	ADIKAVI NANNAYA UNIVERSITY **RAJAMAHENDRAVARAM**

Model Syllabus for 4-Year UG Honours in B.Sc. (Zoology) as Major in consonance with Curriculum framework w.e.f. AY 2025-26

COURSE STRUCTURE (for Semester I to VI)

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	I	1	Animal Diversity-I Biology of Non- Chordates	3	3
			Animal Diversity-I Biology of Non-Chordates-Practical	2	1
		2	Animal Diversity-II Biology of Chordates	3	3
			Animal Diversity-II Biology of Chordates-Practical	2	1
	II	3	Cell and Molecular Biology	3	3
			Cell and Molecular Biology-Practical	2	1
		4	Embryology	3	3
			Embryology-Practical	2	1
II	III	5	Genetics	3	3
			Genetics-Practical	2	1
		6	Evolution and Zoogeography	3	3
			Evolution and Zoogeography-Practical	2	1
		7	Animal Physiology: Life Sustaining systems	3	3
			Animal Physiology: Life Sustaining systems-Practical	2	1
	IV	8	Immunology	3	3
			Immunology-Practical	2	1
		9	Animal Biotechnology	3	3
			Animal Biotechnology-Practical	2	1
		10	Wildlife and Conservation Biology	3	3
			Wildlife and Conservation Biology-Practical	2	1
III	V	11	Economic Zoology	3	3
			Economic Zoology-Practical	2	1

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
		12 A	Biology of Fin Fish & Shell Fish	3	3
			Biology of Fin Fish & Shell Fish-Practical	2	1
		OR			
		12 B	Poultry Products and Management	3	3
			Poultry Products and Management-Practical	2	1
		OR			
		12 C	Mulberry and Silk Worm Rearing	3	3
			Mulberry and Silk Worm Rearing-Practical	2	1
		OR			
		12 D	Basics of Bioinformatics and Computational Tools Course	3	3
			Basics of Bioinformatics and Computational Tools Course-Practical	2	1
		OR			
		12 E	Milk and Milk Products Technology	3	3
			Milk and Milk Products Technology-Practical	2	1
		13 A	Sustainable Aquaculture	3	3
			Sustainable Aquaculture-Practical	2	1
		OR			
		13 B	Poultry Waste Management	3	3
			Poultry Waste Management-Practical	2	1
		OR			
		13 C	Silk Technology	3	3
			Silk Technology-Practical	2	1
		OR			
		13 D	Molecular Biology and Genetic Technology	3	3
			Molecular Biology and Genetic Technology-Practical	2	1
		OR			
		13 E	Milk, Meat Hygiene, Food Safety and Public Health	3	3
			Milk, Meat Hygiene, Food Safety and Public Health-Practical	2	1
	VI	14 A	Ornamental Fishery	3	3
			Ornamental Fishery-Practical	2	1
		OR			

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
		14 B	Poultry Economics and Marketing	3	3
			Poultry Economics and Marketing-Practical	2	1
		OR			
		14 C	Therapeutic and Cosmetic Applications	3	3
			Therapeutic and Cosmetic Applications-Practical	2	1
		OR			
		14 D	Biostatistics and Programming for Life Sciences	3	3
			Biostatistics and Programming for Life Sciences-Practical	2	1
		OR			
		14 E	Livestock Economics, Marketing and Business Management	3	3
			Livestock Economics, Marketing and Business Management-Practical-Practical	2	1
		15 A	Post Harvest Technology of Fish and Fisheries	3	3
			Post Harvest Technology of Fish and Fisheries-Practical	2	1
		OR			
		15 B	Poultry Entrepreneurship	3	3
			Poultry Entrepreneurship-Practical	2	1
		OR			
		15 C	Sericulture Marketing and Entrepreneurship	3	3
			Sericulture Marketing and Entrepreneurship-Practical	2	1
		OR			
		15 D	Genomics, Proteomics- Applications in Zoology	3	3
			Genomics, Proteomics- Applications in Zoology-Practical	2	1
		OR			
		15 E	Livestock Entrepreneurship	3	3
			Livestock Entrepreneurship-Practical	2	1

Note: In the III Year (during the V and VI Semesters), students are required to select a pair of electives from one of the **Five** specified domains. **For example: if set 'A' is chosen, courses 12 to 15 to be chosen as 12 A, 13 A, 14 A and 15 A.** To ensure in-depth understanding and skill development in the chosen domain, students must continue with the same domain electives in both the V and VI Semesters.

SEMESTER-I

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

Theory **Credits: 3** **3 hrs/week**

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 student will able to –

- Describe concept of animal kingdom classification and general characters of Protozoa
- Classify Porifera and Coelenterata with taxonomic keys
- Classify Phylum Platy & Nemathelminthes using examples, parasitic adaptation
- Describe Phylum Annelida & Arthropoda using examples and economic importance of vermicomposting & economic importance of insects.
- Describe Mollusca, Echinodermata & Hemichordata 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 helminths

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 phylogenic 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-I

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

Practical **Credits: 1** **2 hrs/week**

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:

1. Study of museum slides / specimens / models (Classification of animals up to orders)
2. Protozoa: Amoeba, *Paramoecium, Paramoecium Binary fission and Conjugation, Vorticella, Entamoeba histolytica, Plasmodium vivax*
3. Porifera: *Sycon, Spongilla, Euspongia, Sycon*- T.S & L.S, Spicules, Gemmule
4. Coelenterata: *Obelia – Colony & Medusa, Aurelia, Physalia, Velella, Corallium, Gorgonia, Pennatula*
5. Platyhelminthes: *Planaria, Fasciola hepatica, Fasciola* larval forms – *Miracidium, Redia,* Cercaria, *Echinococcus granulosus, Taenia solium, Schistosoma haematobium*
6. Nemathelminths: *Ascaris (Male & Female), Drancunculus, Ancylostoma, Wuchereria*
7. Annelida: *Nereis, Aphrodite, Chaetopteurs, Hirudinaria,* Trochophore larva
8. Arthropoda: Cancer, *Palaemon*, Scorpion, *Scolopendra, Sacculina, Limulus, Peripatus,*
9. Larvae - Nauplius, Mysis, Zoea, Mouth parts of male &female *Anopheles* and *Culex,* Mouthparts of Housefly and Butterfly.
10. Mollusca: *Chiton, Pila, Unio, Pteredo, Murex, Sepia, Loligo, Octopus, Nautilus,* Glochidium larva
11. Echinodermata: *Asterias, Ophiothrix, Echinus, Clypeaster, Cucumaria, Antedon,* Bipinnaria larva
12. 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

RFERENCE WEB LINKS:

- https://virtualmicroscopy.peabody.yale.edu/
- https://tnhm.in/category/assorted-gallery-for-vertebrates-and-invetebrates/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.youtube.com/watch?v=iqrVmz625WA
- https://www.youtube.com/watch?v=5VlJ59oX7G0
- https://www.youtube.com/watch?v=sMutOON6zHE
- https://www.youtube.com/watch?v=zSTYRtliac0

SEMESTER-I

COURSE 2: ANIMAL DIVERISTY-II BIOLOGY OF CHORDATES

Theory **Credits: 3** **3 hrs/week**

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 Protherian mammals.

LEARNING OUTCOMES:

By the completion of the course student will 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

- 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.

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SEMESTER-I

COURSE 2: ANIMAL DIVERISTY-II BIOLOGY OF CHORDATES

Practical **Credits: 1** **2 hrs/week**

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's 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
9. 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

SEMESTER-II

COURSE 3: CELL & MOLECULAR BIOLOGY

Theory **Credits: 3** **3 hrs/week**

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 concept s 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 student will 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

REFERENCE BOOKS:

- Lodish, Berk, Zipursky, Matsudaria, Baltimore, Darnell, Molecular Cell Biology. 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"

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SEMESTER-II

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 ad 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 (Benedicts 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)

RFERENCE 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-II

COURSE 4: EMBRYOLOGY

Theory	**Credits: 3**	**3 hrs/week**

COURSE OBJECTIVES:

- The objective of this course is to provide a comprehensive understanding of the concepts of earlyanimal 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 completion of the course student will 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 Comparative study of Gastrulation in Frog, Chick and Mammal
5.2 Induction and embryonic organizers (Spemann's experiment)

5.3 Organogenesis of Skin
5.4 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:

- 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 Balinksy
- Developmental Biology by Gerard Karp
- Chordate embryology by Varma and Agarwal

- Embryology by V.B. Rastogi
- 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*. Kedar Anath Ram Nath Publishers, Meerut, Uttar Pradesh.
- Schatten H and Schatten G. 1989. *Molecular Biology of Fertilization.* Academic Press, New York.

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SEMESTER-II

COURSE 4: EMBRYOLOGY

Practical **Credits: 1** **2 hrs/week**

COURSE OBJECTIVES:

- The objective of this course is to provide a comprehensive practical knowledge on the embryology
- Must develop a critical understanding of the early embryological events
- Acquire knowledge on the developmental stages of chick
- Understand the histology of placenta

SYLLABUS:

1. Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages)
2. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages)
3. Study of different sections of placenta (photomicrograph/ slides)
4. Project report on chick embryo development

RFERENCE WEB LINKS:

- https://praxilabs.com/en/3d-simulations/cultivation-and-preparation-of-the-virus-in-chick-embryo- virtual-lab
- https://vlab.amrita.edu/
- https://www.vlab.co.in/
- https://www.youtube.com/watch?v=p_tx88He8Pk
- https://core.ac.uk/download/143957972.pdf
- https://egyankosh.ac.in/bitstream/123456789/57549/1/Exercise%207%20Chick%20Embryo.pdf
- http://www.macollege.in/app/webroot/uploads/department_materials/doc_501.pdf
- http://www.zoologyresources.com/uploadfiles/books/dc64b77d8769325515d17c945e461b45.pdf

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SEMESTER-III

COURSE 5: 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 student will 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,

1.3 Back cross and Test cross

1.4 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

2.3 Gene Interactions: Incomplete dominance, codominance, Pleiotropy
2.4 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 anemia – 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:

- 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.
- Atlas of Inherited Metabolic Diseases
- Mendelian 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

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SEMESTER-III

COURSE 5: GENETICS

Practical	**Credits: 1**	**2 hrs/week**

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

RFERENCE 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%20%20Fundamentals%20of%20Genetics .pdf
- https://coabnau.in/uploads/1610707528_GPB3.2PracticalManual-Final.pdf

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SEMESTER-III

COURSE 6: EVOLUTION AND ZOOGEOGRAPHY

Theory **Credits: 3** **3 hrs/week**

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 student will 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 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 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-III

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

RFERENCE 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/

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SEMESTER-III

COURSE 7: ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS

Theory	**Credits: 3**	**3 hrs/week**

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 student will 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 trasnmisson/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 MedicalPublications, New Delhi.
- Prosser CL and Brown FA. *Comparative Animal Physiology.* W.B. Saunders Company, Philadelphia.

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SEMESTER-III

COURSE 7: 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 hemoglobin.
- 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

RFERENCE 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_Pactical_(2013).pdf

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SEMESTER-IV

COURSE 8: IMMUNOLOGY

Theory **Credits: 3** **3 hrs/week**

COURSE OBJECTIVES:

- To promote critical thinking among students.
- To provide students with a foundation in immunological processes
- To provide students with knowledge on how the immune system works building on their previous knowledge
- To clearly state the role of the immune system.
- To compare and contrast the innate versus adaptive immune systems.
- To provide an overview of the interaction between the immune system and pathogens.

LEARNING OUTCOMES:

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

- Articulate the roles of innate recognition receptors in immune responses
- Compare and contrast humoral versus cell-mediated immune responses
- Distinguish various cell types involved in immune responses and associated functions;
- Distinguish and characterize antibody isotypes, development, and functions
- Understand the role of cytokines in immunity and immune cell activation;
- Understand the significance the Major Histocompatibility Complex in terms of immune response and transplantation

SYLLABUS:

UNIT – I: Overview of Immune system

1.1 Introduction to basic concepts in Immunology
1.2 Innate and adaptive immunity
1.3 Cells of immune system
1.4 Organs of immune system

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above/Model chart preparation of cells/organs of immune system
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT – II: Antigens

2.1 Basic properties of antigens
2.2 B and T cell epitopes, paratopes
2.3 Haptens and adjuvants
2.4 Factors influencing immunogenicity

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/ Model chart preparation of organogenesis
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT – III: Antibodies

3.1 Structure of antibody
3.2 Classes of antibodies
3.3 Functions of antibodies
3.4 Monoclonal antibodies

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/ Model chart preparation of antibodies

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

UNIT – IV: Working of Immune system

4.1 Structure and functions of major histocompatibility complexes
4.2 Exogenous pathway of antigen presentation and processing
4.3 Endogenous pathway of antigen presentation and processing
4.4. Basic properties and functions of cytokines

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/ Model chart preparation of MHC

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

UNIT – V: Immune system in health and disease

5.1 Gell and Coombs' classification and brief description of various types of hypersensitivities
5.2 Introduction to concepts of autoimmunity and immunodeficiency
5.3 General introduction to vaccines Types of vaccines, Immunization programme
5.4 Organ transplantation- Graft rejection, immune suppressors

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/ Model chart preparation of classification of Hypersensitivity

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

CO-CURRICULAR ACTIVITIES:

- Organizing awareness on immunization importance in local village in association with NCC and NSS teams
- Charts on types of cells and organs of immune system
- Student study projects on aspects such as – identification of allergies among students (hypersensitivity), blood groups in the class (antigens and antibodies duly reported) etc., as per the creativity and vision of the lecturer and students

REFERENCES BOOKS:

- Judy Owen, Jenni Punt, Sharon Stranford 2013 Kuby Immunology: International Edition W. H. Freeman
- Delves P, Martin S, Burton D, Roitt IM 2011 Roitt's Essential Immunology. 12th Ed. Wiley- Blackwell Scientific Publication, Oxford.
- Murphy K, 2011 Janeway's Immunobiology. 8th Ed. Garland Science Publishers, New York.
- Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.
- Richard Coico, Geoffrey Sunshine 2008 Immunology: A Short Course, 6th Edition Wiley-Blackwell
- Sudha Gangal 2013 Textbook of Basic and Clinical Immunology Orient Blackswan Private Limited New Delhi

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SEMESTER-IV

COURSE 8: IMMUNOLOGY

Practical **Credits: 1** **2 hrs/week**

COURSE OBJECTIVES:

- To acquire knowledge on the distribution of lymphoid organs
- To study the histology of lymphoid organs
- To acquaint with the process of blood grouping with kit
- To acquaint with the ELISA test
- To acquaint with the Widal test

SYLLABUS:

1. Demonstration of lymphoid organs (as per UGC guidelines)
2. Histological study of spleen, thymus and lymph nodes (through prepared slides)
3. Blood group determination
4. Demonstration of ELISA
5. Demonstration of Immunoelectrophoresis
6. Testing for Typhoid antigens by Widal test.
7. Differential Leukocyte Count
8. Isolation of monocytes from blood.
9. Rapid Plasma Reagin (RPR) Test

RFERENCE WEB LINKS:

- https://vlab.amrita.edu/?sub=3&brch=69
- https://ivl1-au.vlabs.ac.in/List%20of%20experiments.html
- https://ivl2-au.vlabs.ac.in/List%20of%20experiments.html
- https://www.medicine.mcgill.ca/physio/vlab/immun/vlabmenuimmun.htm
- http://www.zoologyresources.com/uploadfiles/books/dc64b77d8769325515d17c945e461b45.pdf
- http://www.lucp.net/books-pdf/Lab%20Manual%20Dr.%20Idris%20Adewale%20Ahmed/15.%20BASIC%20IMMUNOLOGY .pdf
- https://www.avit.ac.in/lab/immunology_bioprocess_engineering_lab/download/17BTCC89/lab_man ual.pdf
- https://www.urmc.rochester.edu/MediaLibraries/URMCMedia/labs/frelinger-lab/documents/Immunology-Lab-Manual.pdf
- https://webstor.srmist.edu.in/web_assets/downloads/2021/18BTC106J-lab-manual.pdf

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SEMESTER-IV

COURSE 9: ANIMAL BIOTECHNOLOGY

Theory **Credits: 3** **3 hrs/week**

COURSE 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 student will 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)

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SEMESTER-IV

COURSE 9: ANIMAL BIOTECHNOLOGY

Practical	**Credits: 1**	**2 hrs/week**

COURSE OBJECTIVES:

This course will provide students with a practical knowledge in animal biotechnology, by the completion of the course student shall 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

RFERENCE 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%2 0
- Manual_Fall%202011.pdf

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SEMESTER-IV

COURSE 10: WILDLIFE AND CONSERVATION BIOLOGY

Theory	**Credits: 3**	**3 hrs/week**

COURSE OBJECTIVES:

- To Grasp the principles of wildlife ecology, identify key threats to wildlife in India, and evaluate conservation approaches.
- To Recognize the importance and types of protected areas (National Parks, Sanctuaries, Biosphere Reserves) and their components in habitat conservation.
- To Apply wildlife management strategies and legislation to protect and manage endangered species and their habitats.
- To Examine the complexities of human-wildlife interactions and propose effective mitigation strategies.
- To Discuss national and international conservation initiatives, including conventions (CITES, IUCN, CBD, Ramsar) and their role in biodiversity protection.

