



ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

Programme: B.Sc. Honours in Zoology (Major)

w.e.f. AY 2023-24

SEMESTER - III

COURSE 5: ANIMAL DIVERSITY-II BIOLOGY OF CHORDATES

Theory

Credits: 3

3 hrs/week

LEARNING 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 Protherian mammals.

LEARNING OUTCOMES: By the completion of the course the graduate should 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 Dipnoi
- 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 (suggested)

- 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. Reprinted
- 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-III

COURSE 5: ANIMAL DIVERSITY-II BIOLOGY OF CHORDATES

Practical

Credits: 1

2 hrs/week

LEARNING 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*, *Amblystoma*, *Axolotl* larva, *Hyla*,
5. Reptilia: *Draco*, *Chamaeleon*, *Uromastix*, *Testudo*, *Trionyx*, *Russels 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/>
- <http://www.zoologyresources.com/uploadfiles/books/dc64b77d8769325515d17c945e461b45.pdf>

COURSE 6: PRINCIPLES OF GENETICS

Theory

Credits: 3

3 hrs/week

LEARNING 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 be 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 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 Inbred 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. 3.
- Stevenson, A. C., & Davison, B. C. (2016). Genetic counselling. Elsevier.
- Evans, C. (2006). Genetic counselling: a psychological approach. Cambridge University Press.
- References:
- Atlas of Inherited Metabolic Diseases.
- Mendelian Inheritance in Man: A Catalog of Human Genes and Genetic Disorders, Victor A. McKusick, 2 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.
- REFERENCES:

- 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-III

COURSE 6: PRINCIPLES OF GENETICS

Practical

Credits: 1

2 hrs/week

LEARNING 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.rlbcu.ac.in/pdf/Agriculture/AGP%20113%20%20Fundamentals%20of%20Genetics.pdf>
- https://coabnau.in/uploads/1610707528_GPB3.2PracticalManual-Final.pdf

SEMESTER-III
COURSE 7: ANIMAL BIOTECHNOLOGY

Theory

Credits: 3

3 hrs/week

LEARNING OBJECTIVES:

- To provide knowledge on animal cell and tissue culture and their preservation
- To empower students with latest biotechnology techniques like stem cell technology, genetic engineering, hybridoma technology, transgenic technology and their application in medicine and industry for the benefit of living organisms
- To explain *in vitro* fertilization, embryo transfer technology and other reproduction manipulation methodologies.
- To get insight in applications or recombinant DNA technology in agriculture, production of therapeutic proteins.
- To understand principles of animal culture, media preparation.

LEARNING OUTCOMES:

This course will provide students with a deep knowledge in animal biotechnology, by the completion of the course the graduate shall be able to –

- Get knowledge of the Vectors and Restriction enzymes used in biotechnology
- Describe the gene delivery mechanism and PCR technique
- Acquire basic knowledge on media preparation and cell culture techniques
- Understand the manipulation of reproduction with the application of biotechnology
- Understand the applications of Biotechnology in the fields of industry and agriculture including animal cell/tissue culture, stem cell technology and genetic engineering.

SYLLABUS:

UNIT-I:

- 1.1 Enzymes and Vectors Restriction modification systems: Types I, II and III.
- 1.2 Mode of action, nomenclature, applications of Type II restriction enzymes in genetic engineering
- 1.3 DNA modifying enzymes and their applications: DNA polymerases. Terminal deoxynucleotidyl transferase, kinases and phosphatases, and DNA ligases
- 1.4 Cloning Vectors: Plasmid vectors: pBR and pUC series, Bacteriophage lambda and M13 based vectors, Cosmids, BACs, YACs,

Activity: *Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above/ Preparation of models of Cloning vectors with biodegradable material/*

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

UNIT- II:

- 2.1 Gene delivery: Microinjection, electroporation, biolistic method (gene gun), liposome and viral mediated delivery
- 2.2 PCR: Basics of PCR.

