmosphere, formation of macromolecules
- 1.2 Biological evolution: Coacervates, Microspheres, formation of Nucleic acids, Nucleoproteins
- 1.3 Formation of primary organisms, evolution of modes of nutrition, oxygen revolution, present day atmosphere, evolution of eukaryotes.
- 1.4 Experimental evidences in support of Biochemical origin of life (Miller and Urey experiment)

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above

Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-II:

- 2.1 Paleontological and taxonomical evidences of evolution
- 2.2 Morphological and anatomical evidences of evolution
- 2.3 Embryological and physiological evidences of evolution
- 2.4 Evidences from connecting links, missing links and bio geographical distribution

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above/Visit to Archaeological Museum for observation of fossils

Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT -III:

- 3.1 Lamarckism-Neo Lamarckism
- 3.2 Germplasm theory-August Weismann
- 3.3 Darwinism-Theory of Natural selection
- 3.4 Modern synthetic theory of evolution (Neo Darwinism)

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above

Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-IV:

- 4.1 Variations-types-sources of variations- importance in evolution
- 4.2 Mutations-classification-causes-significance in evolution
- 4.3 Isolation mechanisms-role in evolution
- 4.4 Sewall wright effect, Hardy Weinberg Principle

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above

Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-V:

- 5.1 Animal distribution and barriers of distribution
- 5.2 Zoogeographical realms – Palearctic & Nearctic regions
- 5.3 Zoogeographical realms – Neotropical & Ethiopian regions
- 5.4 Zoogeographical realms – Oriental & Australian regions

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above/Case study on the observation of fauna in the college locality/in the residential area

Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

CO-CURRICULAR ACTIVITIES:

- Chart on industrial melanism to teach directed selection, Darwin's finches to teach genetic drift, collection of data on weight of children born in primary health centres to teach stabilizing selection etc.

REFERENCES BOOKS:

- Ridley, M. (2004). Evolution. III Edition. Blackwell Publishing
- Hall, B. K. and Hallgrímsson, B. (2008). Evolution. IV Edition. Jones and Bartlett Publishers
- Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.
- Minkoff, E. (1983). Evolutionary Biology. Addison-Wesley.
- Organic evolution by Organic evolution by Dr. Veer Bala Rastogi, 2019 Kedar Nath Ramnath
- Palaeontology and Zoogeography Organic evolution by Dr. Veer Bala Rastogi, 2019 Kedarnath
- Ramnath
- Rastogi VB. 1991. *Organic Evolution*. Kedar Nath Ram Nath Publications, Meerut, Uttar Pradesh, India.
- Stahl FW. 1965. *Mechanics of Inheritance*. Prentice-Hall.
- White MJD. 1973. *Animal Cytology and Evolution*. Cambridge Univ. Press

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SEMESTER-VI

COURSE 6: EVOLUTION AND ZOOGEOGRAPHY

Practical

Credits: 1

2 hrs/week

COURSE OBJECTIVES:

- Acquainting and skill enhancement in the usage of laboratory equipment
- To apply the basic concept of inheritance for applied research
- To get familiar with phylogeny ad geological history of origin & evolution of animals
- To understand the zoogeographical distribution of animals

SYLLABUS:

1. Study of fossil evidences
2. Study of homology and analogy from suitable specimens and pictures
3. Study of embryological evidences by charts/ pictures
4. Study of Lamarckism with images /animations
5. Study of Darwinism with images/ animation
6. Study of connecting links/missing links images/charts
7. Phylogeny of horse with pictures
8. Study of Genetic Drift by using examples of Darwin's finches (pictures)
9. Visit to Natural History Museum and submission of report
10. Mapping distribution of animals according to zoogeographical regions.
11. Mapping zoogeographical regions

REFERENCE WEB LINKS:

- <https://www.labster.com/course-packages/evolution-and-diversity>
- <https://www.biointeractive.org/classroom-resources/stickleback-evolution-virtual-lab>
- <https://www.youtube.com/watch?v=tXbmPhrS4eA>
- <https://www.studocu.com/en-us/document/temple-university/bioe-lab-2-biomaterials/1632834116536-zoogeography-assignment/17915777>
- <https://guides.library.tulsacc.edu/c.php?g=932434&p=6720765>
- https://bio.libretexts.org/Courses/Butte_College/BC%3A_BIOL_2
- [Introduction to Human Biology %28Grewal%29/Text/09%3A_Biological_Evolution/9.3%3A_Evidence_for_Evolution](https://www.coursehero.com/study-guides/boundless-biology/evidence-of-evolution/)
- <https://www.coursehero.com/study-guides/boundless-biology/evidence-of-evolution/>