LEARNING OUTCOMES:

This course will provide students with a deep knowledge in acquiring laboratory skills, by completion of the course the graduate shall able to –

- Know the Concept of wildlife and reasons for their depletion
- Know the wild life management strategies
- Know the Importance of ecologically sensitive areas
- Know the human Impact on environmental resources
- Understand the human wildlife interaction

SYLLABUS:

UNIT I

1.1 Wildlife wealth of India & threatened wildlife.

1.2 Reasons for wildlife depletion in India. Wildlife conservation approaches and limitations.

1.3 National Parks, Sanctuaries and Biosphere Reserves, cores and Buffers, Nodes and corridors. Community Reserve and conservation Reserves

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

UNIT II

2.1 Red Data Book and Conservation status (endangered, vulnerable, rare, threatened and near threatened species)-definitions.

2.2 Wild life Trade & legislation- Assessment, documentation, Prevention of trade

2.3 Policies and laws in Wild life management (national) and ethics.

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

UNIT III

3.1 Biodiversity extinction and conservation approaches- Identification and prioritization of Ecologically sensitive area (ESA).

3.2 Regional and National approaches for biodiversity conservation.

3.3 Population viability analysis-conceptual foundation, uses of PVA models.

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

UNIT IV

4.1 National and International efforts for conservation- Information on CITES, IUCN, CBD

4.2 International agreements for conserving marine life. Convention on wetlands of International Importance (Ramsar convention).

4.3 Human impact on Terrestrial and Aquatic resources. Overview of conservation of Forest &Grassland resources

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

UNIT V

5.1 Human – wildlife interactions

5.2 Strategies to reduce human-wildlife interactions

5.3 Role of Government and NGOs in controlling human-wildlife interactions Socio-economic issues related to human-wildlife interactions

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

REFERENCE BOOKS

- M.Kato. The Biology of Biodiversity, Springer.
- J.C. Avise. Molecular Markers, Natural History and Evolution, Chapman & Hall, New York.
- E.O. Wilson. Biodiversity, Academic Press, Washington.
- G.G. Simpson. Principle of animal taxonomy, Oxford IBH Publishing Company.
- E. Mayer. Elements of Taxonomy.
- E.O. Wilson. The Diversity of Life (The College Edition), W.W. Northem& Co.
- B.K. Tikadar. Threatened Animals of India, ZSI Publication, Calcutta.

SUGGESTED ACTIVITIES:

- Visit to nearby biosphere reserve
- Visit to local Ramsar site and report preparation with pics

SEMESTER-IV

COURSE 10: WILD LIFE AND CONSERVATION BIOLOGY

Practical	**Credits: 1**	**2 hrs/week**

COURSE OBJECTIVES:

To Understand the importance of various biomes

To Understand and gain knowledge of animal architecture

SYLLABUS:

1. Using photographs / paintings / coloured drawings identify and study ecological role of characteristic animal species (major representative species only) of various Biomes.
2. Identify marine and fresh water planktons (preserved water samples may be used).
3. Study of animal architecture (photographs / diagram / abandoned specimen); Hive of honey bee, nest of COURSE wasp, nest of potter wasp, Mount of termite, Nests of Weaver Bird and tailor bird.
4. Using photographs / paintings / coloured drawings identify and study distribution and ecological role of common bivalves and gastropods that occur along a sea-shore.
5. Compare and interpret given sonograms of bird calls (any two e.g. Courtship calls, Alarm calls)
6. On a phytogeographic map of India locate & demarcate major sanctuaries / national parks

WEB RESOURCES FOR LAB:

https://www.naturepl.com/pictures/pdfs/NPL_Architecture.pdf

https://youtu.be/31PWjb7Do1s

SEMESTER-V

COURSE 11: ECONOMIC ZOOLOGY

Theory	**Credits: 3**	**3 hrs/week**

COURSE OBJECTIVES:

- To Understand fish, prawn, and pearl culture methods and their economic significance.
- To Learn dairy and poultry breed management, housing, nutrition, and disease control.
- To Gain knowledge of silkworm biology, silk types, and Bombyx mori lifecycle.
- To Study apiculture and lac culture, species, cultivation techniques, and product value.
- To Understand pests, vectors, and integrated pest management strategies.

LEARNING OUTCOMES:

By the successful completion of the course the students will be able to

- Identify livestock breeds, assess their productivity, and apply appropriate methods for housing, feeding, and disease control.
- Differentiate between types of silkworms, and understand the structure and function of the silk gland.
- Recognize important honeybee and lac insect species, describe their cultivation, and explain the uses and processing of honey and lac.
- Identify major agricultural pests and vectors, and recommend suitable control strategies using biological and integrated pest management techniques.

SYLLABUS:

UNIT I: Aquaculture

1.1 Types of Fish culture, Site Selection and Pond Preparation
1.2 Composite fish farming
1.3 Prawn culture and pearl culture
1.4 Fish by-products and their economic value

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

UNIT-II: Livestock management

2.1 Dairy: Indigenous and exotic breeds, Types of Housing systems.
2.2 Types of milk and milk products, Cattle diseases and control measures
2.3 Poultry: Types of breeds, Types of Housings, Feed formulations for chicks,
2.4 Nutritive value of egg and meat, Disease of poultry and control measures

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

UNIT III: Sericulture

3.1 Mulberry and non-mulberry plants.
3.2 Types of silk and silk worms,
3.3 Structure of silk gland and Composition of silk
3.4 Life cycle of *Bombyx mori*

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

UNIT IV: Apiculture & Lac culture

4.1 Apiculture - Common Species of Honeybees, Structure of a Beehive and Bee Castes
4.2 Products of Apiculture, Economic and Ecological Significance
4.3 Lac Culture - Life cycle of Lac Insect (*Kerria lacca*), Host Plants for Lac cultivation
4.4 Lac cultivation method, Processing and Refining of Lac, Lac products and their uses

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

UNIT V: Pest Management and Harmful Animals

5.1 Major agricultural pests (e.g., Helicoverpa, Locusts)
5.2 Stored grain pests and control strategies
5.3 Vectors of diseases: mosquitoes, houseflies, rats
5.4 Biological control and Integrated Pest Management (IPM)

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

REFERENCE BOOKS:

- Ekambaranatha Ayyar, *Textbook of Economic Zoology*, Wisdom Press, New Delhi, 2013 edition.
- G.S. Shukla & V.B. Upadhyay, *Economic Zoology*, 5th revised edition (2016–2017), Rastogi Publications, Meerut
- R.L. Kotpal, *Modern Textbook of Zoology: Vertebrates*, Rastogi Publications, Meerut, 2010 (10th edition).
- G. Ganga & J. Sulochana Chetty, *An Introduction to Sericulture*, 2nd revised reprint edition, CBS Publishers & Distributors Pvt. Ltd., New Delhi, April 1, 1997 or 2019 reprint.
- V.B. Awasthi, *Introduction to General and Applied Entomology*, 3rd revised edition, Scientific Publishers (Journals Dept.), Jodhpur, 2007 (or 2016 edition).
- *An Introduction to Sericulture* (Ganga & Chetty) on Amazon (1997 edition)
- J.K. Gupta: *Lac Culture and Its Economic Importance*

ONLINE REFERENCES:

- https://vikaspedia.in – Rural and agricultural resources
- https://icar.org.in – Indian Council of Agricultural Research
- https://nbsslup.icar.gov.in – Lac and natural resin resources
- https://www.fishbase.in – Fish information and database

SEMESTER-V

COURSE 11: ECONOMIC ZOOLOGY

Practical **Credits: 1** **2 hrs/week**

COURSE OBJECTIVES:

- To Understand fish, prawn, and pearl culture methods and their economic significance.
- To Learn dairy and poultry breed management, housing, nutrition, and disease control.
- To Gain knowledge of silkworm biology, silk types, and Bombyx mori lifecycle.
- To Study apiculture and lac culture, species, cultivation techniques, and product value.
- To Understand pests, vectors, and integrated pest management strategies.

SYLLABUS:

1. Identification and observation of Indian Major Carps with key features
2. Identification of prawn species with key features
3. Identification of pearl oyster with key features.
4. Study of indigenous and exotic cattle breeds
5. Study of indigenous and exotic poultry breeds (broilers/layers)
6. Cattle Dairy housing systems through images or field visits.
7. Poultry housing system through images or field visits.
8. Chart/model-based study of types of silkworms, and structure of silk gland.
9. Study of bee castes and lac insect life stages using charts or preserved specimens; observation of beehive/lac host plants.
10. Identification of common pests and vectors

REFERENCE BOOKS:

- Ekambaranatha Ayyar, *Textbook of Economic Zoology*, Wisdom Press, New Delhi, 2013 edition.
- G.S. Shukla & V.B. Upadhyay, *Economic Zoology*, 5th revised edition (2016–2017), Rastogi Publications, Meerut
- R.L. Kotpal, *Modern Textbook of Zoology: Vertebrates*, Rastogi Publications, Meerut, 2010 (10th edition).
- G. Ganga & J. Sulochana Chetty, *An Introduction to Sericulture*, 2nd revised reprint edition, CBS Publishers & Distributors Pvt. Ltd., New Delhi, April 1, 1997 or 2019 reprint.
- V.B. Awasthi, *Introduction to General and Applied Entomology*, 3rd revised edition, Scientific Publishers (Journals Dept.), Jodhpur, 2007 (or 2016 edition).
- *An Introduction to Sericulture* (Ganga & Chetty) on Amazon (1997 edition)
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- https://nbsslup.icar.gov.in – Lac and natural resin resources
- https://www.fishbase.in – Fish information and database

FREE TOOLS & RESOURCES:

- Fish Base App and Database
- Bee ID App – for apiculture identification
- YouTube: ICAR-CIFA, CSB (Central Silk Board), IINRG (Lac Institute) resources
- Paid Tools/Resources
- Commercial apiculture and sericulture kits
- Lac insect host plants and processing UNITs (available via IINRG)
- CABI Crop Protection Compendium – Pest management support

SEMESTER-V

COURSE 12 A: BIOLOGY OF FIN FISH & SHELL FISH

Theory	**Credits: 3**	**3 hrs/week**

COURSE OBJECTIVES:

- To Acquire knowledge on the Classification of major groups of Finfish and Shell fish
- To Understand the commercial importance of crustaceans and Fish
- To Understand and learn breeding in fishes, breeding habits, method of induced breeding in fishes.

LEARING OUTCOMES:

After Successful completion of this course Students will able to-

- Familiar with the general characters of Finfish and Shell fish
- Gain knowledge on the structure and functions of Digestive system
- Understand the difference between the brain of fish and prawn
- Acquire knowledge on the functional anatomy of fish and prawn
- Acquire knowledge about Endocrine system in fishes.

SYLLABUS:

UNIT -I:
General characters & Classification of fish and shell fish

1.1 General Characters of fishes
1.2 General Characters of Crustacea
1.3 Classification of Fishes Major groups up to subclass and their important characters.
1.4 Classification of Crustacean: Major groups up to orders and their important characters

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

UNIT II:
Digestive and Respiratory systems of Fish and shellfish

2.1 Digestive system of fish
2.2 Respiratory system of fish
2.3 Digestive system of Prawn/ shrimp
2.4 Respiratory system of prawn/ shrimp

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

UNIT- III:
Circulatory systems of Fish and shell fish

3.1 Cardiovascular system: Structure of heart in fishes
3.2 Blood vascular system in prawn/ shrimp

3.3 Buoyancy in fishes-swim bladder and mechanism of gas secretion
3.4 Sense organs of fishes and crustaceans.

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

UNIT- IV:

Nervous system of Fish and shellfish

4.1 Nervous system in fish: Structure and functions of Brain
4.2 Central Nervous system in prawn/ shrimp
4.3 Specialized organs in fishes – electric organ, venom and toxins
4.4 Neuro-secretory cells

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

UNIT- V

Reproductive system of Fish and shellfish

5.1 Urino-genital system in fishes
5.2 Reproductive system in prawn/ shrimp
5.3 Endocrine system in fishes.
5.4 Androgenic glands

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

REFERENCE BOOKS:

- Bone Q et al., 1995. Biology of fishes, Blackie academic & professional, LONDON.
- Saxena AB 1996. Life of Crustaceans. Anmol Publications Pvt.Ltd., New Delhi
- Tandon KK & Johal MS 1996. Age and Growth in Indian Fresh Water
- Fishes. Narendra Publishing House, New Delhi.
- Raymond T et al., 1990. Crustacean Sexual Biology, Columbia University Press, New York
- Guiland J.A (ed) 1984. Penaeid shrimps- Their Biology and Management.

SEMESTER-V

COURSE 12 A: BIOLOGY OF FIN FISH & SHELL FISH

Practical **Credits: 1** **2 hrs/week**

COURSE OBJECTIVES:

- To Acquire knowledge on the Classification of major groups of Finfish and Shell fish
- To Understand the commercial importance of crustaceans and Fish
- To Understand and learn breeding in fishes, breeding habits, method of induced breeding in fishes.

SYLLABUS:

1. Mouth position of Herbivorous, carnivorous a and detrivorous fishes
2. Comparative study of digestive system of herbivorous and carnivorous fishes
3. Demonstration of brain of fish
4. Demonstration of cranial nerves of fish
5. Demonstration of Nervous system of prawn/ shrimp
6. Exposure of gills of prawn/ shrimp
7. Exposure of gills of fish
8. Mouth parts of Prawn / shrimp
9. Male and Female reproductive system in Fish
10. Male and Female reproductive system in prawn / shrimp

REFERENCE BOOKS:

- Bond E. Carl. 1979. Biology of Fishes, Saunders. 2. Halver JE. 1972. Fish Nutrition Academic Press.
- Hour WS and Randall DJ. 1970. Fish Physiology, Vol. I-IX, Academic Press, New York.
- Lagler KF, Bardach, JE, Miller, RR, Passino DRM. 1977. Ichthyology, 2 Ed. John Wiley & Sons, New York.
- Lovell J. 1989. Nutrition and feeding of Fish Van Nostrand Reinhold, New York.
- Moyle PB and Joseph J. Cech Jr. 2004. Fishes: An Introduction to Ichthyology, 5* Ed. Prentice Hall.
- Nikolsky GV. 1963. Ecology of Fishes, Academic Press.
- Norman JR and Greenwood PH. 1975. A History of Fishes, Halsted Press.
- Potts GW and Wootten RJ. 1984. Fish Reproduction: Strategies and Tactics, Academic Press
- Bone Q et.al., 1995.Biology of fishes, Blackie academic& professional, LONDON.
- Saxena AB1996.Life of Crustaceans. Anmol Publications Pvt.Ltd., NewDelh
- Tandon KK & Johal MS 1996. Age and Growth in Indian Fresh Water Fishes. Narendra Publishing House, New Delhi.
- Raymond Tetal.,1990. Crustacean Sexual Biology, Columbia University Press, New York
- Guiland J. A (ed) 1984.Penaeid shrimps- Their Biology & Management.
- Barrington FJW 1971. Invertebrates: Structure and Function. ELB
- ParkerF&Haswell1992.The text book of Zoology, Vol I. Invertebrates (eds. Marshal AJ & Williams). ELBS & Mc Millan & Co.