2.3 DNA Sequencing: Sanger's method of DNA sequencing- traditional and automated sequencing

2.4 Hybridization techniques: Southern, Northern and Western blotting

Activity: *Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above/ Visit to any clinical testing laboratory for hands on experience of PCR Use*

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

UNIT-III:

3.1 Natural and Synthetic Cell cultures: primary culture, secondary culture, continuous cell lines

3.2 Organ culture; Cryopreservation of cultures.

3.3 Hybridoma Technology: Cell fusion, Production of Monoclonal antibodies (mAb), Applications of mAb

3.4 Stem cells: Types of stem cells, applications

Activity: *Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above/ Visit to any clinical testing laboratory for observation of various cultures*

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

UNIT-IV:

4.1 Manipulation of reproduction in animals: Artificial Insemination, In vitro fertilization

4.2 Manipulation of reproduction in animals: Super ovulation, Embryo transfer, Embryo cloning

4.3 Transgenic Animals: Strategies of Gene transfer;

4.4 Transgenic - sheep, - fish; applications

Activity: *Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above/ Visit to laboratory for observation of Artificial Insemination, In vitro fertilization/model preparation of transgenic animal*

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

UNIT-V:

5.1 DNA fingerprinting

5.2 Application of biotechnology in fisheries – monoculture in fishes, polyploidy in fishes

5.3 Gene therapy-application

5.4 Bio informatics- concept-definition-database types

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

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

REFERENCES BOOKS:

- Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
- Clark DP and Pazdernik NJ. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA
- Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
- Sambrook J and Russell D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press
- Wiley JM, Sherwood LM and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. McGraw Hill Higher Education
- Brown TA. (2007). Genomes-3. Garland Science Publishers
- Primrose SB and Twyman RM. (2008). Genomics: Applications in human biology. Blackwell Publishing, Oxford, U.K.
- Animal Cells Culture and Media, D.C. Darling and S.J. Morgan, 1994. BIOS Scientific Publishers Limited.
- Methods in Cell Biology, Volume 57, Jennie P. Mathur and David Barnes, 1998. Animal Cell Culture Methods Academic Press.
- P.K. Gupta: Biotechnology and Genomics, Rastogi publishers (2003).
- B.D. Singh: Biotechnology, Kalyani publishers, 1998 (Reprint 2001)

SEMESTER-III
COURSE 7: ANIMAL BIOTECHNOLOGY

Practical

Credits: 1

2 hrs/week

LEARNING OBJECTIVES

This course will provide students with a practical knowledge in animal biotechnology, by the completion of the course the graduate shall be able to –

- Acquire knowledge on Cloning vectors widely used in biotechnology
- Empower with the process of DNA quantification and amplification
- Explain purification of biological compounds by paper chromatography
- Get insight maintenance of laboratory apparatus
- Understand principles of animal culture, media preparation

SYLLABUS:

1. Cloning Vectors: Plasmid vectors: pBR and pUC series, Bacteriophage lambda and M13 based vectors, Cosmids, BACs, YACs, (Charts/Images/Models)
2. DNA quantification using DPA Method.
3. Techniques: DNA Fingerprinting
4. Separation, Purification of biological compounds by paper chromatography
5. Cleaning and sterilization of glass and plastic wares for cell culture.
6. Preparation of culture media.
7. Amplification of DNA by PCR

Note: above practical may be demonstrated in the lab or demonstrated by V- lab

REFERENCE WEB LINKS:

- <https://vlab.amrita.edu/>
- <https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>
- <https://blog.praxilabs.com/2020/06/30/dna-extraction-virtual-lab/>
- <http://mbvi-au.vlabs.ac.in/>
- https://webstor.srmist.edu.in/web_assets/downloads/2021/18BTC203J-lab-manual.pdf
- https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/files/BT%200312%20-%20ANIMAL%20CELL%20AND%20TISSUE%20CULTURE%20LABORATORY.pdf
- <https://davjalandhar.com/dbt/biotechnology/SOP/BSc%20Biotechnology%20Semester%20V%20%26%20VI.pdf>
- https://www.austincc.edu/awheeler/Files/BIOL%201414%20Fall%202011/BIOL1414_Lab%20Manual_Fall%202011.pdf

