

**D.K.M COLLEGE FOR WOMEN
(AUTONOMOUS)
VELLORE-1**



**DEPARTMENT OF ZOOLOGY
SYLLABUS
FOR
MASTER DEGREE COURSE IN ZOOLOGY**

**WITH EFFECT FROM
2024-2025**

PG and Research Department of Zoology with effect from 2024-2025
The course of study and Scheme of Examination

S. No.	Part	Category	Ins. Hrs/Week	Credit	Title of the paper	Maximum marks		
						CIA	Sem. Exam	Total
SEMESTER I								
1	Part I	Core Paper I	7	5	Structure and Function of Invertebrates	25	75	100
2		Core Paper II	7	5	Comparative Anatomy of Vertebrates	25	75	100
3		Core Paper III	6	4	Lab course-I-Invertebrates & Vertebrates	25	75	100
4		Discipline Centric Elective-I	5	3	Molecules and their interaction relevant to Biology	25	75	100
5		Generic Elective - II	5	3	Biostatistics	25	75	100
			30	20		125	375	500
SEMESTER II								
6	Part I	Core Paper IV	6	5	Cellular and Molecular Biology	25	75	100
7		Core Paper V	6	5	Developmental Biology	25	75	100
8		Core Paper VI	6	4	Lab course-II Cell Biology and Developmental Biology	25	75	100
9		Discipline Centric Elective-III	3	3	Economic Entomology	25	75	100
10		Generic Elective – IV	3	3	Research Methodology	25	75	100
11	Part II	Skill Enhancement I	4	2	Poultry Farming	25	75	100
12		Compulsory Paper	2	2	Human rights	25	75	100
13		Self study paper	-	2	Vermiculture	-	-	-
			30	26				700

SEMESTER III								
14	Part I	Core Paper VII	6	5	Genetics	25	75	100
15		Core Paper VIII	6	5	Evolution	25	75	100
16		Core Paper IX	6	5	Animal Physiology	25	75	100
17		Core Paper - X	6	4	Lab Course-III - Animal Physiology, Genetics and Evolution	25	75	100
18		Discipline Centric Elective-V	3	3	Stem Cell Biology	25	75	100
19	Part II	Skill Enhancement II	3	2	Dairy Farming	25	75	100
20		Internship/ Industrial Activity	-	2	Internship	-	-	-
			30	26				600
SEMESTER IV								
21	Part I	Core Paper XI	6	5	Immunology	25	75	100
22		Core Paper XII	6	5	Ecology	25	75	100
23		Core Project	10	7	Project with viva-voce	25	75	100
24		Elective – VI (Industry/ Entrepreneurship)	4	3	Aquaculture	25	75	100
25	Part II	Skill Enhancement Course/ Professional Competency Skill	4	2	Animal Behaviour	25	75	100
26	Part III		-	1	Extension activity	-	-	-
			30	23				500
Total			120	95				2300

CONSOLIDATED TABLE FOR CREDIT DISTRIBUTION

	Category of Courses	Number of Courses	Credits for each course	Number of Credits in each Category of courses	Total Credits	Total Credits for the Programme
Part I	Core Theory	9	5	45	82	92(CGPA)
	Lab course	3	4	12		
	Project with viva-voce	1	7	07		
	Discipline centric/Generic centric elective	6	3	18		
Part II	Skill Enhancement	3	2	6	10	
	Human rights	1	2	2		
	Self Study Paper	1	2	2		
	Summer Internship	1	2	2	03	3(Non CGPA)
Part III	Extension activity	1	1	1		

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO 1 : Demonstrate the ability to connect and apply biological knowledge to other disciplines and to integrate knowledge into their personal and professional lives. Be proficient at communication and annotation of scientific information and able to succeed in competitive examinations and interviews.

PEO 2 : Demonstrate the ability to engage in critical, independent, and creative thinking. Understand how scientific knowledge grows, and is organized, evaluated and disseminated.

PROGRAMME OUTCOMES (PO)

Upon completion of these courses the student would

PO1: Problem Solving Skill

Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context.

PO2: Decision Making Skill

Foster analytical and critical thinking abilities for data-based decision-making.

PO3: Ethical Value

Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities.

PO4: Communication Skill

Ability to develop communication, managerial and interpersonal skills.

PO5: Individual and Team Leadership Skill

Capability to lead themselves and the team to achieve organizational goals.

PO6: Employability Skill

Inculcate contemporary business practices to enhance employability skills in the competitive environment.

PO7: Entrepreneurial Skill

Equip with skills and competencies to become an entrepreneur.

PO8: Contribution to Society

Succeed in career endeavors and contribute significantly to society.

PO 9 Multicultural competence

Possess knowledge of the values and beliefs of multiple cultures and a global perspective.

PO 10: Moral and ethical awareness/reasoning

Ability to embrace moral/ethical values in conducting one's life.

PROGRAMME SPECIFIC OUTCOMES (PSOS)

PSO1 – Placement

To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions.

PSO 2 - Entrepreneur

To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.

PSO3 – Research and Development

Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.

PSO4 – Contribution to Business World

To produce employable, ethical and innovative professionals to sustain in the dynamic business world.

PSO 5 – Contribution to the Society

To contribute to the development of the society by collaborating with stakeholders for mutual benefit.

STRUCTURE AND FUNCTION OF INVERTEBRATES

Semester	Subject Code	Category	Lecture		Theory		Practical	Credits
			Hrs/week	Total Hours/Semester	Hrs/week	Total Hours/Semester		
I	24CPZO1A	Core - I	6	75	6	75	Nil	5

COURSE OBJECTIVES:

The main objectives of this course are:

1. To understand the concept of classification and their characteristic features of major group of invertebrates.
2. To realize the range of diversification of invertebrate animals.
3. To enable to find out the ancestors or derivatives of any taxon.
4. To know the functional morphology of system biology of invertebrates.