SEMESTER-V

COURSE 12 B: POULTRY PRODUCTS AND MANAGEMENT

Theory	**Credits: 3**	**3 hrs/week**

COURSE OBJECTIVES:

- To familiarize with various poultry products and their nutritional value
- To acquire the required Knowledge in poultry product processing and preservation
- To acquire Knowledge in poultry product processing and preservation
- To Understand the importance of quality of egg and sanitation
- To Know quality meat production in Poultry

LEARNING OUTCOMES:

This course will provide students with a deep knowledge in poultry products and management by the successful completion of the course student will able to –

- Understand about various poultry products and their management
- Analyze the different types of poultry products and their nutritional value
- Skill in poultry products evaluation
- Understand Sources of contamination of Eggs and prevention methods.
- Develop skills in poultry product processing and preservation techniques

SYLLABUS:

UNIT-I: INTRODUCTION TO POULTRY PRODUCTS

1.1 Types of poultry products
1.2 Nutritional value of poultry products
1.3 Factors affecting the quality and safety of poultry products
1.4 Value-added poultry products

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

UNIT-II: POULTRY PRODUCT PROCESSING AND PRESERVATION

2.1 Principles of poultry product processing
2.2 Processing techniques for various poultry products
2.3 Preservation techniques for poultry products
2.4 Packaging and labelling of poultry products

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

UNIT-III: POULTRY PRODUCTS EVALUATION

3.1 Sensory evaluation of poultry products
3.2 Quality control and assurance of poultry products

3.3 Factors affecting the shelf life of poultry products

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

UNIT-IV QUALITY OF EGG AND SANITATION

4.1 Methods of cooking of Eggs

4.2 The Nutritive value of Egg before cooking after cooking, other advantages of Egg.

4.3 Selection of types of Detergents and Sanitizers for controlling Egg Quality and Poultry Products

4.4 Sources of contamination of Eggs and its Products and prevention methods.

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

UNIT-V: GRADING OF POULTRY MEAT

5.1 Grade - I, Grade – II Poultry Meat

5.2 Abnormalities in Processed Broiler Meat

5.3 Preservation of Meat

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

REFERENCE BOOKS

- Poultry Science by Colin G. Scanes
- Handbook of Poultry Science and Technology, Volume 1 by Isabel Guerrero-Legarreta
- Commercial Chicken Meat and Egg Production by Donald D. Bell
- Poultry Products Processing: An Industry Guide by Simeon Oladele Fasina
- The Poultry Health Handbook by Dr. M. K. Jain

SEMESTER-V

COURSE 12 B: POULTRY PRODUCTS AND MANAGEMENT

Practical **Credits: 1** **2 hrs/week**

COURSE OBJECTIVES:

- To Develop skills in Estimation of External Quality of Chicken Egg
- To impart Skill in sensory evaluation tests, assess the quality of poultry products
- To Develop practical skills in poultry product processing and preservation techniques
- To impart Skill in estimation of percentage of losses in Processing of Broilers
- To provide Knowledge about different Government agencies that provide hands-on experience related to poultry products

SYLLABUS:

1. Estimation of External Quality of Chicken Egg
2. Estimation of Internal Quality of Chicken
3. Study on sensory evaluation tests to assess the quality of poultry products- appearance, flavor, texture, juiciness, and aroma.
4. Study on steps involved in processing and preserving poultry products
5. Estimation of Percentage of Losses in Processing of Broilers
6. Data collection about different Government agencies that provide hands-on experience related to poultry products.

REFERENCE BOOKS:

- Poultry Products Processing: An Industry Guide by Thomas J. Roach
- Poultry Meat and Egg Processing, Second Edition by Richard J. Stier
- Technology of Chicken Meat and Poultry Products by Dr. V.K. Singh
- The Science of Poultry and Meat Processing by Dr. Shai Barbut
- Sensory Evaluation of Food: Statistical Methods and Procedures by Michael O'Mahony
- Handbook of Food Preservation by M. Saifur Rahman

CO-CURRICULAR ACTIVITIES:

- Visit a poultry farm to learn about the various poultry products
- Participation in trade shows, conferences, and workshops related to poultry products and technologies.
- Collection and display of articles related to poultry industry
- Working on internship or apprenticeship programs with poultry processing plants
- Conducting research projects on topics related to poultry products, such as processing, quality, or safety,

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SEMESTER-V

COURSE 12 C: MULBERRY AND SILKWORM REARING

Theory	**Credits: 3**	**3 hrs/week**

COURSE OBJECTIVES:

- To impart knowledge about the cultivation and management of mulberry plants.
- To provide in-depth training in the biology and rearing of the silkworm, Bombyx mori.
- To explore environmental and nutritional factors affecting silk yield.
- To introduce students to the scientific and commercial aspects of silkworm rearing practices

LEARNING OUTCOMES:

Upon successful completion of this course, students will be able to:

- Understand the importance of mulberry as the sole food plant for silkworms.
- Learn scientific methods of mulberry cultivation and leaf harvesting.
- Acquire knowledge of silkworm biology, life cycle, and races.
- Master techniques of indoor and outdoor silkworm rearing.
- Evaluate factors influencing cocoon and silk production.

SYLLABUS:

UNIT-I: Introduction to Sericulture and Mulberry Cultivation

1.1 Definition, scope, and history of sericulture
1.2 Importance of Bombyx mori and mulberry in Indian sericulture
1.3 Varieties of mulberry and Propagation methods
1.4 Mulberry cultivation practices: Land preparation, spacing, irrigation, fertilization

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-II: Mulberry Leaf Management and Pest Control

2.1 Pruning methods and leaf harvesting techniques

2.2 Mulberry diseases (powdery mildew, root rot) and their control

2.3 Pests of mulberry (tukra, spiraling whitefly) and IPM strategies

2.4 Storage and preservation of mulberry leaves

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-3: Biology of Silkworm (*Bombyx mori*)

3.1 Taxonomy and domestication of *B. mori*

3.2 Morphology and Life cycle and duration of stages

3.3 Different types of silkworm races: Uni-, bi-, and multivoltine

3.4 Economic traits of silkworms

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-4: **Silkworm Rearing Techniques**

4.1 Rearing house design and Rearing methods

4.2 Disinfection of rearing room and equipment

4.3 Feeding schedules, bed cleaning, spacing

4.4 Mounting, spinning, and harvesting of cocoons

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-5: Cocoon Harvesting and Quality Management

5.1 Cocoon grading and characteristics of quality cocoons

5.2 Transportation and marketing of cocoons

5.3 Common silkworm diseases (grasserie, flacherie, muscardine) and control measures

5.4 By-products of sericulture: Silkworm pupae, faeces, bed refuse

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

REFERENCE BOOKS:

- Ganga, G. & Sulochana, C. – An Introduction to Sericulture
- Sengupta, K. – Silkworm Rearing
- Jolly, M.S. – Manual of Sericulture (FAO)
- CSB Manuals – Central Silk Board publications
- Sarkar, D.C. – Mulberry Cultivation and Utilization

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SEMESTER-V

COURSE 12 C: MULBERRY AND SILKWORM REARING

Practical **Credits: 1** **2 hrs/week**

COURSE OBJECTIVES:

- To identify different mulberry varieties and understand their propagation methods.
- To study the life cycle of the silkworm from egg to adult stage.
- To observe different larval instars and understand their feeding stages.
- To practice mounting techniques and learn proper cocoon harvesting methods.
- To identify common diseases and pests affecting silkworms.
- To understand cocoon grading and measure renditta for silk yield estimation.
- To gain field exposure by visiting a silkworm rearing UNIT and preparing a report

SYLLABUS:

1. Identification of mulberry varieties and propagation methods
2. Soil preparation and pruning techniques (demo or field observation)
3. Study of silkworm life cycle
4. Observation of larval instars and feeding stages
5. Mounting techniques and cocoon harvesting
6. Identification of silkworm diseases and pests
7. Cocoon grading and measurement of renditta
8. Visit to a silkworm rearing UNIT and preparation of field report

REFERENCE BOOKS:

- Ganga, G. & Sulochana, C. – An Introduction to Sericulture
- Sengupta, K. – Silkworm Rearing
- Jolly, M.S. – Manual of Sericulture (FAO)
- CSB Manuals – Central Silk Board publications
- Sarkar, D.C. – Mulberry Cultivation and Utilization

CO-CURRICULAR ACTIVITIES:

- Field visits to mulberry farms and research centers'
- Guest lectures by experts in the field
- Seminars and presentations on current research in mulberry physiology, breeding, and genetics
- Conduct a research project on a topic related to mulberry physiology, breeding, or genetics
- Present a seminar or poster on a mulberry-related topic at a conference or symposium.

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SEMESTER-V

COURSE 12 D: BASICS OF BIOINFORMATICS AND COMPUTATIONAL TOOLS

Theory **Credits: 3** **3 hrs/week**

COURSE OBJECTIVES:

- To Understand fundamental concepts of bioinformatics in zoology
- To Learn to use biological databases and retrieve information
- To Analyse biological sequences using alignment tools
- To Visualize molecular structures using bioinformatics software
- To Apply computational tools in taxonomy, evolution, and conservation

LEARNING OUTCOMES:

By successful completion of this course student will able to.

- Define basic terms and types of biological data
- Access and interpret genetic and protein databases
- Conduct basic sequence analysis and alignment
- Use molecular visualization tools to explore structures
- Apply phylogenetic tools in zoological research

SYLLABUS:

UNIT -I: Introduction to Bioinformatics

1.1 Definition and scope of bioinformatics in zoology
1.2 Biological data types such as DNA, RNA, protein, and structure
1.3 Central dogma of molecular biology, Overview of the Human Genome Project
1.4. File formats used in bioinformatics such as FASTA, GenBank, and PDB

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT -II: Biological Databases

2.1 DNA databases including GenBank, EMBL, and DDBJ
2.2 Protein databases such as UniProt and SWISS-PROT
2.3 Structure database such as PDB
2.4 Literature database such as PubMed
2.5 Accession numbers and retrieval of data entries

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT -III: Sequence Alignment and Tools

3.1 Concepts of sequence similarity, identity, and homology
3.2 Pairwise alignment using Needleman-Wunsch and Smith-Waterman methods
3.3 Use of BLAST for nucleotide and protein sequences
3.4 Multiple sequence alignment using Clustal. W and Clustal Omega
3.5 Primer design using Primer-BLAST

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT -IV: Next Generation Sequencing (NGS) Data Analysis

4.1 Introduction to genome sequencing technologies: 1st, 2nd & 3rd generation
4.2 Quality control and preprocessing of sequencing data
4.3 Read alignment and mapping of genomic (DNA) and transcriptomic (RNA) data
4.4 Quantification and expression analysis

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT -V: Phylogenetics and Applications in Zoology

5.1 Principles of molecular phylogenetics
5.2 Tree construction methods such as UPGMA and Neighbor-Joining
5.3 Software overview including MEGA and Phylip
5.4 Applications in species identification and evolutionary studies
5.5 Role of bioinformatics in conservation and wildlife forensics

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

SEMESTER-V

COURSE 12 D: BASICS OF BIOINFORMATICS AND COMPUTATIONAL TOOLS

Practical **Credits: 1** **2 hrs/week**

COURSE OBJECTIVES:

- To Understand how to use NCBI and Uniprot
- To Learn to File conversion process
- To Analyze Sequence alignments
- To interpret phylogenetic trees

PRACTICAL SYLLABUS:

1. Retrieval of DNA and protein sequences using NCBI and UniProt
2. Identification and conversion of file formats such as FASTA, GenBank, and PDB
3. Sequence alignment using BLAST and Clustal tools
4. Quality control of sequencing data with FastQC
5. Construction and interpretation of phylogenetic trees using MEGA software

SOFTWARE AND TOOLS:

Free Web-based and Desktop Tools

- NCBI Entrez tools - https://www.ncbi.nlm.nih.gov/
- UniProt - https://www.uniprot.org/
- BLAST - https://blast.ncbi.nlm.nih.gov/Blast.cgi
- Clustal Omega - https://www.ebi.ac.uk/Tools/msa/clustalo/
- Primer-BLAST - https://www.ncbi.nlm.nih.gov/tools/primer-blast/
- FigTree - http://tree.bio.ed.ac.uk/software/figtree/

REFERENCE BOOKS & WEB LINKS:

- Mount, D.W. – Bioinformatics: Sequence and Genome Analysis – https://www.cshlpress.com/default.tpl?action=full&--eqskudatarq=280
- Lesk, A.M. – Introduction to Bioinformatics – https://global.oup.com/academic/product/introduction-to-bioinformatics-9780199651566
- Campbell, A.M. & Heyer, L.J. – Discovering Genomics, Proteomics, and Bioinformatics – https://www.pearson.com/store/p/discovering-genomics-proteomics-and-bioinformatics/P100001255776
- Zvelebil, M. & Baum, J.O. – Understanding Bioinformatics – https://www.routledge.com/Understanding-Bioinformatics/Zvelebil-Baum/p/book/9780815340249

FREE AND PAID TOOLS:

FREE / OPEN-SOURCE TOOLS:

- NCBI BLAST – https://blast.ncbi.nlm.nih.gov/Blast.cgi
- ExPASy Bioinformatics Tools – https://www.expasy.org
- EMBOSS – http://emboss.sourceforge.net
- Clustal Omega – https://www.ebi.ac.uk/Tools/msa/clustalo/
- UniProt – https://www.uniprot.org
- BWA - https://github.com/lh3/bwa
- STAR - https://github.com/alexdobin/STAR
- FastQC - https://www.bioinformatics.babraham.ac.uk/projects/fastqc/
- DESeq2 - https://bioconductor.org/packages/release/bioc/html/DESeq2.html
- MEGA (Molecular Evolutionary Genetics Analysis) – https://www.megasoftware.net
- Genome Browser (Ensembl) – https://www.ensembl.org

PAID / COMMERCIAL TOOLS:

- Geneious Prime – https://www.geneious.com
- CLC Genomics Workbench – https://digitalinsights.qiagen.com
- DNASTAR Laser gene – https://www.dnastar.com
- PyMOL Pro – https://pymol.org/2/
- Vector NTI – https://www.thermofisher.com/order/catalog/product/VectorNTI

SEMESTER-V

COURSE 12 E: MILK AND MILK PRODUCTS TECHNOLOGY

Theory	**Credits: 3**	**3 hrs/week**

COURSE OBJECTIVES:

- To Understand milk and milk products' basics, composition, and processing.
- To Learn about milk deterioration and preservation methods.
- To Familiarize with preparation processes for various milk products.
- To Gain knowledge of organic milk products and their benefits.
- To Understand regulations and standards for milk and milk products.

LEARNING OUTCOMES:

After successful completion of the course the student will able to –

- Understand the basics of milk and milk products
- Know the composition, processing, and packaging of milk and milk products
- Understand the reasons for deterioration of milk and milk products
- Understand the process in preparation of different milk products
- Gain knowledge about different organic milk products
- Understanding the regulations and standards related to milk and milk products.