SEMESTER-III
COURSE 8: EVOLUTION AND ZOOGEOGRAPHY

Theory

Credits: 3

3 hrs/week

LEARNING 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 Palaeontological 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 (Suggested)

- 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 Hallgrimsson, 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 Kedar Nath 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

SEMESTER-III
COURSE 8: EVOLUTION AND ZOOGEOGRAPHY

Practical

Credits: 1

2 hrs/week

LEARNING 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 and 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/>

SEMESTER-IV
COURSE 9: EMBRYOLOGY

Theory

Credits: 3

3 hrs/week

LEARNING OBJECTIVES

- The objective of this course is to provide a comprehensive understanding of the concepts of early animal development.
- Students taking this course must develop a critical appreciation of methodologies specifically used to study the process of embryonic development in animals.
- In this course different concepts of animal development will be elaborated
- Students will be made familiar with different approaches that have been used to study embryology.
- Topics that will be discussed are organogenesis and regeneration.

LEARNING OUTCOMES:

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

- Understand the historical perspective and concepts of embryology
- Acquire knowledge on gametogenesis, fertilization and cleavage patterns
- Understand the fate of germinal layers and extraembryonic membranes
- Explain the process of regeneration in certain animals
- Examine the process of organogenesis

SYLLABUS:

UNIT-I:

- 1.1 Historical perspective and basic concepts: Phases of development
- 1.2 Cell-Cell interaction, Pattern formation, Differentiation and growth
- 1.3 Differential gene expression,
- 1.4 Cytoplasmic determinants and asymmetric cell division

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 Gametogenesis, Spermatogenesis, Oogenesis;
- 2.2 Types of eggs, Egg membranes; Fertilization (External and Internal)
- 2.3 Planes and patterns of cleavage; Types of Blastulae; Fate maps
- 2.4 Early development of frog and chick up to gastrulation

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

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

UNIT-III:

- 3.1 Fate of Germ Layers
- 3.2 Extra-embryonic membranes
- 3.3 Placenta (Structure, types and functions of placenta)
- 3.4 Amniocentesis

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

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

UNIT-IV:

- 4.1 Metamorphosis: Changes, hormonal regulations in amphibians
- 4.2 Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (in Turbellarians)
- 4.3 Ageing: Concepts and Theories
- 4.4 Teratogenic agents and their effects on embryonic development

Activity: *Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above /Flow chart preparation on the process of metamorphosis highlighting the periodical changes vs hormone activity*

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

UNIT-V:

- 5.1 Organogenesis of Central Nervous system
- 5.2 Organogenesis of Eye, Ear
- 5.3 Organogenesis of Skin
- 5.3 Organogenesis of Circulatory system
- (* Organogenesis in Human need to be explained)

Activity: *Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above /Flow chart preparation on the process of organogenesis highlighting the gradual developments of organ systems*

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

Co-curricular activities (Suggested)

- Preparation of models of different types of eggs in animals
- Chart on frog embryonic development, fate map of frog blastula, cleavage etc.
- Chart on the organogenesis
- RBPT on the Placenta
- Model of extra embryonic membrane
- Laboratory observation of chick embryonic development

REFERENCES BOOKS:

- Developmental Biology by Balinsky
- Developmental Biology by Gerard Karp
- Chordate embryology by Varma and Agarwal
- Embryology by V.B. Rastogi

SEMESTER-V
COURSE 15 B: LIVE STOCK MANAGEMENT -II
(DAIRY PRODUCTION AND MANAGEMENT)

- Austen CR and Short RV. 1980. *Reproduction in Mammals*. Cambridge University Press.
- Gilbert SF. 2006. *Developmental Biology*, 8th Edition. Sinauer Associates Inc., Publishers, Sunderland, USA.
- Longo FJ. 1987. *Fertilization*. Chapman & Hall, London.
- Rastogi VB and Jayaraj MS. 1989. *Developmental Biology*. KedaraNath Ram Nath Publishers, Meerut, Uttar Pradesh.
- Schatten H and Schatten G. 1989. *Molecular Biology of Fertilization*. Academic Press, New York.