COURSE OUTCOMES

On the successful completion of the course, students will be able to:

CO Number	CO Statement	Knowledge Level (K1-K4)
CO1	Remember the general concepts and major groups in animal classification, origin, structure, functions and distribution of life in all its forms.	K1 & K2
CO2	Understand the evolutionary process. All are linked in a sequence of life patterns.	K2 & K4
CO3	Apply this for pre-professional work in agriculture and conservation of life forms.	K3 & K5
CO4	Analyze what lies beyond our present knowledge of life process.	K4 & K6
CO5	Evaluate and to create the perfect phylogenetic relationship in classification.	K5 & K6

K1-Remember ; K2 –Understand ; K3 – Apply ; K4 – Analyze; K5-Evaluate; K6- Create

MAPPING WITH PROGRAMME OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	S	M	S	S	S
CO2	S	S	M	M	S	S	M	M	S	S
CO3	S	M	S	M	S	S	M	M	S	S
CO4	S	M	S	M	S	S	M	M	S	M
CO5	S	M	S	M	S	S	M	M	S	M

S- Strong; M - Medium ; L- Low

DISTRIBUTION OF MARKS: THEORY 100%

UNIT-I

Introduction on the Structure and functions of various systems in invertebrates: Principles of Animal taxonomy; Species concept; International code of zoological nomenclature; Taxonomic procedures- hierarchical taxonomy.

UNIT-II

Organization of coelom: Acoelomates-Porifera and Coelenterata, Pseudocoelomates-Aschelminthes, Coelomates-Annelida and Echinodermata, Locomotion: Flagella and ciliary movement in Protozoa; Hydrostatic movement in Coelenterata, Annelida and Echinodermata.

UNIT-III

Nutrition and Digestion: Patterns of feeding and digestion in lower metazoan – Corals and sponges, Filter feeding in Mollusca and Echinodermata. Respiration: Organs of respiration: Gills, lungs and trachea, Mechanism of respiration.

UNIT-IV

Excretion: Organs of excretion: Coelom, coelomoducts, Nephridia and Malphigian tubules; Mechanisms of excretion; Excretion and osmoregulation. Nervous system: Primitive nervous system: Coelenterata and Echinodermata; Advanced nervous system: Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda).

UNIT-V

Invertebrate larvae: Larval forms of free living invertebrates- - Larval forms of parasites; Strategies and Evolutionary significance of larval forms. Minor Phyla: Nemertinea and Rotifera - Concept and significance; Organization and general characters.

TEXT BOOKS

S.NO	AUTHORS	TITLE	PUBLISHERS	YEAR OF PUBLICATION
1.	Hyman L.H.	The Invertebrata, Vol I to VI.	Mc Graw – Hill Book Co., New York.	1951
2.	Carter, G.S.A.	General Zoology of Invertebrates	Sidewick & Jackson Ltd., London.	1969.
3.	Barrington, E.J. W.	Invertebrate Structure and Functions	English Language Book Society.	1969.
4.	Marshall A.J and Williams W.D	Textbook of Zoology, Vol. I: Invertebrates	7 th Edition – ELBS	1976.

REFERENCE BOOKS

S.NO	AUTHORS	TITLE	PUBLISHERS	YEAR OF PUBLICATION
1.	Barnes. R.D	Invertebrate Zoology	W.B. Saunders Co., Philadelphia	1974
2.	Borradile, L.A. Eastham, L.E.S. and J.T. Saunders	The Invertebrate	Cambridge University Press	1977
3.	Moore, R.C. Lalicker, C.G. and Fisher, A.G.	Invertebrate Fossils.	Mc Graw Hill Book Co., New York	1952
4.	Gardinar, M.S.	Biology of the Invertebrates,	McGraw - Hill Book Co., New York.	1972
5.	Richard C Brusca	Invertebrate Zoology	Hardcover Publisher	2003

COMPARATIVE ANATOMY OF VERTEBRATES

Semester	Subject Code	Category	Lecture		Theory		Practical	Credits
			Hrs/week	Total Hours/Semester	Hrs/week	Total Hours/Semester		
I	24CPZO1B	Core - II	6	75	6	75	Nil	5

COURSE OBJECTIVES:

The main objectives of this course are:

1. Exemplifying the vertebrate origin and the intermediary position of Prochordates between invertebrates and vertebrates.
2. Acquires the knowledge on evolution and adaptive radiation of Agnatha and Pisces.
3. Understanding knowledge about the first terrestrial vertebrates and the adaptive radiation of land animals.
4. Imparting conceptual knowledge about the animal life in the air and their behaviours.
5. Understanding the origin and efficiency of mammals and evolutionary changes that occurred in the life of vertebrates.

COURSE OUTCOMES

On the successful completion of the course, students will be able to:

CO Number	CO Statement	Knowledge Level (K1-K4)
CO1	Remember the general concepts and major groups in animal classification, origin, structure, functions and distribution of life in all its forms.	K1 & K2
CO2	Understand the evolutionary process. All are linked in a sequence of life patterns.	K2 & K4
CO3	Apply this for pre-professional work in agriculture and conservation of life forms.	K3 & K5
CO4	Analyze what lies beyond our present knowledge of life process.	K4 & K6
CO5	Evaluate and to create the perfect phylogenetic relationship in classification.	K5 & K6

K1-Remember ; K2 –Understand ; K3 – Apply ; K4 – Analyze; K5-Evaluate; K6- Create

MAPPING WITH PROGRAMME OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	L	S	M	S	M	S	M	S
CO2	S	L	L	S	M	S	M	M	M	M
CO3	S	M	L	S	M	S	M	L	M	M
CO4	S	L	L	S	L	S	M	L	M	L
CO5	S	M	L	S	S	S	M	S	M	M

S-Strong; M – Medium ; L- Low

DISTRIBUTION OF MARKS: THEORY 100%

UNIT-1

Origin of chordates, Concept of Protochordata; The nature of vertebrate morphology; Definition, scope and relation to other disciplines; Importance of the study of vertebrate morphology.

UNIT-II

General characteristics and classification of vertebrates. General structure and functions of skin and its derivatives; Glands, scales, horns, claws, nails, hoofs, feathers and hairs.

UNIT-III

General plan of circulation in various groups; Blood; Evolution of heart; Evolution of aortic arches and portal systems. Respiratory system - Internal and external respiration; Comparative account of respiratory organs.

UNIT-IV

Skeletal system - Skeletal elements of the body; Comparative account of jaw suspension, Vertebral column; Limbs and girdles; Evolution of Urinogenital system in vertebrate series.

UNIT-V

Sense organs: Simple receptors; Organs of Olfaction and taste; Electroreception, Nervous system: Comparative anatomy of the brain and spinal in relation to its functions; Peripheral – Cranial and spinal nerves, and Autonomous nervous systems.