SYLLABUS:

UNIT-I:

1.1 Definition of milk and milk products

1.2 Composition of milk and factors affecting composition

1.3 Nutritional value of milk and milk products

1.4 Types of milk products

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT- II:

2.1 Collection and transportation of milk

2.2 Processing of milk - Chilling, standardization

2.3 Processing of milk -pasteurization, UHT treatment

2.4 Processing of milk homogenization, bactofugation

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-III:

3.1 Packaging, storage and distribution of milk and milk products.

3.2 Microbiological deterioration of milk and milk products.

3.3 Common defects of milk products and their remedial measures.

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-IV:

4.1 Preparation of cream, butter, paneer or channa, ghee,

4.2 Preparation of khoa, lassi, dahi, ice-cream, mozzarella

4.3 Preparation of cheese, Yogurt, Butter and Ghee

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT -V:

5.1 Organic milk products.

5.2 Pesticides residues in milk and milk products

5.3 Legal and BIS standards of milk and milk products

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

REFERENCE BOOKS:

Dairy Science and Technology Handbook by P. Walstra, J.T.M. Wouters, and T.J. Geurts

- Dairy Processing and Quality Assurance by Ramesh C. Chandan, Arun Kilara, and Nagendra Shah
- Principles of Dairy Science by W.J. Hurst, R.W. Griffiths, and T.P. Toulouse
- Dairy Processing: Improving Quality by M. K. Hailu and G. K. Kebede
- Cheese: Chemistry, Physics and Microbiology by P.F. Fox, T.P. Guinee, T.M. Cogan, and P.L.H. McSweeney
- Yogurt: Science and Technology by A.Y. Tamime and R.K. Robinson
- Butter: Chemistry, Technology and Microbiology by P.F. Fox and T.A. McSweeney
- Handbook of Milk Composition by R.G. Jensen
- Dairy Plant Engineering and Management by Tufail Ahmad and N.P. Pandey
- Dairy Microbiology by Marth and Steele
- Milk and Milk Products Technology by Sunita Mann and Y.C. Gupta
- Milk Processing and Milk Products Handbook by NPCS Board of Consultants & Engineers

SEMESTER-V

COURSE 12 E: MILK AND MILK PRODUCTS TECHNOLOGY

Practical **Credits: 1** **2 hrs/week**

COURSE OBJECTIVES:

To Develop skill in estimation of fat content in milk

- To Develop skill in estimation of SNF content in milk
- To Gain knowledge about various platform tests at milk reception sites
- To Develop practical skills in milk testing, quality control and assurance
- To Develop practical skills in determination of specific gravity of milk
- To Develop practical skills in analysis of butter and cream content.

SYLLABUS:

1. Estimation of Fat Content in milk
2. Estimation of SNF Content in Milk
3. Various Platform Tests at milk reception sites
4. Tests For Adulteration in Milk
5. Determination of Specific Gravity by Lactometer
6. Analysis of Butter by Khoman Method
7. Estimation of Fat in Cream by Fat Method
8. Estimation of Acidity in Cream

REFERENCE BOOKS:

- Dairy Processing and Quality Assurance by Ramesh C. Chandan, Arun Kilara, and Nagendra Shah
- Practical Manual for Quality Assurance in Milk and Milk Products by M.S. Grewal and S. Chavan
- Manual of Methods of Analysis of Milk and Milk Products by BIS (Bureau of Indian Standards)
- Dairy Plant Management and Pollution Control by S. Ranganathan and K.K. Srivastava

CO-CURRICULAR ACTIVITIES:

- Conduct a milk quality and safety awareness campaign to promote safe and healthy consumption of milk and milk products.
- Organize an industrial visit to a dairy plant to provide hands-on experience to students on milk and milk products technology.
- Organize a dairy product exhibition or fair to showcase and market student-made dairy products.
- Conduct a milk testing competition to test the knowledge and practical skills of students
- Organize a cheese, yogurt, butter, or ghee making competition to encourage creativity and innovation among students

SEMESTER-V

COURSE 13 A: SUSTAINABLE AQUACULTURE

Theory	**Credits: 3**	**3 hrs/week**

COURSE OBJECTIVES:

- To study the preset status of Aquaculture at Global and National level
- To familiarize with the major cultivable species for aquaculture
- To Understand different types of ponds used in aquaculture
- To focus on the management practices of various ponds in aquaculture
- To Acquaint with the Commercial importance of fish and prawn
- To familiarize with the disease management in aquaculture

LEARNING OUTCOMES:

Students after successful completion of this course will able to..

- Evaluate the present status of aquaculture at the Global level and National level
- Classify different types of ponds used in aquaculture
- Demonstrate induced breeding of carps
- Acquire critical knowledge on commercial importance of shrimps
- Identify fin and shell fish diseases

SYLLABUS:

UNIT- I

1.1 Present status of Aquaculture-Global and National scenario
1.2 Major cultivable species for aquaculture: freshwater, brackish water and marine.
1.3 Traditional, extensive, modified extensive, semi-intensive and intensive cultures of fish and shrimp.
1.4 Design and construction of fish and shrimp ponds

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

UNIT- II

2.1 Functional classification of ponds-head pond, hatchery, quarantine ponds
2.2 Functional classification of ponds –nursery, rearing, and grow out ponds
2.3 Need of fertilizer and manure application in culture ponds
2.4 Physio-chemical conditions of soil and water optimum for culture (Temperature, depth, turbidity. light, pH, BOD, COD, CO2, Nitrates and Ammonia)

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

UNIT-III

3.1. Induced breeding in fishes

3.2. Culture of Indian major carps: Pre-stocking management (Dewatering. drying. ploughing/desilting: Predators, weeds and algal blooms and their control methods, Liming and fertilization)

3.3. Culture of Indian major carps - Stocking management

3.4. Culture of Indian major carps - post-stocking management

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

UNIT-IV

4.1 Commercial importance of shrimp & prawn

4.2 *Macrobrachium rosenbergii*- Biology and seed production.

4.3 Culture of *L. vannamei*-hatchery technology and culture practices

4.4 Mixed culture of fish and prawn management

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

UNIT: V

5.1 Bacterial diseases of Finfish & Shell fish

52 Fungal diseases of Fin & Shell fish

5.3 Viral diseases of Fin fish & shell fish

5.4 Therapeutic and Prophylaxis treatment in aquaculture

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

REFERENCE BOOKS:

- Pillay TVR & M.A. Dill, 1979. Advances in Aquaculture. Fishing News Books Ltd., London
- Stickney RR 1979. Principles of Warm Water Aquaculture. John Wiley & Sons Inc.1981
- Boyd CE 1982. Water Quality Management for Pond Fish Culture. Elsevier Scientific Publishing Company.
- Bose AN et.al. 1991. Costal Aquaculture Engineering. Oxford & IBH Publishing Company Pvt. Ltd.

WEB RESOURCES:

- http://www.fao.org/fishery/docs/CDrom/FAO_Training/FAO_Training/General/x6708e/x670 8e06.htm
- http://aquaticcommons.org/1666/1/Better-Practice3_opt.pdf
- https://www.notesonzoology.com/india/fishery/fish-diseases-symptoms-and-control-fishery/871

SEMESTER-V

COURSE 13 A: SUSTAINABLE AQUACULTURE

Practical **Credits: 1** **2 hrs/week**

COURSE OBJECTIVES:

- Identify the characters of Fresh water cultivable species
- Estimate physio chemical characteristics of water used for aquaculture Examine the diseases of fin and shell fish
- Suggest measures to prevent diseases in aquaculture

SYLLABUS:

1. Fresh water Cultivable species any (Fin & Shell Fish Specimens - Observation of morphological characters by observation and drawings)-5
2. Brackish water cultivable species (Fin & Shell fish- Specimens Observation of Morphological Character by observing drawing)-5
3. Hands on training on the use of kits for determination of water quality in aquaculture (DO, Salinity, pH, Turbidity- Testing kits to be used for the estimation of various parameters/ Standard procedure can be demonstrated for the same)
4. Demonstration of Hypophysation (Procedure of hypophysation to be demonstrated in the practical lab with any edible fish as model)
5. Viral diseases of Fin & Shell Fish (Observation of pathological slides/Charts/ Models of viral pathogens in fin/ shell fish - one edible specimen can be used for observation of same in the laboratory)
6. Bacterial diseases of Fin & Shell Fish (Observation of his to pathological slides / Charts/ Models of Bacterial pathogens in fin/ shell fish-One edible specimen can be used for observation of same in the laboratory)
7. Fungal diseases of Fin & Shell Fish (Observation of his to pathological slides / Charts/Models of Bacterial pathogens in fin/ shell fish-One edible specimen can be used for observation of same in the laboratory)

REFERENCES BOOKS & WEB RESOURCES:

- Boyd CE 1982. Water Quality Management for Pond Fish Culture. Elsevier Scientific Publishing Company
- https://www.fao.org/fishery/docs/CDrom/FAO_Training/FAO_Training/General/x6709e/Index.htm
- http://aquaticcommons.org/1666/1/Better-Practice3 opt.pdf
- https://www.notesonzoology.com/india/fishery/fish-diseases-symptoms-and-control-fishery/871

SEMESTER-V

COURSE 13 B: POULTRY WASTE MANAGEMENT

Theory	**Credits: 3**	**3 hrs/week**

COURSE OBJECTIVES:

- To Impart Skill in sampling techniques for poultry waste
- To Impart Skill in preparation of manure from poultry waste
- Familiarize to Analyze the composition of litter
- To develop Skill in preparing fuel from fecal material
- To enhance existing Skill in preparing of fertilizer from poultry litter

LEARNING OUTCOMES:

By the successful completion of the course student will able to –

- Understand the basic principles of poultry waste management
- Understand the sources and types of poultry waste.
- Evaluate and select appropriate poultry waste treatment technologies
- Understand the importance of poultry litter and its value addition
- Understand about poultry litter management
- Gain knowledge about the methods and types of poultry litter disposal and uses

SYLLABUS:

UNIT-I: INTRODUCTION TO POULTRY WASTE MANAGEMENT

1.1 Definition, Types, Importance of poultry waste management
1.2 Environmental and health concerns associated with poultry waste
1.3 Basic principles of poultry waste management

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

UNIT-II.: POULTRY WASTE TREATMENT TECHNOLOGIES

2.1 Conventional treatment methods (composting, land application, anaerobic digestion)
2.2 Innovative treatment methods (wetland systems, bioreactors, thermal treatment)
2.3 Selection of appropriate treatment methods based on waste characteristics and local conditions

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

UNIT-III: POULTRY LITTER

3.1 Poultry Litter - Bedding Material
3.2 Importance of Poultry Farm Pollution
3.3 Value of Poultry Manure

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

UNIT-IV: POULTRY LITTER MANAGEMENT

4,1 Moisture management methods.
4.2 Litter Re-utilization methods
4.3 Litter Amendments, Acidifiers and other Amendments

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

UNIT-V: POULTRY LITTER DISPOSAL AND USES

5.1 Methods of disposal of fecal material
5.2 Types of uses of fecal material
5.3 Environmental advantages due to use of poultry litter

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

REFERENCE BOOKS:

- Poultry Waste Management: Agricultural and Environmental Issues edited by B. P. Singh and T. A. El-Masry
- Poultry Waste Management: Towards a Sustainable Future by G. T. Patel and B. V. Changela
- Poultry Production and Management by N. G. Das (available on Amazon)
- Livestock Waste Facilities Handbook by G. L. Riskowski
- Handbook of Poultry Science and Technology, Volume 2: Secondary Processing by Y. H. Hui and S. C. Dai

SEMESTER-V

COURSE 13 B: POULTRY WASTE MANAGEMENT

Practical	**Credits: 1**	**2 hrs/week**

COURSE OBJECTIVES:

To create Awareness about litter collection from cage rearing systems
To create Awareness on site selection and preparation for poultry waste management
To impart Skill development in poultry waste treatment techniques

SYLLABUS:

1. Study of different types of sampling techniques for poultry waste
2. Preparation of manure from poultry waste and spreading on cropland or green land
3. Composition of litter
4. Preparing fuel from fecal material
5. Preparing fertilizer from poultry litter
6. Steps to be considered for site selection and preparation for poultry waste management
7. Study of some common poultry waste treatment techniques
8. Data collection of different methods on disposal of chicken skin waste and carcass waste from chicken shops.

REFERENCE BOOKS:

- Handbook of Poultry Science and Technology, Volume 2: Secondary Processing by Y. H. Hui and S. C. Dai (available on Amazon.in)
- Livestock Waste Facilities Handbook by G. L. Riskowski (available on Amazon.in)
- Poultry Science and Practice by J. L. Shelton and N. B. Anthony (available on Amazon.in)
- Reference Books:
- Poultry Diseases by H. V. Narasimha Murthy (available on Amazon.in)
- Poultry Nutrition by T. Kotaiah (available on Amazon.in)
- Handbook of Poultry Feed from Waste: Processing and Use by P. B. Patil and S. K. Sahoo (available on Amazon.in)

CO-CURRICULAR ACTIVITIES:

- Field trips to poultry farms and waste management facilities
- Guest lectures by industry professionals and government regulators
- Group projects on poultry waste management planning and implementation
- Case studies of successful and unsuccessful poultry waste management systems
- Participation in conferences and workshops related to poultry waste management

SEMESTER-V

COURSE 13 C: SILK TECHNOLOGY

Theory	**Credits: 3**	**3 hrs/week**

COURSE OBJECTIVES:

- To impart comprehensive knowledge on silk types, processing, and technology.
- To introduce students to modern methods in reeling, dyeing, weaving, and finishing of silk.
- To create awareness of silk grading, quality control, and by-product utilization.
- To prepare students for entrepreneurship and careers in the silk industry.

LEARNING OUTCOMES:

By the successful completion of the course student will able to –

- Understand different types of silk and their characteristics.
- Learn the processes involved in silk reeling, twisting, dyeing, and weaving.
- Evaluate quality and grading of silk through standard protocols.
- Apply techniques for silk waste utilization and value-added products.
- Gain exposure to modern trends and machinery in silk production.

SYLLABUS:

UNIT I: Introduction to Silk and Sericulture

1.1 History and scope of silk production in India and the world
1.2 Types of silk: Mulberry, Tasar, Eri, Muga – their origin and distribution
1.3 Morphology and composition of silk fiber
1.4 Silk production statistics and market trends

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-II: Silk Reeling Technology

2.1 Types of cocoons and their suitability for reeling
2.2 Reeling methods: Charkha, Cottage Basin, Multi-end reeling
2.3 Cocoon processing - stifling, drying, Cooking and brushing
2.4 Quality parameters of raw silk (renditta, denier.)

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-III: Post-Reeling Processes

3.1 Silk throwing and twisting

3.2 Degumming, bleaching and dyeing of silk

3.3 Finishing treatments (softening, weighting, sizing)

3.4 Silk printing techniques: Screen printing, digital printing

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resources on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-IV: Weaving and Fabric Construction

4.1 Basic weaving mechanisms (warp, weft, loom types)

4.2 Types of silk fabrics: Plain, satin, twill, brocade.

4.3 Modern looms: Jacquard, Dobby, Rapier looms

4.4 Defects in silk fabric and their remedies

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resources on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-V: Quality Control and By-product Utilization

5.1 Grading of silk: BIS standards, international quality standards

5.2 Silk testing: Tensile strength, elongation, twist, moisture regain

5.3 Silk waste and its management: Spun silk, silk noil, sericin

5.4 By-products from silk industry: Silk powder, cosmetics, textiles

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

REFERENCE BOOKS:

- Ullal, S.R. & Narasimhanna, M.N. – Handbook of Practical Sericulture
- Datta, R.K. – Mulberry Silk Reeling Technology
- Gokhale, V.M. – Introduction to Textile Fibers
- Sen, A.K. – Coated Textiles: Principles and Applications
- CSB Publications – Central Silk Board, Bangalore

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SEMESTER-V

COURSE 13 C: SILK TECHNOLOGY

Practical **Credits: 1** **2 hrs/week**

COURSE OBJECTIVES:

- To Differentiate between mulberry, eri, tasar, and muga cocoons
- To Recognize silk fiber qualities based on visual and tactile cues
- To Operate basic reeling equipment and understand filament extraction principles
- To Measure denier, tensile strength, and twist per inch
- To Analyze the impact of quality on silk grading and pricing
- To Understand the importance of silk waste utilization and the steps in converting it into usable yarn
- To Document key processes, machinery, products, and entrepreneurial insights from field exposure

SYLLABUS:

1. Identification of different types of cocoons and silk fibers
2. Demonstration of reeling process using charkha or multi-end basin
3. Degumming and dyeing of silk yarn with natural/synthetic dyes (Farm visit)
4. Observation of weaving samples (plain, satin, brocade)
5. Quality testing of silk (denier, twist, tensile strength)
6. Preparation of spun silk from silk waste
7. Visit to a silk reeling/weaving UNIT (report submission)

REFERENCE BOOKS:

- Practical Manual on Silkworm Rearing by V. Anitha
- Handbook of Sericulture Technologies by T.S. A. Shantha and V. D. Devasahayam
- Silkworm Rearing by D.N. Srivastava and B.P. Sinha
- Silkworm Seed Production and Management by D.N. Srivastava and B.P. Sinha
- Silkworm Breeding and Genetics by D.N. Srivastava and B.P. Sinha
- Silkworm Diseases and Pest Management by D.N. Srivastava and B.P. Sinha

CO-CURRICULAR ACTIVITIES:

- Visit to a Sericulture Research Center or a Silk Production UNIT to understand the practical aspects of sericulture.
- Conducting surveys and research on the different types of silkworms, their habitat, and their importance in sericulture.
- Activities for Students-Rearing silkworms in the laboratory and studying their growth

SEMESTER-V

COURSE 13 D: MOLECULAR BIOLOGY AND GENETIC TECHNOLOGY

Theory **Credits: 3** **3 hrs/week**

COURSE OBJECTIVES:

- To Understand the structure and function of DNA and RNA
- To Learn gene expression mechanisms and regulation
- To Gain practical knowledge of tools such as PCR and cloning
- To Understand mutations and gene editing technologies
- To Acquire basic skills in statistics, Excel, and C programming for genetic data

LEARNING OUTCOMES:

After successful completion of this course students will able to

- Explain DNA and RNA structure, replication, and gene expression
- Describe genetic regulation and mutation
- Apply molecular biology techniques like PCR and cloning
- Analyze genetic data using statistical and computational tools
- Visualize and edit sequence data using Excel and Bio Edit

SYLLABUS:

UNIT -I: Structure and Function of Nucleic Acids

1.1 DNA double helix structure and forms (A, B, Z-DNA)
1.2 Types of RNA and their functions (mRNA, tRNA, rRNA, miRNA)
1.3 Chargaff's rules and nucleotide structure
1.4 Nucleic acid hybridization and its applications
1.5 Role in evolution and heredity

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT -II: Gene Expression and Regulation

2.1 Transcription and translation overview
2.2 Lac and trp operons in prokaryotes
2.3 Promoters, enhancers, silencers
2.4 post-transcriptional and post-translational modifications
2.5 Differences in gene expression between eukaryotes and prokaryotes

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT- III: Mutations and Gene Editing

3.1 Types: point, insertion, deletion, frameshift
3.2 Causes: spontaneous and induced

3.3 Effects: silent, missense, nonsense
3.4 DNA repair mechanisms
3.5 Introduction to CRISPR-Cas9

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT -IV: Tools and Techniques in Genetic Engineering

4.1 DNA isolation and purification
4.2 Polymerase Chain Reaction (PCR): principle and uses
4.3 Gel electrophoresis methods
4.4 Cloning vectors and transformation
4.5 Applications in zoological research

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT -V: Data Tools and Applications in Molecular Biology

5.1 Basic statistics: mean, median, standard deviation, variance
5.2 C programming: variables, loops, DNA sequence analysis
5.3 Excel: bar graphs and scatter plots
5.4 Bio Edit: sequence entry and editing
5.5 Applications in barcoding and phylogenetics

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

REFERENCE BOOKS & WEBLINKS:

- Watson, J.D. et al. – Molecular Biology of the Gene – https://www.pearson.com/en-us/subject-catalog/p/molecular-biology-of-the-gene/P200000005802/9780321762436
- Lodish et al. – Molecular Cell Biology – https://www.macmillanlearning.com/college/us/product/Molecular-Cell-Biology/p/1319208525
- Brown, T.A. – Gene Cloning and DNA Analysis –
- https://www.wiley.com/enus/Gene+Cloning+and+DNA+Analysis%3A+An+Introduction%2C+7th+Edition-p-9781119072560
- Campbell & Reece – Biology – https://www.pearson.com/en-us/subject-catalog/p/biology/P200000005771/9780134093413

SEMESTER-V

COURSE 13 D: MOLECULAR BIOLOGY AND GENETIC TECHNOLOGY

Practical **Credits: 1** **2 hrs/week**

COURSE OBJECTIVES:

- To isolate Genomic DNA
- To set up PCR using Primer BLAST
- To Gain practical knowledge BioEdit software
- To Understand Gene expression data suing Excel
- To Acquire basic skills in statistics, Excel, and C programming for genetic data

SYLLABUS:

1. Isolation of Genomic DNA and gel electrophoresis
2. PCR setup and primer design using Primer-BLAST
3. Mutation analysis using BioEdit software
4. Gene expression data analysis and visualization using Excel
5. Basic R programming for GC content and DNA parsing

SOFTWARE AND TOOLS:

- BioEdit - https://www.mbio.ncsu.edu/BioEdit/bioedit.html
- Primer-BLAST - https://www.ncbi.nlm.nih.gov/tools/primer-blast
- Snap Gene Viewer - https://www.snapgene.com/snapgene-viewer
- NCBI and GenBank - https://www.ncbi.nlm.nih.gov/
- Google Sheets or Microsoft Excel
- GCC or Code: Blocks or Turbo C compiler

REFERENCE BOOKS & WEBLINKS:

- Watson, J.D. et al. – Molecular Biology of the Gene – https://www.pearson.com/en-us/subject-catalog/p/molecular-biology-of-the-gene/P200000005802/9780321762436
- Lodish et al. – Molecular Cell Biology – https://www.macmillanlearning.com/college/us/product/Molecular-Cell-Biology/p/1319208525
- Brown, T.A. – Gene Cloning and DNA Analysis –
- https://www.wiley.com/enus/Gene+Cloning+and+DNA+Analysis%3A+An+Introduction%2C+7th+Edition-p-9781119072560
- Campbell & Reece – Biology – https://www.pearson.com/en-us/subject-catalog/p/biology/P200000005771/9780134093413

FREE AND PAID TOOLS:

FREE / OPEN-SOURCE TOOLS:

- NCBI Tools (BLAST, GenBank, Gene, Genome) – https://www.ncbi.nlm.nih.gov
- Ensembl Genome Browser – https://www.ensembl.org
- Snap Gene Viewer – https://www.snapgene.com/snapgene-viewer
- Expasy Molecular Biology Tools – https://www.expasy.org
- Benchling (Academic version) – https://www.benchling.com
- Genome Compiler (Cloud version) – https://www.genomecompiler.com
- UCSC Genome Browser – https://genome.ucsc.edu
- ORF Finder – https://www.ncbi.nlm.nih.gov/orffinder/

PAID / COMMERCIAL TOOLS:

- Geneious Prime – https://www.geneious.com
- CLC Genomics Workbench – https://digitalinsights.qiagen.com
- SnapGene (Full version) – https://www.snapgene.com
- DNASTAR Lasergene – https://www.dnastar.com
- Vector NTI – https://www.thermofisher.com/order/catalog/product/VectorNTI
- ChromasPro – https://technelysium.com.au/wp/chromas

SEMESTER-V

COURSE 13 E: MILK AND MEAT HYGIENE, FOOD SAFETY AND PUBLIC HEALTH

Theory **Credits: 3** **3 hrs/week**

COURSE OBJECTIVES:

- To Understand milk and meat hygiene's role in public health.
- To Identify contamination sources and control measures.
- To Apply quality control and inspection methods.
- To Manage foodborne pathogens and hazards.
- To Implement food safety regulations, laws, and HACCP principles.
- To Evaluate food preservation techniques for safety and quality.

LEARNING OUTCOMES:

After the successful completion of the course the graduate shall able to –

- Understand the importance of Milk and Meat Hygiene in public health
- Identify sources of milk and meat contamination
- Describe methods for milk and meat quality control and inspection
- Identify and control milk and meat-borne pathogens
- Understand about hazards of milk and meat
- Understand food safety regulations and laws
- Implement HACCP principles in food safety evaluation
- Evaluate food preservation techniques

SYLLABUS:

UNIT-I: INTRODUCTION OF MILK AND MEAT HYGIENE

1.1 Definition and scope of Milk and Meat Hygiene

1.2 Historical development and importance of Milk and Meat Hygiene

1.3. Public health aspects of Milk and Meat Hygiene

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-II: MILK HYGIENE

2.1 Sources of milk contamination

2.2 Pasteurization and sterilization of milk

2.3 Milk-borne diseases

2.4 Milk quality control and inspection

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-III: MEAT HYGIENE

3.1 Sources of meat contamination

3.2 Slaughtering and dressing of animals

3.3 Meat-borne diseases

3.4 Meat quality control and inspection

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-IV: HAZARDS FOR MILK AND MEAT

4.1 Chemical and microbial toxicities associated with milk, meat and aquatic foods.

4.2 Toxic residues: pesticides, antibiotics, metals and hormones in food and their health hazards.

4.3 Microbial toxins in food and their health hazards.

4.4 Sanitary and phytosanitary measures in relation to foods of animal origin and aquatic foods.

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-V: FOOD SAFETY AND PUBLIC HEALTH

5.1 Hazard Analysis and Critical Control Points (HACCP)

5.2 Food safety regulations and laws

5.3 Food preservation techniques

5.4 Emerging issues in food safety and public health

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

REFERENCE BOOKS:

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- Food Safety: Principles and Practices by Ronald Schmidt and Gary Rodrick
- Food Safety and Quality Systems in Developing Countries, Volume One: Export Challenges and Implementation Strategies by Jeffrey Hoorfar, Sibel Roller, and Jorgen Schlundt
- Meat Hygiene by K. Singh and R. K. Sharma
- Milk and Dairy Products: Technology, Chemistry and Microbiology by Nivedita Datta and Dattatreya Mukhopadhyay
- Handbook of Food Safety Engineering by Da-Wen Sun
- Food Safety and Toxicity by Debasis Bagchi and Sreejayan Nair
- Handbook of Food Preservation by M. Shafiur Rahman
- Food Safety: The Science of Keeping Food Safe by Ian C. Shaw
- Milk Processing and Quality Management edited by Adnan Y. Tamime
- Meat Hygiene by J.F. Gracey, D.S. Collins, and R.J. Huey
- Handbook of Food Science, Technology, and Engineering edited by Y.H. Hui
- Principles of Food Sanitation by Norman G. Marriott and Robert B. Gravano

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SEMESTER-V

COURSE 13 E: MILK AND MEAT HYGIENE, FOOD SAFETY AND PUBLIC HEALTH

Practical **Credits: 1** **2 hrs/week**

COURSE OBJECTIVES:

- To Demonstrate skills in Microbiological analysis of raw milk and meat samples
- To impart skill in grading of milk by MBR test process
- To impart required skill in Ante-mortem inspection of food animals.
- To Understand Food safety and hygiene practices among consumers, food handlers, and food processors.

SYLLABUS:

1. Microbiological examination of raw milk and meat samples
2. Grading of milk by MBR test.
3. Ante-mortem inspection of food animals.
4. Post mortem inspection of food animals.
5. Food safety and hygiene practices among consumers, food handlers, and food processors.
6. Study the role of the Andhra Pradesh Public Health and Municipal Engineering Department (PHMED) in food safety and hygiene

REFERENCE BOOKS:

- Practical Meat Hygiene by J. J. Vogel and S. G. Tindall
- Practical Dairy Chemistry: Methods of Analysis by T. Varadarajan and B. S. Narang
- Food Safety and Quality Management: A Practical Approach by Hal King and Joyce Igoe
- Meat Processing Technology: For Small- to Medium-Scale Producers by Fidel Toldrá and Leo M.L. Nollet
- Dairy Processing Handbook by Tetra Pak Processing Systems AB
- Food Microbiology: Fundamentals and Frontiers by Michael Doyle and Robert Buchanan

CO-CURRICULAR ACTIVITIES:

- Visit to local dairy and meat processing facilities
- Guest lectures by industry professionals and government regulators
- Research and presentation on a specific food safety issue or outbreak
- Food safety training for local community members or organizations
- Participation in food safety competitions or events.

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SEMESTER-VI

COURSE 14 A: ORNAMENTAL FISHERY

Theory **Credits: 3** **3 hrs/week**

COURSE OBJECTIVES:

- To Learn about aquarium fishes and aerators.
- To Identify ornamental fish species suitable for aquarium culture.
- To Set up and maintain aquariums.
- To Manage water quality in aquarium.
- To Explore self-employment opportunities in ornamental fish industry.

LEARNING OUTCOMES:

By the completion of this course student will able to-

- Gain knowledge about aquarium fishes and the use of aerators.
- Learn to identify freshwater and marine ornamental fishes.
- Acquire practical skills in setting up and maintaining aquariums.
- Understand water quality management for different types of aquariums.
- Apply the acquired knowledge to pursue self-employment opportunities in the ornamental fish industry.

SYLLABUS:

UNIT- I: Introduction

1.1 Introduction of Aquarium and ornamental fishes
1.2 Present status of Aquarium trade in the world and India
1.3 Aquarium accessories - aerators, filters, lighters and heaters
1,4 Importance of aquarium plants and weeds

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT- II: Fresh water ornamental fishes

2.1 Live bearers, Gold fish, Koi, Gourami,
2.2 Barbs and tetras, Angel fish and Cichlid fish
2.3 Brood stock development, breeding, larval rearing and grow out
2.4 Larval and adult feeds and feeding

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT- III: Marine ornamental fishes

3.1 Major marine ornamental fish resources of India
3.2 Collection and transportation of live fish, use of anesthetics
3.3 Breeding of marine ornamental fish

3.4 Other aquarium animals -- sea anemones, lobsters, shrimps, octopus and starfish

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study

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

UNIT- IV: Aquarium management

4.1 Setting up fresh water, marine and reef aquariums

4.2 Water quality management for different types of aquariums

4.3 Common diseases of aquarium fish, diagnosis and treatment

4.4 Temperature acclimatization and oxygen packing for aquarium fish

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study

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

UNIT -V: Commercial production of aquarium fish and plants

5.1 Commercial production UNITs of ornamental fish- requirements and design

5.2 Commercial production of goldfish, live bearers, gouramies, barbs, angels and tetras

5.3 Mass production of aquarium plants

5.4 Retail marketing and export of ornamental fish

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study

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

REFERENCE BOOK:

- Dick Mills 1998. Aquarium fishes, Dorling Kindersley Ltd, London
- Van Ramshort JD 1978. The complete aquarium encyclopedia, Elsevier
- Jameson JD and Santhanan R 1996. Manual of ornamental fishes and farming technologies, Fisheries College and research institute, Tuticorn
- Stephen Spotte 1993. Marine aquarium keeping. John Wiley and sons, USA
- Andhra Pradesh Fisheries - Compendium on ornamental fishes
- Best Management Practices for Freshwater Ornamental Fish Production – NFDB, Hyderabad.
- Brianward “The Aquarium Fish Survival Manual”.
- Brianwari – “The Aquarium Fish Survival Manual” A comprehensive guide to keeping fresh water and marine fish, published by New Burlington Books, London.
- Coloured fish in water garden (A status report in West Bengal) – Published by MPEDA and Dept. of Fisheries, Aquaculture, Aquatic resources and Fishing harbour, Govt. of West Bengal.