TEXT BOOK

S.NO	AUTHORS	TITLE	PUBLISHERS	YEAR OF PUBLICATION
1.	Jolie. M	Chordate Morphology.	East West Press. Pvt, Ltd,	1968.
2.	Romer.A.S and Parson. T.S.	Vertebrate Body	W.B. Saunders Co., Philaelpia.	1978
3.	Holstead	The Pattern of Vertebrate Evolution.	Freeman and Co. San Francisco. U.S.A.	1969
4.	Kapoor. V.C.	Theory and Practice of Animal Taxonomy.	Oxford and IBH Publishing Co., Pvt, Ltd. New Delhi	1998
5.	Kenneth V. Kardong	Vertebrates- Comparative Anatomy, Functions, Evolution, 4 th Edition	Tata McGraw Hill Editions	2011

REFERENCE BOOKS

S.NO	AUTHORS	TITLE	PUBLISHERS	YEAR OF PUBLICATION
1.	Waterman. A.J	Chordate Structure and Function.	McMillan Co. London.	1971
2.	Hyman, L.H	Comparative Vertebrate Anatomy.	The University of Chicago Press, Chicago.	1966
3.	Young, J.2	Life of Vertebrates. Clarendon Press, Oxford.	Clarendon Press, Oxford.	1969
4.	Colbert, E.H	Evolution of Vertebrates.	John Wiley and Sons Inc, New York.	1969
5.	Hobart M. Smith	Evolution of Chordate Structure	Holt, Rinehart and Winston. Inc. New York.	1960

LAB COURSE IN INVERTEBRATES & VERTEBRATES

Semester	Subject Code	Category	Practical		Theory	Practical	Credits
			Hrs/week	Total Hours/Semester			
			I	24CPZO11			

COURSE OUTCOMES

CO Number	CO Statement	Knowledge Level (K1-K4)
CO1	Understand the structure and functions of various systems in animals	K2 & K4
CO2	Learn the adaptive features of different groups of animals	K1 & K2
CO3	Learn the mounting techniques	K2 & K3
CO4	Acquire strong knowledge on the animal skeletal system	K2 & K4
CO5	Understand the structure and functions of various systems in animals	K2 & K4

K1- Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5**-Evaluate; **K6** – Create

Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	M	S	M	S
CO2	S	M	L	S	M	S	M	M	M	M
CO3	M	M	L	S	L	S	M	L	M	M
CO4	S	S	L	S	L	S	M	L	M	L
CO5	S	S	M	L	M	S	M	S	M	M

S-Strong; M-Medium; L-Low

INVERTEBRATES

Dissection

- Earthworm : Nervous system (Demo)
Sepia : Nervous system
Cockroach : Nervous system (Demo)
Grasshopper : Digestive system and mouth parts (Demo)
Prawn : Appendages and nervous system
Crab : Nervous system (Demo)

Study of the following slides with special reference to their salient features and their modes of life

1. Amoeba
2. *Entamoeba histolytica*
3. Paramecium
4. Hydra with bud
5. Sporocyst – Liver fluke
6. Cercaria larva
7. Tape worm (Scolex)
8. *Ascaris T. S.*
9. Mysis of prawn

Spotters

1. Scorpion
2. *Penaeus indicus*
3. *Emerita (Hippa)*
4. *Perna viridis*

Mounting

- Honeybee :Sting Apparatus
Honeybee : Mouth parts
Cockroach :Mouthparts (Demo)
Housefly : Mouth parts

CHORDATES

Study the nervous system of Indian dog shark - Dissection

1. Nervous system of *Scoliodon laticaudatus* – 5th or Trigeminal nerve (Demo)
2. Nervous system of *Scoliodon laticaudatus* – 7th or Facial nerve (Demo)
3. Nervous system of Cat fish - 9th and 10th Cranial Nerves

Study of the following specimens with special reference to their salient features and their modes of life

1. *Amphioxus* sp. (Lancelet)
2. *Ascidia* sp. (sea squirt)
3. *Scoliodon laticaudatus* (Indian dog shark)
4. *Trygon* sp. (Sting ray)
5. *Torpedo* sp. (Electric ray)
6. *Arius maculatus* (Cat fish)
7. *Belone cancila* (Flute fish)
8. *Exocoetus poecilopterus* (Flying fish)
9. *Mugil cephalus* (Mullet)
10. *Tilapia mossambicus* (Tilapia)
11. *Rachycentron canadum* (Cobia)
12. *Tetrodon punctatus* (Puffer fish)

Study of the different types of scales in fishes

1. Cycloid scale
2. Ctenoid scale
3. Placoid scale

Study of the frog skeleton system (Representative samples)

1. Entire skeleton
2. Skull
3. Hyoid apparatus
4. Pectoral girdle and sternum
5. Pelvic girdle
6. Fore limb
7. Hind limb

Mounting

1. Weberian ossicles of cat fish

TEXT BOOKS

S.NO	AUTHORS	TITLE	PUBLISHERS	YEAR OF PUBLICATION
1	Lal, S.S.	Practical Zoology	Rastogi Publications,	2009.
2	Iuliis G. D. and D. Pulerà,	The Dissection of Vertebrates: A Laboratory Manual.	Imprint of Elsevier Publication	2007
3	Verma, P.S	Manual of Practical Zoology: Chordates,	S. Chand Publishing Company	2000

REFERENCE BOOKS

S.NO	AUTHORS	TITLE	PUBLISHERS	YEAR OF PUBLICATION
1	Preeti, G., and C. Mridula	Modern Experimental Zoology	Indus International Publication	2000
2	Sinha, J., A. K. Chatterjee, P. Chattopadhyaya.	Advanced Practical Zoology	Arunabha Sen Publishers	2011

MOLECULES AND THEIR INTERACTION RELEVANT TO BIOLOGY

Semester	Subject Code	Category	Lecture		Theory		Practical	Credits
			Hrs/week	Total Hours/Semester	Hrs/week	Total Hours/Semester		
I	24CPZO1C	Discipline Centric Elective-I	5	60	5	60	Nil	3

COURSE OBJECTIVES:

The main objectives of this course are:

1. Understanding fundamental properties of elements, atoms, molecules, chemical bonds, linkages and structure, composition, metabolism and functions of biomolecules.

COURSE OUTCOME:

On the successful completion of the course, student will be able to:

CO Number	CO Statement	Knowledge Level (K1-K4)
CO1	Learn the structure, properties, metabolism and bioenergetics of biomolecules	K1 & K3
CO2	Acquire knowledge on various classes and major types of enzymes, classification, their mechanism of action and regulation	K1 & K2
CO3	Understand the fundamentals of biophysical chemistry and biochemistry, importance and applications of methods in conforming the structure of biopolymers	K2 & K3
CO4	Comprehend the structural organization of and proteins, carbohydrates, nucleic acids and lipids	K2 & K4
CO5	Familiarize the use of methods for the identification, characterization and conformation of biopolymer structures	K5 & K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	M	S	L	S	M	S	M	M
CO2	S	S	L	S	S	S	M	M	M	S
CO3	M	M	M	S	M	S	S	S	S	L
CO4	S	M	S	M	S	M	S	S	S	M
CO5	M	S	S	M	M	S	M	L	S	M

*S - Strong; M - Medium; L-Low

DISTRIBUTION OF MARKS: THEORY 100%

UNIT-1

Basics of biophysical chemistry and biochemistry: Structure of atoms, molecules and chemical bonds - Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).

UNIT-II

Biomolecular interactions and their properties: Stabilizing interactions (Vander Waals, electrostatic, hydrogen bonding, hydrophobic interaction - Composition, structure, metabolism and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids).

UNIT-III

Bioenergetics and enzymology: Bioenergetics, glycolysis, oxidative phosphorylation, Krebs cycle, Electron transport chain- Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isoenzymes

UNIT-IV

Structural conformation of proteins and nucleic acids: Conformation of proteins (Primary, secondary, tertiary and quaternary structure, Ramachandran plot) - Conformation of nucleic acids (A-, B-, Z-DNA), t-RNA, micro-RNA).

UNIT-V

Stabilizing interactions in biomolecules: Stability of protein and nucleic acid structures - hydrogen bonding, covalent bonding, hydrophobic interactions and disulfide linkage.

TEXT BOOKS:

S.NO	AUTHORS	TITLE	PUBLISHERS	YEAR OF PUBLICATION
1	Berg, J. M., J. L. Tymoczko and L. Stryer	Biochemistry	W.H. Freeman & Co., New York,	2002
2	Kuchel P.W. and G. B. Ralston	Biochemistry	McGraw Hill (India) Private Limited,UP	2008
3	McKee T. and J. R. McKee.	Biochemistry	Oxford University Press, US	2012
4	Nelson D.L. and M.M. Cox.	Principles of Biochemistry	W. H. Freeman Publishers, New York	2012.
5	Satyanarayana U. and U. Chakrapan	Biochemistry. (3rd Edition)	Books and Allied (P) Ltd	2006

REFERENCE BOOKS:

S.NO	AUTHORS	TITLE	PUBLISHERS	YEAR OF PUBLICATION
1	Buchanan, B.B., W. Gruissem and R.L. Jones.	Biochemistry and Molecular Biology of Plants.	John Wiley and Sons Ltd., UK	2015
2	Murray, R.K., D.K. Granner, P.A. Mayes and V.W. Rodwell	Harper's Illustrated Biochemistry (26th Edition)	The McGraw-Hill Companies, Inc., USA	2003
3	Palmer, T.	Enzymes	Affiliated East-West Press Pvt. Ltd., New Delhi	2004
4	Voet D. and J.G. Voet	Biochemistry. (4th Edition)	John Wiley & Sons (Asia) Pvt. Ltd.	2011

BIOSTATISTICS

Semester	Subject Code	Category	Lecture		Theory		Practical	Credits
			Hrs/week	Total Hours/Semester	Hrs/week	Total Hours/Semester		
I	24CPZO1D	Generic Elective - II	5	60	5	60	Nil	3

COURSE OBJECTIVES:

Students should be aware of importance of analysis of quantitative and qualitative information from biological studies.

COURSE OUTCOME:

On the successful completion of the course, student will be able to:

CO Number	CO Statement	Knowledge Level (K1-K4)
CO1	Clear understanding of design and application of biostatistics relevant to experimental and population studies.	K2 & K3
CO2	Acquired skills to perform various statistical analyses using modern statistical techniques and software.	K3 & K4
CO3	Knowledge on the merits and limitation of practical problems in biological/ health management study as well as to propose and implement appropriate statistical design/ methods of analysis.	K5 & K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	L	M	S	S	M	S	M	M
CO2	S	S	S	S	S	S	S	S	S	S
CO3	M	S	S	S	S	S	S	S	S	L
CO4	M	M	S	L	M	M	M	S	L	M
CO5	M	M	S	L	M	S	M	L	S	M

*S-Strong ;M-Medium; L-Low

DISTRIBUTION OF MARKS: THEORY 100%

UNIT-I

Definition, scope and application of statistics; Primary and secondary data: Source and implications; Classification and tabulation of biological data: Types and applications. Variables: Definition and types. Frequency distribution: Construction of frequency, distribution table for grouped data; Graphic methods: Frequency polygon and Ogive curve; Diagrammatic representation: Histogram, bar diagram, pictogram and pie chart.

UNIT-II

Measures of central tendency: Mean, median and mode for continuous and discontinuous variables. Measures of dispersion: Range, variation, standard deviation, standard error and coefficient of variation

UNIT-III

Probability: Theories and rules; Probability - Addition and multiplication theorem; Probability distribution: Properties and application of Normal, Binomial and Poisson distributions.

UNIT-IV

Hypothesis testing: Student 't' test - paired sample and mean difference 't' tests. Correlation: Types - Karl Pearsons Co-efficient, Rank correlation, Significance test for correlation coefficients. Regression analysis.

UNIT-V

Analysis of variance: one way and two way classification. Data analysis with comprehensive statistical software using Statistical Package for the Social Sciences (SPSS).

TEXT BOOKS

S.NO	AUTHORS	TITLE	PUBLISHERS	YEAR OF PUBLICATION
1	Arora, P. N. and P. K. Malhan	Biostatistics	Himalaya Publishing House, Mumbai	1996
2	Gurumani, N	Introduction to Biostatistics	M.J.P. Publishers, Delhi,	2005
3	Das, D. and A. Das	Academic Statistics in Biology and Psychology.	Academic Publisher, Kolkata,	2004
4	Palanichamy, S. and Manoharan, M	Statistical Methods for Biologists	PalaniParamount Publications, Tamil Nadu	1990

REFERENCE BOOKS

S.NO	AUTHORS	TITLE	PUBLISHERS	YEAR OF PUBLICATION
1	Bailey, N. T. J	Statistical Methods in Biology (Third Edition)	Cambridge University Press, Cambridge	1994
2	Wayne Daniel. W.	Biostatistics:A Foundation for Analysis in the Health Sciences	John Wiley & Sons Inc, USA	1995
3	Snedecor, G. W. and W. G. Cochran	Statistical Methods (Sixth Edition)	Oxford& IBH Publishing Co., New Delhi	1967
4	Pagano, M. and K. Gauvreau	Principles of Biostatistics (Second Edition)	Cengage Learning, New Delhi	2008

WEB SOURCES:

www.sciencedirect.com

www.livescience.com

Wikipedia.org

www.journals.elsevier.com

SEMESTER II
CELLULAR AND MOLECULAR BIOLOGY

Semester	Subject Code	Category	Lecture		Theory		Practical	Credits
			Hrs/week	Total Hours/Semester	Hrs/week	Total Hours/Semester		
II	24CPZO2A	CORE-IV	6	75	6	75	Nil	5

COURSE OBJECTIVES:

The main objectives of this course are:

1.	To understand the ultrastructures and functions of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.
2.	To realize involvement of various cellular components in accomplishing cell division.
3.	To enable a successful performance in cell biology component of CSIR-UGC NET.
4.	To understand the ultrastructures and functions of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.