SEMESTER-VI

COURSE 14 A: ORNAMENTAL FISHERY

Practical	**Credits: 1**	**2 hrs/week**

COURSE OBJECTIVES:

To Differentiate between various types of aquariums and filters
To Identify common aquarium fishes and plants.
To Acquire knowledge of breeding techniques.
To Develop marketing skills for the production and sale of ornamental fishes.

SYLLABUS:

1. Study of aerators - types and structures
2. Water circulation methods in aquarium and filtration
3. Collection and identification of aquarium plants (Minimum 5)
4. Identification of common marine aquarium fishes (Minimum 5)
5. Identification of common fresh water aquarium fishes (Minimum 5)
6. Breeding of egg layers (Gold fish)
7. Breeding of live bearers (Guppy)
8. Evaluation of significance of aquaria for commercial and domestic use.

REFERENCE BOOK:

- Dick Mills 1998. Aquarium fishes, Dorling Kindersley Ltd, London
- Van Ramshort JD 1978. The complete aquarium encyclopedia, Elsevier
- Jameson JD and Santhanan R 1996. Manual of ornamental fishes and farming technologies, Fisheries College and research institute, Tuticorn
- Stephen Spotte 1993. Marine aquarium keeping. John Wiley and sons, USA

SEMESTER-VI

COURSE 14 B: POULTRY ECONOMICS, MARKETING AND INTEGRATION

Theory **Credits: 3** **3 hrs/week**

COURSE OBJECTIVES:

- To Understand poultry economics, marketing, and integration principles.
- To Identify key factors influencing poultry production and marketing.
- To Develop market research, pricing, and promotional skills.
- To Understand supply chain management in poultry industry.
- To Develop business planning and management skills.
- To Learn about innovations and developments in poultry industry.

LEARNING OUTCOMES:

By the completion of this course student will able to

- Understand the basic principles of poultry economics, marketing, and integration.
- Identify the key factors that influence poultry production, marketing, and integration.
- Develop skills in market research, pricing strategies, and promotional activities for poultry products.
- Develop an understanding of supply chain management in the poultry industry.
- Gain knowledge about different innovations and new developments in poultry industry

SYLLABUS:

UNIT-I:

1.1 Definition and scope of poultry economics and marketing
1.2 Importance of poultry industry in the economy
1.3 Overview of the global poultry market

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-II:

2.1 Economics of poultry production
2.2 Cost and returns analysis for poultry farming
2.3 Determinants of poultry production

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-III:

3.1 Market research for poultry products
3.2 Pricing strategies for poultry products
3.3 Promotion and branding of poultry products

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-IV:

4.1 Supply chain management in poultry integration
4.2 Benefits and challenges of poultry integration
4.3 Business planning and management for integrated poultry enterprises

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-V:

5.1 Innovations and new developments in the poultry industry
5.2 Sustainability and ethical considerations in poultry production and marketing
5.3 Global trends in poultry economics and marketing

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

REFERENCE BOOKS:

- Poultry Production and Management by Dr. M.G. Patel (Krishikosh, 2019)
- Poultry Business Management by Dr. R.R. Sharma and Dr. R.N. Chatterjee (Vikas Publishing House, 2016)
- Poultry Farming: Indian Perspective by Dr. D.K. Singh (Daya Publishing House, 2014)
- Handbook of Poultry Science and Technology by B. Kannan and T. Ramasamy (New India Publishing Agency, 2015)
- Poultry Diseases and Their Control by Dr. B. R. Yadav and Dr. J.K. Chaudhari (Daya Publishing House, 2013)
- Poultry Marketing and Management by Dr. J.P. Sinha (Kalyani Publishers, 2014)
- Poultry Economics and Marketing" by Dr. S.K. Srivastava and Dr. M.K. Singh
- Poultry Farming and Marketing" by Dr. R.C. Roy
- Poultry Business in India" by Dr. Suresh Kumar Sharma
- Poultry Science by Colin G. Scanes
- Poultry Production and Management by James R. Gillespie
- Resources from the following organizations in India: National Institute of Animal Nutrition and Physiology (NIANP), Indian Council of Agricultural Research (ICAR), Central Poultry Development Organization (CPDO), Poultry India

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SEMESTER-VI

COURSE 14 B: POULTRY ECONOMICS, MARKETING

Practical **Credits: 1** **2 hrs/week**

COURSE OBJECTIVES:

- To Gain knowledge about data on prices, quantities, and quality of different poultry products from your local poultry market.
- To acquire required Skill of analyzing various costs involved in poultry production and calculate the loss and profitability.
- To Understand about different methods of Poultry processing and value addition
- To Gain knowledge about different Poultry equipment's and their market prices.
- To impart required Skill sects in analyzing consumer behavior in relation to poultry products

SYLLABUS:

1. Collection of data on prices, quantities, and quality of different poultry products from your local poultry market (Any wholesale markets, retail outlets, and supermarkets)
2. Collection and analyzing the data on from a local poultry farm on various costs involved in poultry production such as feed, labor, housing, medication, and electricity. to calculate the total cost of production, break-even point, and profitability of the farm.
3. Study on different methods of Poultry processing and value addition such as slaughtering, evisceration, chilling, grading, and packaging, and understand the quality standards and hygiene practices followed in the plant.
4. Collection of data from Poultry breeding farm- Noting the selection and mating practices followed by the breeder, analyze the genetic traits of the birds
5. Prepare a business plan for a poultry farm by identifying the market opportunites, estimating the costs and revenues, and analyzing the risks and challenges.
6. Conducting market research and analysing consumer behaviour in relation to poultry products

REFERENCE BOOKS:

- Poultry Feed Formulation: Mathematics and Computer Applications by Ravi Ravindran
- Poultry Production Systems: Behaviour, Management and Welfare by C. Weeks and A.M. Nicol
- Commercial Chicken Meat and Egg Production by D. D. Bell and W. D. Weaver
- Practical Management of Poultry by H. V. McKay
- Poultry Housing and Management by Michael Roberts
- Hatchery Management Guide for Game Bird and Small Poultry Flock Owners by James Hermes

CO-CURRICULAR ACTIVITIES:

- Poultry field trips to local farms or processing facilities
- Participation in poultry exhibitions and fairs
- Research projects on poultry economics and marketing
- Develop a business plan for a small-scale poultry operation
- Conduct a market analysis for a new poultry product or service

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SEMESTER-VI

COURSE 14 C: THERAPEUTIC AND COSMETIC INDUSTRY

Theory	**Credits: 3**	**3 hrs/week**

COURSE OBJECTIVES:

- To introduce the pharmacological and biomedical value of silkworm and silk proteins
- To explore cosmeceutical applications of silk derivatives
- To understand the biological properties of sericin, fibroin, chitin, and pupal oil
- To examine commercial products developed from silkworm-based bioresources
- To promote entrepreneurship and innovation in the sericulture-based health & wellness industry

LEARNING OUTCOMES:

By the completion of this course student will able to

- By the end of the course, students will be able to:
- Explain the bio-functional properties of silk proteins and their biomedical potential
- Analyze sericin- and fibroin-based products used in cosmetics and skin care
- Understand the nutritional and therapeutic value of silkworm pupae
- Examine recent research and product developments in silk biotechnology
- Develop ideas for sericulture-based value-added product development and startups

SYLLABUS:

UNIT-I: **Introduction to Therapeutic and Cosmetic Potential of Sericulture**

1.1 Overview of silk proteins: Fibroin, sericin, chitin, and chitosan

1.2 Functional properties: Biocompatibility, biodegradability, antioxidant, anti-inflammatory

1.3 Scope of sericulture in health, wellness, and cosmetics industries

1.4 Market trends: Global demand for silk-based cosmetics and nutraceuticals

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-II: Biomedical and Therapeutic Applications of Silk Proteins

2.1 Sericin in wound healing, burn treatment, and surgical sutures
2.2 Fibroin as a biopolymer scaffold for tissue engineering
2.3 Silkworm gut membrane in ophthalmic and dental applications
2.4 Use of silk proteins in drug delivery systems and hydrogels

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-III: Cosmetic Applications of Sericin and Silk Fibers

3.1 Role of sericin in skincare: Moisturizing, UV protection, anti-aging

3,2 Sericin in shampoos, creams, masks, and soaps

3.3 Nano-silk and fibroin in hair care and dermal delivery systems

3.4 Preparation of silk protein-based face packs, gels, and serums

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-IV: Nutritional and Pharmaceutical Uses of Silkworm Pupae

4.1 Composition of pupae: Proteins, fats (omega-3), vitamins, and minerals

4.2 Extraction and uses of silkworm pupal oil (SPO) in dermatology and dietetics

4.3 Pupal protein powder as a food supplement

4.4 Anti-obesity, anti-diabetic, antimicrobial, and antioxidant properties of pupal derivatives

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-V: Entrepreneurship and Product Development in Silk Bio-Industries

5.1 Startup ideas: Silk-based herbal creams, nutraceutical capsules, wound dressings

5.2 Value-added products from reeling waste, pupae, sericin waste

5.3 Case studies: Indian & global biotech startups using silk

5.4 Challenges in standardization, safety testing, and regulations (FDA, AYUSH, CDSCO)

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

REFERENCE BOOKS:

- Kato, N., & Kurioka, A. (2005). Bioactive Components of Silk Proteins
- CSB Publications on Silk Bio-Products
- Research papers from journals: Silk Biomaterials, Journal of Cosmetic Science, Biomedical Materials
- Startup case studies: Sericare, SeriTech, Silk Therapeutics, etc.

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SEMESTER-VI

COURSE 14 C: THERAPEUTIC AND COSMETIC INDUSTRY

Practical	**Credits: 1**	**2 hrs/week**

COURSE OBJECTIVES:

- To learn the method of extracting sericin from degummed silk cocoons.
- To develop a basic cosmetic product such as a sericin-based face cream or moisturizer.
- To understand the basics of formulation, including emulsification and preservation techniques.
- To assess the nutritional and pharmaceutical potential of silkworm-derived proteins.
- To observe the industrial process of cosmetic and therapeutic product development from silk.
- To document observations and learning through a structured field visit report.
- To design a product label, brand name, and packaging for a silk-based product.

SYLLABUS:

1. Extraction of sericin from silk cocoons
2. Preparation of sericin face cream or moisturizer
3. Isolation of fibroin and film formation
4. Estimation of protein content in silkworm pupae
5. Visit to a cosmetic product UNIT or silk pharma lab
6. Mini project: Design a product label and business plan for a silk-based cosmetic/therapeutic item

REFERENCE BOOKS:

- Kato, N., & Kurioka, A. (2005). Bioactive Components of Silk Proteins
- CSB Publications on Silk Bio-Products
- Research papers from journals: Silk Biomaterials, Journal of Cosmetic Science, Biomedical Materials
- Startup case studies: Sericare, SeriTech, Silk Therapeutics, etc.

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SEMESTER-VI

COURSE 14 D: BIOSTATISTICS AND PROGRAMMING FOR LIFE SCIENCES

Theory	**Credits: 3**	**3 hrs/week**

COURSE OBJECTIVES:

- To Understand statistical tools relevant to biological research
- To Apply descriptive statistics and probability to interpret biological data
- To Gain skills in MS Excel for data management and visualization
- To Learn the basics of C programming for handling biological sequences
- Acquire the knowledge to Use Bio Edit software for sequence analysis and biological data formatting

LEARNING OUTCOMES:

By the completion of the course the student will able to

- Apply basic statistical concepts to analyse biological data
- Use Excel for data entry, cleaning, and visualization in zoological research
- Write simple C programs for solving basic biological problems
- Use Bio Edit for sequence formatting and basic analysis
- Interpret and present biological data effectively using digital tools

SYLLABUS:

UNIT- I: Basics of Biostatistics

1.1 Definition and scope of biostatistics in life sciences
1.2 Types of data: qualitative vs quantitative
1.3 Sampling methods and data collection
1.4 Levels of measurement: nominal, ordinal, interval, ratio
1.5 Data presentation: tables, charts, frequency distribution

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT- II: Descriptive Statistics and Probability

2.1 Measures of central tendency: mean, median, mode
2.2 Measures of dispersion: range, standard deviation, variance
2.3 Basic concepts of probability
2.4 Probability distributions: normal, binomial (conceptual only)
2.5 Use of statistical tools in biological research

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT- III: Data Handling and Visualization in Excel

3.1 Data entry and formatting in Excel
3.2 Sorting, filtering, and data cleaning techniques
3.3 Use of formulas: SUM, AVERAGE, STDEV, IF, COUNTIF
3.4 Graphs and charts: bar, pie, line, scatter
3.5 Case study: presenting gene expression or animal population data

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT- IV: Basics of R Programming

4.1 Introduction to R and R studio
4.2 Data structures in R: vectors, matrices, data frames & lists
4.3 Basic data operations and functions: Data manipulation, functions, import/export & control structures
4.4 R packages for statistical analysis of biological data: DESeq2
4.5 Visualization in R; basic plotting tools including ggplot2

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT- V: Regression and Correlation Analysis with R

5.1 Introduction to linear regression
5.2 Logistic regression: modelling binary outcomes
5.3 Multiple regression analysis
5.4 Correlation analysis: Pearson vs Spearman
5.5 Assumptions and interpretation of results from models

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

REFERENCE BOOKS AND RESOURCES

- Zar, J.H. – Biostatistical Analysis – https://www.pearson.com/en-us/subject-catalog/p/biostatistical-analysis/P200000000348/9780131008465
- Khan, I.A. & Khanum, A. – Fundamentals of Biostatistics – Ukaaz Publications
- Sundararajan, V. & Kalaimani, P. – An Introduction to Bioinformatics and Programming
- NCBI – https://www.ncbi.nlm.nih.gov/
- BLAST Tutorials – https://blast.ncbi.nlm.nih.gov/
- Excel Tutorials – https://support.microsoft.com/en-us/excel
- R Programming Tutorials – https://github.com/rstudio-education/hopr?tab=readme-ov-file

SEMESTER-VI

COURSE 14 D: BIOSTATISTICS AND PROGRAMMING FOR LIFE SCIENCES

Practical	**Credits: 1**	**2 hrs/week**

COURSE OBJECTIVES:

- To Apply data analysis techniques using Excel and R.
- To Calculate and interpret descriptive statistics (mean, SD, range).
- To Clean and manipulate data using R (dplyr, tidyr).
- To Visualize data using ggplot2 in R.
- To Conduct regression analysis and report findings.