COURSE OUTCOMES:

On the successful completion of the course, students will be able to:

CO Number	CO Statement	Knowledge Level (K1-K4)
CO1	Understand the general concepts of cell and molecular biology.	K2
CO2	Visualize the basic molecular processes in prokaryotic and eukaryotic cells, especially relevance of molecular and cellular structures influencing functional features.	K1 & K2
CO3	Perceive the importance of physical and chemical signals at the molecular level resulting in modulation of response of cellular responses.	K3 & K4

CO4	Updated the knowledge on the rapid advances in cell and molecular biology for a better understanding of onset of various diseases including cancer.	K5
CO5	Understand the general concepts of cell and molecular biology.	K2

K1-Remember ; K2 –Understand ; K3 – Apply ; K4 – Analyze:K5-Evaluate; K6- Create

Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	L	L	S	S	S	M	M	M
CO2	M	M	M	S	S	S	S	M	S	M
CO3	S	S	S	M	M	S	M	M	L	S
CO4	M	M	S	L	S	S	L	M	S	S
CO5	S	M	M	S	S	S	S	M	S	S

*S - Strong; M - Medium; L - Low

DISTRIBUTION OF MARKS: THEORY 100%

UNIT-I

General features of the cell: Basic structure of prokaryotic and eukaryotic cells , Protoplasm and deutoplasm, cell theory.

UNIT-II

Cellular organization: Membrane structure and functions – Different models of membrane structure, lipid bilayer and membrane proteins - diffusion, osmosis, active transport, mechanism and regulation of intracellular transport, Structure and functions of Intracellular organelles: Nucleus, Mitochondria, Golgi bodies, lysosomes and Endoplasmic reticulum.

UNIT-III

Cell division and Cell cycle: Mitosis and meiosis, their regulation, Phases of cell cycle and control of cell cycle. Molecular biology of cell: Structure of DNA and RNA; Process of DNA replication, transcription and translation in prokaryotic and eukaryotic cells; Genetic maps.

UNIT-IV

Cell communication and cell signaling: Membrane- associated receptors for peptide and steroid hormones. Cellular Interactions-General principles of cell communication: extracellular space and matrix, interaction of cells with other cells and non-cellular structures.

UNIT-V

Cancer cells: Characteristic features of normal and cancer cells; Carcinogens: types and cancer induction; Metastasis; Oncogenes and tumor suppressor genes, apoptosis; therapeutic interventions of uncontrolled cell growth.

TEXT BOOKS

S.NO	AUTHORS	TITLE	PUBLISHERS	YEAR OF PUBLICATION
1.	De Robertis. E.D.F. and De Robertis. E.M.F.	Cells and Molecular Biology	B.I Publications Pvt Ltd, India.	2001
2.	Lewin. B.	Genes VII	Oxford University Press, New York.	2000
3.	Shanmugam, G.	A laboratory manipulation in fish	Madurai Kamaraj University	1988
4.	De Witt	An evolutionary approach. Biology of the cell.	Saunders Company	1977
5.	Karp, G.	Cell Biology	McGraw Hill Ltd., Japan.	1979

REFERENCE BOOKS

S.NO	AUTHORS	TITLE	PUBLISHERS	YEAR OF PUBLICATION
1.	Howland J.L.	Cell Physiology	McMillan Publishing Co., New York	1973
2.	Avers. C.J.	Cell Biology	Van Nostrand Company, New York	1976
3.	Korenberg. A	DNA Replication	Dorothy- W.H. Freeman and Company, San Francisco	1974
4.	Hawkins, J.D	Gene Structure and Expression	Cambridge University Press, London.	1996
5.	Albert, B and Watson. J.D.	Molecular Biology of the cell.	Garland Publishing, London.	1990

DEVELOPMENTAL BIOLOGY

Semester	Subject Code	Category	Lecture		Theory		Practical	Credits
			Hrs/week	Total Hours/Semester	Hrs/week	Total Hours/Semester		
II	24CPZO2B	CORE-V	6	75	6	75	Nil	5

COURSE OBJECTIVES

The main objectives of this course are:	
1.	Understand the process of gametogenesis, cleavage and gastrulation, embryonic development, extra embryonic membrane and placenta in various animals and human.
2.	Learn the principles, methods and applications of cryo-preservation of gametes and embryo.

COURSE OUT COMES

On the successful completion of the course, students will be able to:

CO Number	CO Statement	Knowledge Level (K1-K4)
CO1	Define the concepts of embryonic development	K1
CO2	Observe various stages of cell divisions under microscope	K2 & K3
CO3	Understand the formation of zygote	K4
CO4	Differentiate the blastula and gastrula stages	K4 & K5
CO5	Learn the distinguishing features of three different germ layers and formation of various tissues and organs	K4

K1-Remember ; K2 –Understand ; K3 – Apply ; K4 – Analyze:K5-Evaluate; K6- Create

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	L	S	M	L	M
CO2	S	S	S	S	S	L	S	S	S	S
CO3	S	M	S	S	S	S	S	L	L	M
CO4	S	S	S	S	S	M	S	S	S	L
CO5	S	S	S	M	S	S	S	L	L	M

S-Strong; M-Medium; L – Low

DISTRIBUTION OF MARKS: THEORY 100%

UNIT-I

Gametogenesis: Origin of germ cells, spermatogenesis - Sperm morphology in relation to the type of fertilization, Oogenesis - Oogenesis in insects and amphibians.

UNIT-II

Fertilization: Mechanism- Sperm aggregation, Sperm activation, Chemotaxis, Sperm maturation in mammals, Acrosome reaction. Sperm-egg interaction. Sperm entry into the egg - Egg activation - Intracellular calcium release - Cortical reaction - Physiological polyspermy - Fusion of male and female pronuclei - Post fertilization metabolic activation – Parthenogenesis- Natural and Artificial

UNIT-III

Cleavage and gastrulation: Pattern and planes of cleavage, mechanisms of cleavage, Factors affecting cleavage. mechanisms and types of gastrulation in respective animal embryos (Amphibian and Chick); Fate maps - (Amphibian and Chick) - Determinate and regulatory embryos.

UNIT-IV

Embryonic Development; Embryonic development of frog, formation of extra embryonic membranes in mammals – Organogenesis - Development of endodermal, mesodermal and ectodermal derivatives. Embryonic Induction, primary and secondary neurulation.

UNIT-V

Post embryonic development - metamorphosis: Endocrine control of metamorphosis in insects- Endocrine control of moulting and growth in insects .

Regeneration: Formation of ectodermal cap and regeneration blastema – Types of regeneration in planaria, Regenerative ability in different animal groups.

Aging and senescences: Biology of senescences- cause of aging- mechanism involved in apoptosis. Endocrine changes associated with normal pregnancy.

TEXT BOOKS

S.NO	AUTHORS	TITLE	PUBLISHERS	YEAR OF PUBLICATION
1.	Gilbert, B. F	Developmental Biology, VIII Ed	Sinaur Associates Inc. Publishers, Sunderland, Massachusetts USA	2006
2.	Balinsky, B.I	Introduction to Embryology. V Ed	Saunders, Toppan	1981
3.	Lewis Wolpert	Principles of Development. II Ed	Oxford University Press	2002
4.	Nakamura, O., & Sulo, J	Organizer, A milestone of a HalfCentury from Spemann	Elsevier/North Holland Biomedical Press	1978

5.	VasundaraRao	Developmental Biology - A Modern Synthesis	Oxford IBH, New Delhi.	1994
6.	Russo, V.E.A., Brody, S., Cove, D and Ottolenghi, S	Development. The Molecular Genetic Approach	Springer Verlag, Berlin	1992
7.	N.Arumugam	A Text book of Developmental Biology	Saras publication	2014

REFERENCE BOOKS

S.NO	AUTHORS	TITLE	PUBLISHERS	YEAR OF PUBLICATION
1.	Dr. Subramanian A.	Development biology	Springer	2012
2.	A.K. Rathoure	Understanding embryological origins	Brillion publishers	2017
3.	K.S. Madhavan	Developmental biology	Wave books publishers	2017
4.	Manuel mari	Beffa kay experiment in practical development biology	Cambridge university press	2005
5.	Oppenheimer, S.B	Introduction to Embryonic Development	Allyn and Bacon, Inc. U.S.A.	1980

WEB SOURCES:

www.sciencedirect.com

www.pubmed.com

www.livescience.com

Wikipedia.org

www.journals.elsevier.com

LAB COURSE IN CELL BIOLOGY AND DEVELOPMENTAL BIOLOGY

Semester	Subject Code	Category	Practical		Theory	Practical	Credits
			Hrs/week	Total Hours/Semester			
II	24CPZO22	Lab course-II	4	60	Nil	60	4

COURSE OBJECTIVES

The main objectives of this course are:

- 1.To understand the developmental stages of frog.
- 2.To analyse the C.S of heart ,kidney lens ,limb of chick and uterine cycles in rat.
- 3.To observe and identification of microorganisms in pond water.
- 4.To understand the bacterial staining methods and identification of parasitic protozoans.
- 5.To analyse the preparation techniques of culture medium for bacterial growth.

COURSE OUTCOMES

On the successful completion of the course, students will be able to:

CO Number	CO Statement	Knowledge Level (K1-K4)
CO1	Acquire knowledge to differentiate the cells of various living organisms and become aware of physiological processes of cells e.g. cell divisions, various stages of fertilization and embryodevelopment.	K2
CO2	Understand and observe as well as correctly identify different cell types, cellular structures using different microscopic techniques.	K3
CO3	Develop handling - skills through the wet-lab course.	K6
CO4	Learn the method of culturing of <i>Drosophila</i> and identification of their wild and mutant strains	K1 & K2
CO5	Acquire skills to perform human karyotyping and chromosomemapping to identify abnormalities	K1 & K2

K1-Remember ; K2 –Understand ; K3 – Apply ; K4 – Analyze
K5 - Evaluate; K6 – Create

Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	S	S	S	L	L	M
CO2	S	S	S	S	S	M	M	M	M	M
CO3	S	S	M	S	S	L	S	M	L	M
CO4	M	M	L	M	L	M	M	S	M	L
CO5	S	S	M	L	S	M	L	S	S	S

*S-Strong; M-Medium; L – Low

CELL BIOLOGY

1. Determination of cell size using micrometer.
2. Mitosis in roots- meristematic cells of plants.
3. Identification of various stages of meiosis in the testes of grasshopper(Demo)
4. Detection of polytene chromosome in salivary gland cells of the larvae of the Chironomus.(Demo).
5. Detection of sex chromatin.(Demo).
6. Isolation of genomic DNA from eukaryotic tissue(Demo).
7. Isolation of total RNA from bacterial cells/tissues(Demo).
8. Agarose gel electrophoresis of DNA (Demo).
9. SDS-Polyacrylamide gel electrophoresis (Demo).

DEVELOPMENTAL BIOLOGY

Gametogenesis - Observation of gametes from gonadal tissue sections (Demo).

Observation of T.S of mammalian ovary and T.S of Mammalian testis.

Observation of egg developmental stages in *Frog*.

Embryogenesis- Observation and whole mount preparation of the chick blastoderm ,
18 hours of development, 24hours of development, 48hours of development,
72hours of development, 96hours of development.

ECONOMIC ENTOMOLOGY

Semester	Subject Code	Category	Lecture		Theory		Practical	Credits
			Hrs/week	Total Hours/Semester	Hrs/week	Total Hours/Semester		
II	24CPZO2C	Discipline Centric Elective-III	4	60	4	60	Nil	3

COURSE OBJECTIVES:

The main objectives of this course are

1. Students should acquire a fairly good understanding about the life of insects and their classification.

COURSE OUTCOMES:

On the successful completion of the course, students will be able to:

CO Number	CO Statement	Knowledge Level (K1-K4)
CO1	Understand taxonomy, classification and life of insects in the animal kingdom.	K1 & K2
CO2	Know the life cycle, rearing and management of diseases of beneficial insects.	K2 & K3
CO3	Know the type of harmful insects, life cycle, damage potential and management of pests including natural pest control	K2 & K3
CO4	Recognize insects which act as vectors causing diseases in animals and human.	K2 & K4
CO5	Overall understanding on the importance of insects in human life.	K2 & K6

Knowledge Level : K1-Remember ; K2 –Understand ; K3 – Apply ; K4 – Analyze

K5 - Evaluate; K6 -Create

Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	M	S	M	M	M	S	L	M
CO2	S	S	M	S	S	S	S	S	S	L
CO3	S	M	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	M	S	M	M
CO5	S	S	S	M	M	S	M	L	S	M

*S - Strong; M - Medium; L-Low

DISTRIBUTION OF MARKS: THEORY 100%

UNIT-1

Overview of Insects and Insect taxonomy: Insects and their biological success - Man and insects; Basic concepts in Insect Taxonomy and classification.