SYLLABUS:

1. Data Analysis Using Excel: Input biological data, apply basic formulas and create charts
2. Descriptive Statistics: Calculate mean, SD, range using Excel and interpret variability
3. R Programming – Data cleaning and data manipulation in Rstudio with dplyr and tidyr packages
4. Plotting data in R with ggplot2
5. Mini-Project: Do regression analysis on a sample dataset and compile findings in a report

SOFTWARE AND TOOLS

- MS Excel or Google Sheets
- R & R studio
- Online statistical calculators
- Optional: SPSS, GraphPad Prism, MATLAB

RECOMMENDED BOOKS AND RESOURCES

- Zar, J.H. – Biostatistical Analysis – https://www.pearson.com/en-us/subject-catalog/p/biostatistical-analysis/P200000000348/9780131008465
- Khan, I.A. & Khanum, A. – Fundamentals of Biostatistics – Ukaaz Publications
- Sundararajan, V. & Kalaimani, P. – An Introduction to Bioinformatics and Programming
- NCBI – https://www.ncbi.nlm.nih.gov/
- BLAST Tutorials – https://blast.ncbi.nlm.nih.gov/
- Excel Tutorials – https://support.microsoft.com/en-us/excel
- R Programming Tutorials – https://github.com/rstudio-education/hopr?tab=readme-ov-file
- Assessment Pattern

FREE AND PAID TOOLS

FREE / OPEN-SOURCE TOOLS

- R Project for Statistical Computing – https://www.r-project.org
- RStudio (IDE for R) – https://posit.co/download/rstudio-desktop/
- Python – https://www.python.org
- Jupyter Notebook – https://jupyter.org
- Google Colab – https://colab.research.google.com
- LibreOffice Calc – https://www.libreoffice.org/discover/calc/
- Bio Stat (Basic version) – https://www.biostat.com/
- SOFA Statistics – https://www.sofastatistics.com/
- PSPP (GNU) – https://www.gnu.org/software/pspp/
- GraphPad Prism (limited demo) – https://www.graphpad.com/demos/

PAID / COMMERCIAL TOOLS

- SPSS – https://www.ibm.com/products/spss-statistics
- GraphPad Prism – https://www.graphpad.com
- Minitab – https://www.minitab.com
- SAS – https://www.sas.com
- Stata – https://www.stata.com
- Origin Pro – https://www.originlab.com

SEMESTER-VI

COURSE 14 E: LIVESTOCK ECONOMICS, MARKETING AND BUSINESS

Theory **Credits: 3** **3 hrs/week**

COURSE OBJECTIVES:

- To Understand livestock economics, marketing, and business principles.
- To Identify key factors influencing the livestock industry.
- To Analyze livestock production and management principles.
- To Evaluate factors affecting productivity and profitability.
- To Understand livestock marketing and sales principles.
- To Understand policies and regulations governing the livestock industry.

LEARNING OUTCOMES:

After the completion of the course student will able to

- Understand the basic concepts and principles of livestock economics, marketing, and business theory
- Identify the key factors that influence the livestock industry
- Understand the principles of livestock production and management
- Analyze the factors that affect the productivity and profitability of livestock enterprises
- Understand the principles of livestock marketing and sales
- Analyze the factors that influence the demand and supply of livestock products

SYLLABUS:

UNIT-I: Introduction--Basic concepts

1.1 Principles of livestock economics,
1.2 Principles of Live Stock marketing, and business theory
1.3 Key factors influencing the livestock industry

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-II: Livestock Production and Management

2.1 Principles of livestock production and management
2.2 Factors affecting the productivity and profitability of livestock enterprises
2.3 Livestock breeding, feeding, and health management

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-III: Livestock Marketing and Sales

3.1 Principles of livestock marketing and sales
3.2 Factors influencing the demand and supply of livestock products
3..3 Livestock product processing and packaging

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT- IV: Livestock Business Management

4.1 Principles of livestock business management
4.2 Financial and economic analysis of livestock enterprises
4.3 Livestock business planning and risk management

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-V: Livestock Policy and Regulations

5.1 Livestock policies and regulations
5.2 Impact of policy and regulatory changes on livestock enterprises
5.3 Livestock industry development and sustainability

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

REFERENCE BOOKS:

- Livestock Economics and Marketing by Ramesh Chand and R.P. Singh
- Livestock Production and Management by N. Srinivasulu and D. Dhandapani
- Dairy Farming: A Way to Livelihood by S.S. Sengar
- Livestock Business Management by P. R. Bhat
- Economic Analysis of Animal Diseases by N.S. Randhawa and R.K. Singh
- Animal Husbandry and Veterinary Science by V.K. Kapoor
- Principles of Agricultural Economics by C.B. Singh and R.K. Singh
- Livestock Economics and Marketing by John D. Lawrence and Gary W. Williams
- Livestock Management and Marketing by M. Saiful Islam and Mohammad M. Rahman
- Agricultural Marketing and Price Analysis by Bailey Norwood and Jayson L. Lusk
- Livestock Production and Marketing by Donald R. Monke
- Livestock Economics: Theory and Practice by John W. Longworth and Paul R. Beedle

SEMESTER-VI

COURSE 14 E: LIVESTOCK ECONOMICS, MARKETING AND BUSINESS

Practical **Credits: 1** **2 hrs/week**

COURSE OBJECTIVES:

- To Identify and observe the different types of livestock farms and their production practices
- Analyse the market dynamics and competition in the livestock industry
- To Acquire Knowledge on Government policies such as subsidies, taxes, import/export regulations, and animal welfare regulations
- To acquire Skill in maintenance of records to be maintained in livestock management
- To equip the Skill in maintenance of records to be maintained in livestock business

SYLLABUS:

1. Visit to a livestock farm and report on animal husbandry practices- Feeding, Breeding and Health management.
2. Conduct a market analysis of a particular livestock product such as beef, pork, or chicken to understand consumer preferences, market trends, and competition.
3. Government policies on subsidies, taxes, import/export regulations, and animal welfare regulations.
4. Records to be maintained in livestock management - Production record, Breeding record, Veterinary record, Personnel record
5. Records to be maintained in livestock business: Financial records, Sales and marketing records, Inventory records,
6. Develop a business plan for a livestock enterprise which involve researching the costs of production, developing marketing strategies, and analyzing potential risks and opportunites.

REFERENCE BOOKS:

- Practical Manual for Livestock Economics and Marketing by Ramesh Chand and R.P. Singh
- Practical Manual for Livestock Production and Management by N. Srinivasulu and D. Dhandapani
- Practical Manual for Dairy Farming by S.S. Sengar
- Practical Manual for Livestock Business Management by P. R. Bhat
- Livestock Economics and Marketing by Ramesh Chand and R.P. Singh
- Livestock Production and Management by N. Srinivasulu and D. Dhandapani
- Livestock Business Management by P. R. Bhat
- Agricultural Marketing in India: Analysis, Planning and Development by K.N. Rahaman
- Economic Analysis of Animal Diseases by N.S. Randhawa and R.K. Singh
- Principles of Agricultural Economics by C.B. Singh and R.K. Singh

CO-CURRICULAR ACTIVITIES:

- Visiting a livestock farm and preparing a report
- Participation in Livestock shows and competitions
- Collection of different livestock breeds that are with market value
- Participation in Livestock auctions
- Guest lectures by industry professionals

SEMESTER-VI

COURSE 15 A: POST HARVEST TECHNOLOGY OF FISH AND FISHERIES

Theory **Credits: 3** **3 hrs/week**

COURSE OBJECTIVES:

- To Understand aquaculture preservation methods.
- To Apply suitable processing techniques.
- To Ensure quality control in aquaculture.
- To Implement seafood quality assurance.

LEARNING OUTCOMES:

Students at the successful completion of this course will able to

- Identify the types of preservation methods employed in aquaculture
- Choose the suitable Processing methods in aquaculture
- Maintain the standard quality control protocols laid down in aqua industry
- Identify the best Seafood quality assurance system

SYLLABUS:

UNIT – I: Handling and Principles of fish Preservation

1.1 Handling of fresh fish, storage and transport of fresh fish

1.2 Post mortem changes (rigor mortis and spoilage), spoilage in marine fish and freshwater fish.

1.3 Principles of preservation – cleaning, lowering of temperature, rising of temperature, denudation, use of salt, use of fish preservatives, exposure to low radiation of gamma rays.

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT – II: Methods of fish Preservation

2.1 Traditional methods - sun drying, salt curing, pickling and smoking.

2.2. Advanced methods – Solar drying, chilling or icing, refrigerated sea water, freezing,

2.3 Advanced methods – Canning, irradiation and Accelerated Freeze drying (AFD).

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT – III: Processing and preservation of fish and fish by-products

3.1 Fish products – fish minced meat, fish meal, fish oil, fish liquid (ensilage), fish protein concentrate, fish chowder, fish cake,

3.2 Fish products – fish sauce, fish salads, fish powder, pet food from trash fish, fish manure.

3.3 Fish by-products – **Collagen and Gelatin,** fish glue, Using glass, chitosan, pearl essence, shark fins, fish Leather and fish maws.

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT – IV: Sanitation and Quality control

4.1 Sanitation in processing plants - Environmental hygiene and Personal hygiene in processing plants.

4.2 Quality Control of fish and fishery products – pre-processing control, control during processing and control after processing.

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT – V: Quality Assurance, Management and Certification

5.1. Seafood Quality Assurance and Systems: Good Manufacturing Practices (GMPs); Good Laboratory Practices (GLPs); Standard Operating Procedures (SOPs);

5.2 Concept of Hazard Analysis and Critical Control Points (HACCP) in seafood safety.

5.3 National and International standards – ISO 9000: 2000 Series of Quality Assurance System, Codex Alimentarius or Food code, **HACCP**.

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

REFERENCE BOOKS:

- Santharam R, N Sukumaran and P Natarajan 1987. A manual of aquaculture, Oxford-IBH, New Delhi
- Lakshmi Prasad's, Fish Processing Technology 2012, Arjun Publishing House
- Dr Sunitha Rai, Fish Processing Technology, 2015, Random Publications
- Safety and Quality Issues in Fish Processing (Woodhead Publishing Series in Food Science, Technology and Nutrition) by H A Bremner K.A Mahanthy, Innovations in Fishing and Fish Processing Technologies, January 2021 Web resources:
- http://ecoursesonline.iasri.res.in/mod/page/view.php?id=145743
- https://ecourses.icar.gov.in/e-Leaarningdownload3_new.aspx?Degree_Id=03

SEMESTER-VI

COURSE 15 A: POST HARVEST TECHNOLOGY OF FISH AND FISHERIES

Practical **Credits: 1** **2 hrs/week**

COURSE OBJECTIVES:

- To Determine the quality of fishery by products by observation
- To Analyze the protocols of aqua processing methods
- To know the preparation of various fish by products

SYLLABUS:

1. Evaluation of fish/ fishery products for organoleptic, chemical and microbial quality.
2. Preparation of dried, cured and fermented fish products
3. Examination of salt, protein, moisture in dried / cured products
4. Examination of spoilage of dried / cured fish products, marinades, pickles, sauce.
5. Preparation of isinglass, collagen and chitosan from shrimp and crab shell.
6. Developing flow charts and exercises in identification of hazards – preparation of hazard analysis worksheet
7. Corrective action procedures in processing of fish- flow chart- work sheet preparation
8. Project on Dry fish from nearby Fish markets/ Icings techniques in local markets

(*Refer the following web sites for complete procedure method and estimations of above listed practicals)

REFERENCE BOOK:

- Dr Sunitha Rai, Fish Processing Technology, 2015, Random Publications
- https://ecourses.icar.gov.in/e-Leaarningdownload3_new.aspx?Degree_Id=03
- https://vikaspedia.in/agriculture/fisheries/post-harvest-and-marketing/processing-infisheries/fermented-products
- http://jebas.org/00200620122014/Abujam%20et%20al%20JEBAS.pdf
- https://krishi.icar.gov.in/jspui/bitstream/123456789/20770/1/Training%20Manual_Hygienic
- https://agritech.tnau.ac.in/fishery/fish_byproducts.html
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5352841/
- http://www.fao.org/3/i1136e/i1136e.pdf
- http://www.fao.org/3/x5989e/X5989e01.htm#What%20is%20sensory%20assessment)

SUGGESTED CO-CURRICULAR ACTIVITIES:

- Observation of fish/shrimp processing plants – visit web sites of processing companies and record the details of that unit.
- Interaction with local fishermen to know the method of preservation and details with the available traditional technology
- Collection of web resources on the Quality assurance, quality control measures in Aqua Industries cross checking the standards during the visit to any processing units.
- Assignments, Seminar, Group discussion. Quiz, Collection of Material, invited lectures, Video preparation etc.,

SEMESTER-VI

COURSE 15 B: POULTRY ENTREPRENEURSHIP

Theory	**Credits: 3**	**3 hrs/week**

LEARNING OUTCOMES:

1. Understand about different types of egg marketing, activities involved and challenges faced in marketing of eggs.
2. Understand about different poultry enterprises.
3. Gain knowledge about different Government Supporting schemes to Poultry Industry
4. Understand about financial losses caused and follow precautionary measures.
5. Understand about Financial Management in Poultry Entrepreneurship

SYLLABUS:

UNIT-I: MARKETING OF EGGS

1.1 Egg Marketing – Types - Organized and Unorganized Marketing

1.2 Marketing Activities — Collection, Cleaning and Washing, Candling, Grading, Oiling, Package

1.3 Major Problems in Egg Marketing

1.4 Factors Influencing the Marketing cost.

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT - II: POULTRY ENTERPRISES

2.1 Factors involving to produce Eggs in Layer Farms and Other Products of Egg (Shell Utility: as a feed, Fertilizer, Decoration)

2.2 Different methods of cooking of Eggs

2.3 Marketing Channels

2.4 Farmer share in Egg Marketing

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT - III: GOVERNMENT SUPPORT TO POULTRY INDUSTRY

3.1 Subsidiaries by the Government for the Promotion of Egg Marketing

3.2 Technical Support sponsored by the Government for Marketing of Eggs

3.3 Technical Support sponsored by the Government for Marketing of Meat

3.4 The Government contribution for the construction of Egg storage

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT - IV: POULTRY ECONOMICS

4.1 Value of Broken Eggs during transportation
4.2 Value of the Dead Birds (Broilers) during transportation
4.3 Precautions to prevent mortality of Birds during transportation
4.4 Prevention methods for Egg Breakage during the transportation

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-V: FINANCIAL MANAGEMENT IN POULTRY ENTREPRENEURSHIP

5.1 Basic accounting principles
5.2 Financial statements and their analysis
5.3 Budgeting and cost management in Poultry Entrepreneurship
5.4 Sources of finance for Poultry Entrepreneurship

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

REFERENCE BOOKS:

- Poultry Science by Colin G. Scanes
- Poultry Production by Leslie E. Card
- Poultry Science by A. K. Verma and M. P. Sagar.
- Commercial Poultry Production in India by M. K. Shivaram.
- Poultry Business Management by Dr. R.R. Sharma and Dr. R.N. Chatterjee (Vikas Publishing House, 2016)
- Poultry Farming: Indian Perspective by Dr. D.K. Singh (Daya Publishing House, 2014)
- Poultry Marketing and Management by Dr. J.P. Sinha (Kalyani Publishers, 2014)
- Poultry Economics and Marketing" by Dr. S.K. Srivastava and Dr. M.K. Singh
- Poultry Farming and Marketing" by Dr. R.C. Roy
- Poultry Business in India" by Dr. Suresh Kumar Sharma
- Poultry Science by Colin G. Scanes
- Poultry Production and Management by James R. Gillespie
- Resources from the following organizations in India: National Institute of Animal Nutrition and Physiology (NIANP), Indian Council of Agricultural Research (ICAR), Central Poultry Development Organization (CPDO), Poultry India

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SEMESTER-VI

COURSE 15 B: POULTRY ENTREPRENEURSHIP

Practical **Credits: 1** **2 hrs/week**

COURSE OBJECTIVES:

- To impart Skill in identification of quality and defective eggs
- To Impart required Skill in estimation of yield for a dressed chicken
- To Identify different marketing methods for poultry products
- To acquire required Skill in Candling of Eggs
- To Demonstration on different Marketing methods for poultry products

SYLLABUS:

1. Simple Tests to Know the quality of Eggs
2. Identification of quality defects in Eggs
3. Study on Candling of Eggs
4. Evaluation of Dressing yield of dressed chicken
5. Marketing methods for disposal of Eggs and Poultry Products in different making UNITs
6. Study on different poultry companies in our district (egg production, Hatchery, chicken, feed etc.)