UNIT-II

Beneficial insects: Silkworms - types, life history, disease management and rearing methods - Types of honey bees, life history, social organization (colonies and caste system), honey bee care and management of bee hive - Lac insects-life history, lac cultivation; Pollinators, predators, parasitoids, scavengers, weed killers, soil-builders.

UNIT-III

Destructive insects: Insect pests - definition - Categories of pests - Types of damage to plants by insects - Causes of pest outbreak - Economic threshold level - Biology of the insect pests - Pests of paddy, cotton, sugarcane, vegetables, coconut and stored grains cereals.

UNIT-IV

Pest management/Control strategies: Methods and principles of pest control - Natural control, Artificial control, Merits and demerits or limitations of these methods in pest control - Integrated pest management .

UNIT-V

Vector biology: Vectors of veterinary and public health importance - Mosquitoes as potential vectors of human diseases-control measures

TEXT BOOKS

S.NO	AUTHORS	TITLE	PUBLISHERS	YEAR OF PUBLICATION
1.	William S. Romoser and John G. Stoffolano.W.	The Science of Entomology	C.Brown Publishers, England	1994
2.	Yataro Tazima, Kodarsha	The silkworm	Scientific Book Ltd., Japan	1978
3.	Ananthkrishnan, T.N	Insect Plant Interactions	Oxford and I.B.H, New Delhi.	2002
4.	P.G.Fenemore, Alkaprakash	Applied Entomology	Wiley Eastern Ltd., Delhi	1992
5.	Nayar, K.K., Ananthkrishnan, T.N. and B.V.David	General and Applied Entomology	Tata McGraw Hill Publications, New Delhi.	1989
6.	Larry P.Pedigo	Entomology and Pest Management	Prentice Hall, New Jersey.	1989
7.	Richards, O.W. and Davies, R.G	General Text Book of Entomology Tenth Edition. Vol I and II	R.I Publications, New Delhi.	1997

REFERENCE BOOKS

S.NO	AUTHORS	TITLE	PUBLISHERS	YEAR OF PUBLICATION
1.	T.V. Prasad	Hand Book Of Entamoly Third Edition	New Vishal Publication	2014
2.	D.S.Reddy	Applied Entamoly New Revised Edition	New Vishal Publication	2010
3.	David B.V., Muralirangan M.C. And Meera Murali Rangan	Harmful And Beneficial Insects.	Popular Book Depot, Chennai	1992
4.	Ramakrishna Ayyar T.V	Handbook Of Economic Entomology For South India.	Books And Periodicals Supply Service, New Delhi	1989
5.	Frost S.W	General Entomology	Narendra Publishing House, Delhi	1994

RESEARCH METHODOLOGY

Semester	Subject Code	Category	Lecture		Theory		Practical	Credits
			Hrs/week	Total Hours/Semester	Hrs/week	Total Hours/Semester		
II	24CPZO2D	Generic Elective-IV	4	60	4	60	Nil	3

COURSE OBJECTIVES

- To acquire the knowledge of the Chromatography, spectroscopy
- To understand the Preparation of manuscripts and collection of data.
- To imbibe the knowledge and analysis of statistical data

.COURSE OUTCOMES:

On the successful completion of the course, students will be able to:

CO Number	CO Statement	Knowledge Level (K1-K4)
CO1	Understand the Objectives and Types of Research	K1
CO2	It also helps to acquire knowledge on the preparation of research manuscripts etc	K2
CO3	Gain the Knowledge on Research reports and IPR	K2 & K4
CO4	Gain the knowledge on techniques of histology and histochemistry , Learn the working principles of different instruments	K3 & K5
CO5	Learn the working principles of different instruments and to understand the knowledge in Bioinformatics .	

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**- Create

Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	M	S	M	S	M	S	M	M
CO2	S	S	M	S	S	S	M	M	M	S
CO3	S	M	S	S	S	S	S	S	S	L
CO4	S	S	S	S	S	M	S	S	S	M
CO5	S	S	S	M	M	S	M	L	S	M

*S-Strong; M-Medium; L-Low

DISTRIBUTION OF MARKS: THEORY 100%

UNIT-I CONCEPTS OF RESEARCH

Meaning, Objectives, Motivation and Approaches, Types of Research (Descriptive / Analytical, Applied / Fundamental, Quantitative / Qualitative, Conceptual / Empirical, Research Methodology). Research methods Vs Research Methodology.

Research Design- Definition-Characteristics and Types of research design.

UNIT-II RESEARCH FORMULATION

Observation and Facts, Prediction and explanation, Induction, Deduction. Defining and formulating the research problem, Selecting the problem and necessity of defining the problem.

Literature review - Importance of literature reviewing in defining a problem, Critical literature review, Identifying gap areas from literature review, Hypothesis - Null and alternate hypothesis and testing of hypothesis.

UNIT-III RESEARCH REPORTS AND IPR

Effective technical writing of a report, research paper and review paper. Preparation of a Research Proposal, Format of research proposal, a presentation and assessment by a review committee. Academic Writing Tools and Research Software.

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development .International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT-IV

Databases and Research metrics

Indexing database and citation databases. Research metrics: Impact of journal as per journal citation report, SNIP, SJR, Cite score B, Research Metrics: h- index, i10 index and alt metrics.

UNIT –V

Morphological/Chemical techniques – Chemical method – physical method –biological method - fixation, embedding, sectioning and staining.Principles and Applications of tracer techniques in biology, Animal cell culture techniques.

Bioinformatics:Scope and objectives – components – data, databases – Database mining tools – Application in biological sciences.