REFERENCE BOOKS:

- Poultry Feed Formulation: Mathematics and Computer Applications by Ravi Ravindran
- Poultry Production Systems: Behavior, Management and Welfare by C. Weeks and A.M. Nicol
- Commercial Chicken Meat and Egg Production by D. D. Bell and W. D. Weaver
- Practical Management of Poultry by H. V. McKay
- Poultry Housing and Management by Michael Roberts
- Hatchery Management Guide for Game Bird and Small Poultry Flock Owners by James Hermes

CO-CURRICULAR ACTIVITIES:

- Poultry field trips to local farms or processing facilities
- Hatch and raise their own chickens
- Poultry science fairs
- Develop a business plan for a small-scale poultry operation
- Conduct a market analysis for a new poultry product or service

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SEMESTER-VI

COURSE 15 C: SERICULTURE MARKETING AND ENTREPRENEURSHIP

Theory	**Credits: 3**	**3 hrs/week**

COURSE OBJECTIVES:

- To equip students with knowledge of sericulture marketing channels, trading platforms, and value chains
- To promote entrepreneurial thinking and business planning in sericulture
- To understand cost-benefit analysis, value addition, and market intelligence
- To provide hands-on experience in marketing, branding, and documentation of silk products
- To encourage self-employment and rural enterprise development

LEARNING OUTCOMES:

By the completion of this course student will able to -

- Understand the principles and practices of silk marketing and trade
- Analyze silk value chains and pricing mechanisms
- Develop entrepreneurial ideas and evaluate market feasibility
- Demonstrate knowledge of business setup, funding, and documentation
- Apply marketing strategies, branding, and customer targeting in silk business

SYLLABUS:

UNIT-I: Basics of Sericulture Marketing

1.1 Definition and importance of marketing in sericulture
1.2 Types of markets and Marketing channels
1.3 Role of Cocoon Markets, Grainages, and Silk Exchanges
1.4 Pricing systems and Government support schemes (CSB, NABARD, SILK SAMAGRA YOGANA.)

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-II: Silk Value Chain and Market Analysis

2.1 Value chain stages (Mulberry →Cocoon → Silk Yarn → Finished Product)
2.2 Product grading and quality assessment
2.3 Demand–supply trends in raw silk, fabric, garments, and export
2.4 Introduction to e-marketing platforms for silk and handicrafts

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-III: Entrepreneurship Development in Sericulture

3.1 Concept and scope of entrepreneurship in sericulture

3.2 Types of enterprises: Cocoon production, silk weaving, seed production, silk handicrafts, reeling/spinning UNITs

3.3 Skills required: Technical, financial, managerial, and marketing

3.4 Identification of business opportunities in sericulture value chain

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-IV: Project Planning and Financial Management

4.1 Business plan preparation for a small-scale sericulture enterprise

4.2 Capital investment, recurring costs, profit estimation

4.3 Sources of finance: Bank loans, NABARD, PMEGP, SHGs, NGOs

4.4 Legal registration: MSME, FSSAI, GST

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-V: Branding, Marketing Strategy and Export Potential

5.1 Branding and packaging of silk and value-added products

5.2 Promotion techniques: Advertising, social media, exhibitions

5.3 Export procedures for silk products

5.4 Intellectual Property Rights (IPR), GI tags (e.g., Pochampally, Banarasi silk)

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

REFERENCE BOOKS:

- CSB Publications: Central Silk Board, Bangalore
- Ganga, G. & Sulochana Chetty – An Introduction to Sericulture
- FAO – Manual on Small-Scale Silk Enterprises
- NABARD & PMEGP Guidelines for Sericulture Startups
- E-books and materials from Ministry of Textiles and APEDA

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SEMESTER-VI

COURSE 15 C: SERICULTURE MARKETING AND ENTREPRENEURSHIP

Practical **Credits: 1** **2 hrs/week**

COURSE OBJECTIVES:

- To understand the functioning of government cocoon markets and reeling UNITs through field visits.
- To perform a cost-benefit analysis from cocoon to finished silk product.
- To design a label, logo, and packaging suitable for a silk-based brand.
- To conduct and analyze a simple survey on customer preferences in silk wear.
- To practice negotiation and pricing skills through role-play of buyer–seller interactions.
- To gain exposure to real-life experiences of entrepreneurs or self-help groups in the sericulture sector.

SYLLABUS:

1. Visit to Government Cocoon Market or Reeling UNIT
2. Preparation of a mini business plan for silk-based enterprise
3. Create a marketing strategy and product pitch for a silk product
4. Simulation of cost-benefit analysis for a cocoon-to-scarf production
5. Design of label, logo, and packaging for a silk-based brand
6. Conduct a survey on customer preferences in silk wear
7. Role-play: Seller–Buyer negotiation and price setting
8. Field exposure to an entrepreneur or self-help group in sericulture

REFERENCE BOOKS:

- CSB Publications: Central Silk Board, Bangalore
- Ganga, G. & Sulochana Chetty – An Introduction to Sericulture
- FAO – Manual on Small-Scale Silk Enterprises
- NABARD & PMEGP Guidelines for Sericulture Startups
- E-books and materials from Ministry of Textiles and APEDA

CO-CURRICULAR ACTIVITIES:

- Case studies of successful sericulture entrepreneurship ventures
- Field visits to sericulture entrepreneurship ventures
- Entrepreneurship project development and presentation

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SEMESTER-VI

COURSE 15 D: GENOMICS, PROTEOMICS- APPLICATIONS IN ZOOLOGY

Theory	**Credits: 3**	**3 hrs/week**

COURSE OBJECTIVES:

To Understand the structure and organization of genomes and proteomes

To Learn the basics of genome sequencing technologies and annotation methods

To Explore 3D protein structure analysis using visualization tools

To Understand applications in zoological research, conservation, and drug discovery

To Gain hands-on experience in retrieving, analyzing, and interpreting omics data

LEARNING OUTCOMES:

By the successful completion of this course the student will able to

- Explain the basic principles of genomics and proteomics
- Describe genome sequencing and annotation processes
- Analyze protein structures using RasMol and PDB
- Apply omics knowledge to species identification and conservation
- Use case studies linking genomics/proteomics to biomedical research

SYLLABUS:

UNIT- I: Basics of Genomics

1.1 Definition and scope of genomics

1.2 Types of genomes: prokaryotic vs eukaryotic

1.3 Animal genome structure: nuclear, mitochondrial, chloroplast

1.4 Model organisms: Drosophila, Zebrafish, Mouse

1.5 Importance in evolutionary biology

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT -II: Genome Sequencing and Annotation

2.1 DNA sequencing methods: Sanger, NGS

2.2 Genome mapping and comparative genomics

2.3 Gene prediction and annotation (Tools: NCBI Genome, ORF Finder, GenScan)

2.4 Challenges in genome assembly

2.5 Variant Detection and Annotation (Tools: GATK & VEP)

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT- III: Introduction to Proteomics

3.1 Definition and types: structural vs functional proteomics

3.2 Protein separation techniques: SDS-PAGE, 2D-Gel (concept only)

3.3 Mass spectrometry basics

3.4 Protein-protein interaction databases: STRING, IntAct

3.5 Applications in physiology and disease biology

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT- IV: Protein Structure and Visualization

4.1 Levels of protein structure: primary to quaternary

4.2 3D protein structure formats (PDB)

4.3 Visualization tools: RasMol, PyMOL, Cn3D

4.4 Active sites, motifs, and domains

4.5 Case study: enzyme/receptor modeling

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT -V: Applications in Zoology and Drug Design

5.1 Genomics in species identification and molecular barcoding

5.2 Population genomics in conservation biology

5.3 Omics in disease pathways and diagnostics

5.4 Drug and vaccine design using proteomics

5.5 Case studies: tiger genome, avian flu, venom proteomics

Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

SEMESTER-VI

COURSE 15 D: GENOMICS, PROTEOMICS- APPLICATIONS IN ZOOLOGY

Practical	**Credits: 1**	**2 hrs/week**

COURSE OBJECTIVES:

- To Retrieve and analyze genome data from NCBI and Ensembl.
- To Annotate genes using ORF Finder.
- To Visualize protein structures using RasMol or PyMOL.
- To Interpret proteomic databases (UniProt, STRING).
- To Apply bioinformatics tools to conservation biology.

SYLLABUS:

1. Explore NCBI and Ensembl to retrieve and analyze genome data of model animals
2. Use ORF Finder and annotate short genes from given sequences
3. Visualize proteins using RasMol or PyMOL and identify structural domains
4. Search and interpret proteomic databases like UniProt and STRING
5. Mini-project: Retrieve endangered species data and report its conservation application

SOFTWARE AND TOOLS REQUIRED:

1. NCBI Genome Database - https://www.ncbi.nlm.nih.gov
2. Ensembl Genome Browser - https://www.ensembl.org
3. UniProt - https://www.uniprot.org
4. Protein Data Bank (PDB) - https://www.rcsb.org
5. PyMOL (open-source) - https://pymol.org/2/
6. RasMol - http://www.rasmol.org/
7. MEGA - https://www.megasoftware.net/
8. STRING DB - https://string-db.org/
9. Pfam - https://pfam.xfam.org/
10. ORF Finder - https://www.ncbi.nlm.nih.gov/orffinder/
11. GATK - https://gatk.broadinstitute.org/hc/en-us
12. VEP - https://useast.ensembl.org/info/docs/tools/vep/index.html

REFERENCE BOOKS:

- Primrose & Twyman – Principles of Genome Analysis and Genomics – https://www.wiley.com/en-us/Principles+of+Genome+Analysis+and+Genomics
- Liebler, D.C. – Introduction to Proteomics – https://www.sciencedirect.com/book/9780896039919/introduction-to-proteomics
- Brown, T.A. – Genomes 4 – https://www.routledge.com/Genomes-4/Brown/p/book/9780815345084
- Baxevanis & Ouellette – Bioinformatics: A Practical Guide – https://www.wiley.com/en-us/Bioinformatics%3A+A+Practical+Guide+to+the+Analysis+of+Genes+and+Proteins
- RasMol & PyMOL tutorials (online) – https://pymolwiki.org

FREE AND PAID TOOLS (CATEGORIZED)

FREE / OPEN-SOURCE TOOLS

- NCBI Genome Database – https://www.ncbi.nlm.nih.gov
- Ensembl Genome Browser – https://www.ensembl.org
- ORF Finder – https://www.ncbi.nlm.nih.gov/orffinder/
- MEGA (Phylogenetic analysis) – https://www.megasoftware.net
- UniProt – https://www.uniprot.org
- STRING DB (Protein-Protein Interaction) – https://string-db.org
- Pfam – https://pfam.xfam.org
- PROSITE – https://prosite.expasy.org
- RasMol – http://www.rasmol.org
- PyMOL (Open-Source Version) – https://pymol.org/2/
- Cn3D – https://www.ncbi.nlm.nih.gov/Structure/CN3D/cn3d.shtml
- Jmol – http://jmol.sourceforge.net/
- Protein Data Bank (PDB) – https://www.rcsb.org
- BLAST – https://blast.ncbi.nlm.nih.gov/Blast.cgi
- ExPASy Proteomics Tools – https://www.expasy.org/proteomics

PAID / COMMERCIAL TOOLS

- Geneious Prime – https://www.geneious.com
- CLC Genomics Workbench – https://digitalinsights.qiagen.com
- PyMOL Pro Version – https://pymol.org/2/
- Discovery Studio – https://discover.3ds.com/discovery-studio-visualizer-download
- Schrödinger Suite – https://www.schrodinger.com

SEMESTER-VI

COURSE 15 E: LIVESTOCK ENTREPRENEURSHIP

Theory	**Credits: 3**	**3 hrs/week**

COURSE OBJECTIVES:

- To Understand livestock entrepreneurship concepts and importance.
- To Develop business plans and market analysis for livestock ventures.
- To Evaluate financial options and risk management strategies.
- To Understand livestock production systems and management practices.
- To Apply animal nutrition, health, and breeding principles.

LEARNING OUTCOMES:

After the completion of this course the student will able to

- Understand the concept and importance of Livestock Entrepreneurship
- Analyze the market and develop a business plan for a Livestock Entrepreneurship venture
- Evaluate financial options and risk management strategies for a Livestock Entrepreneurship venture
- Identify and describe different Livestock Production Systems
- Evaluate animal nutrition and feeding practices for various livestock species
- Evaluate animal health and disease management practices for various livestock species
- Understand breeding and genetics principles for various livestock species

SYLLABUS:

UNIT-I: Introduction to Livestock Entrepreneurship
1.1 Definition of Livestock Entrepreneurship
1.2 Importance of Livestock Entrepreneurship
1.3 Characteristics of successful Livestock Entrepreneurs
1.4 Challenges faced by Livestock Entrepreneurs
Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-II: Market Analysis and Business Planning
2.1 Market analysis and its importance
2.2 Steps in developing a business plan
2.3 Sources of finance for Livestock Entrepreneurs
2.4 Risk management strategies
Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-III: Livestock Production and Management
3.1 Livestock production systems
3.2 Principles of animal nutrition and feeding
3.3 Animal health and disease management
3.4 Breeding and genetics of livestock
Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-IV: Marketing and Sales Strategies
4.1 Principles of marketing
4.2 Marketing mix and its components
4.3 Sales strategies for Livestock products
4.4 Branding and promotion
Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

UNIT-V: Legal and Regulatory Framework
5.1 Laws and regulations related to Livestock Entrepreneurship
5.2 Compliance requirements for Livestock Entrepreneurs
5.3 Intellectual property rights in Livestock Entrepreneurship
Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video/ Research paper/ reference book/ digital resource on the above/Case study
Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity

REFERENCE BOOKS:

- Livestock Entrepreneurship by Donald R. Mooney and Daniel J. Morreale
- Principles of Marketing by Philip Kotler and Gary Armstrong
- Small Business Management by Justin G. Longenecker, J. William Petty, Leslie E. Palich, and Frank Hoy
- The Legal Environment of Business: A Managerial Approach by Sean P. Melvin
- Agricultural Marketing and Price Analysis by Bailey Norwood, Jayson Lusk, and Jason Shogren
- Animal Agriculture and Environmental Sustainability: Future Challenges by Fabio A. Diaz, Manuela Juárez, and Juan A. Fernandez
- Entrepreneurship in Agriculture and Rural Development by Eugenio Diaz-Bonilla and Jamie Morrison
- Fundamentals of Financial Management by Eugene F. Brigham and Joel F. Houston

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SEMESTER-VI

COURSE 15 E: LIVESTOCK ENTREPRENEURSHIP

Practical **Credits: 1** **2 hrs/week**

COURSE OBJECTIVES:

- To impart required Skill in identification of different breeds of livestock.
- To develop required skill sets in health management of livestock.
- To design and develop Livestock products for the market
- To Identify and analyze market opportunities for Livestock products
- To Identify the major challenges faced by Livestock Sector in India

SYLLABUS:

1. Identification of different livestock breeds (cattle, buffaloes, pigs, goats and sheep)
2. Study on different vaccinations schedules for livestock species
3. Treatment of common diseases for livestock species
4. Study on Farm management practices for livestock species
5. Series of activities involved in Livestock marketing and value chain management
6. Keys components in market analysis, product development, branding, pricing, and distribution of livestock products
7. Study on development of entrepreneurship skills such as innovation, creativity and networking
8. Study on major challenges faced by Livestock Sector in India

REFERENCE BOOKS:

- Livestock Production and Management by Gyanendra Singh
- Handbook of Animal Husbandry by A.M. Michael
- Business Planning and Management by Vasant Desai
- Dairy Farming: Challenges and Opportunities by B.V. Mehta
- Livestock Economics by Dinesh Kumar
- Livestock Breeding, Nutrition, and Management by Gurbir Singh
- Marketing Management by Philip Kotler
- Livestock Entrepreneurship by Sanjay Kumar Singh
- Principles of Marketing by Kotler & Keller
- Legal Aspects of Business by Akhileshwar Pathak
- Animal Husbandry and Veterinary Science by A.M. Michael
- Entrepreneurship Development and Management by S. Anil Kumar

CO-CURRICULAR ACTIVITIES

- Field visits to Livestock farms and related enterprises
- Inviting Livestock Entrepreneurs as guest speakers to share their experiences and challenges
- Business plan competition among students
- Market research and product development projects
- Workshops on animal nutrition, health, and breeding techniques

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