TEXT BOOKS

S.NO	AUTHORS	TITLE	PUBLISHERS	YEAR OF PUBLICATION
1.	Bailey, N.T. J	Statistical Method in Biology	The English Language book society and English University Press Ltd	1959
2.	Ipsen, J. and Feigl, P	Bancroft's Introduction to Biostatistics	Harper and Row Publishers, New York, London.	1970
3.	Snedecor, G. W. & William, G.	Statistical methods	Harvard University, Oxford & IBH Publication Co., Calcutta. Bombay, New Delhi	1975
4.	Sokal, R, and James, F.R.	Introduction to Bio-statistics	W.H. Freeman & Company, Toppan company, Ltd., Tokyo, Japan.	1973
5.	Anderson, Durston and Polle.	Thesis and Assignment writing	Wiley Eastern Ltd., New Delhi.	1970
6.	Comir and Peter Wood Ford	Writing scientific papers in English	Pitman Medical Publishing Co., London.	1979
7.	Palanichamy, S. and M. Shanmugavelu	Research methods in biological sciences	Palani Paramount Publications, TamilNadu, India.	1997

REFERENCE BOOKS

S.NO	AUTHORS	TITLE	PUBLISHERS	YEAR OF PUBLICATION
1.	Deepak Chawla, Neena Sondhi	Concepts and Cares	2 nd Edition Vikas Publications	2017
2.	Dr. Vijay & Shende Arvind	Research Methodology	S. Chand Publications	2010
3.	Pranab Kumar Banerjee	A Textbook of Biometry	S. Chand Publication	2007
4.	Orlando Wayne	A Step By Step Approach	Kindle Editions Publications	2017

		To Biostatistics		
5.	Day, R.A	How to write and publish a scientific paper	Cambridge University Press, London.	1994

POULTRY FARMING

Semester	Subject Code	Category	Lecture		Theory		Practical	Credits
			Hrs/week	Total Hours/Semester	Hrs/week	Total Hours/Semester		
II	24SPZO2A	Skill Enhancement I	4		4		Nil	2

COURSE OBJECTIVES

1. To understand the poultry industry based on the past , present and emphasis of future growth To study the statistical data and various functions involved in poultry industry.

COURSE OUT COMES

On the successful completion of the course, students will be able to:

CO Number	CO Statement	Knowledge Level (K1-K4)
CO1	To understand the various practices in Poultry farming. To know the needs for Poultry farming and the status of India in global market.	K2 & K3
CO2	To be able to apply the techniques and practices needed or Poultry farming.	K1, K2 & K3
CO3	To know the difficulties in Poultry farming and be able to propose plans against it.	K5 & K6

K1- Remember; **K2-** Understand; **K3-** Apply; **K4-**Analyze; **K5-**Evaluate; **K6-** Create

Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	L	L	L	L	L	S	S	L	L
CO2	S	L	M	M	S	M	M	M	S	S
CO3	S	M	M	M	S	S	S	S	M	M
CO4	S	S	S	L	S	S	S	S	S	S
CO5	S	S	M	S	S	S	M	L	S	M

*S - Strong; M - Medium; L – Low

DISTRIBUTION OF MARKS: THEORY 100%

UNIT-I

General introduction to poultry farming - Definition of Poultry - Past and present scenario of poultry industry in India - Principles of poultry housing - Poultry houses - Systems of poultry farming .

UNIT-II

Management of chicks - growers and layers - Management of Broilers. - Preparation of project report for banking and insurance.

UNIT-III

Poultry feed management-Principles of feeding, Nutrient requirements for different stages of layers and broilers - Feed formulation and Methods of feeding.

UNIT-IV

Poultry diseases-viral, bacterial, fungal and parasitic (two each); symptoms, control and management; Vaccination programme.

UNIT-V

Selection, care and handling of hatching eggs - Egg testing. Methods of hatching.- Brooding and rearing -. Sexing of chicks. - Farm and Water Hygiene - Recycling of poultry waste.

TEXT BOOKS:

S.NO	AUTHORS	TITLE	PUBLISHERS	YEAR OF PUBLICATION
1	Arumugam, N., Murugan, S., Johnson. and Ram Prabhu, R.	Applied Zoology	Saras Publication, Kanyakumari	2005
2	Isabel Guerrero and Legarreta	Hand Book of Poultry Science and Technology	John Wiley and Sons, New Jersey.	2010
3	Jawaid, A. and Sinha, S. P.	A Handbook of Economic Zoology	S. Chand & Company, New Delhi.	2008
4	Jabde and Pradip V	Text Book of Applied Zoology	Discovery Publishing House, Delhi	2005
5	Upadhya, V.B	Economic Zoology.	Rastogi Publications, Meerut, India.	2006

REFERENCE BOOKS:

S.NO	AUTHORS	TITLE	PUBLISHERS	YEAR OF PUBLICATION
1.	Bell D.Donald and weaver D.William.Jr.	Commercial chicken meat and egg.Production	Springer,India Pvt Ltd.,Noida.	2007
2.	Prakash Malhotra	Economic Zoology	Adhyayna Publishers & Distributors, New Delhi.	2008
3.	Khan, A. A.	Encyclopedia of Economic Zoology. 2 vols	Anmol Publications Pvt. Ltd., New Delhi.	2007
4.	Scott, M.L., Nesheim, M.C. and Young, R.J.	Nutrition of the Chicken. 3rd ed.	Ithaca, New York.	1982
5.	Biester, H.E. and Schwarte, L.H.	Diseases of Poultry, 5th Edn	Oxford and IBH Publishing Co, New Delhi.	1969

WEB SOURCES:

www.livescience.com

www.sciencemag.com

HUMAN RIGHTS

Semester	Subject Code	Category	Lecture		Theory		Practical	Credits
			Hrs/week	Total Hours/Semester	Hrs/week	Total Hours/Semester		
II	24CPHUR2A	Compulsory Paper	2	20	2	20	Nil	2

COURSE OBJECTIVE

- To enable the students to understand the Definition of Human Rights.
- To make the students to understand the Universal Declaration of Human Rights.

COURSE OUTCOMES

On the successful completion of the course the student will be able to

CO Number	CO Statement	Knowledge Level (K1-K4)
CO1	Highlight the Definition of Human Rights	K3
CO2	State the Role of Universal Declaration of Human Rights	K3
CO3	Explain Human Rights Declarations	K2
CO4	Discuss about the International Human Rights in Domestic Courts.	K2
CO5	Understand about Contemporary Issues on Human Rights	K3

Knowledge Level : K1-Remember ;K2 –Understands ; K3 – Apply ; K4- Analyse

MAPPING WITH PROGRAMME OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	S	M	S	M
CO2	M	S	S	S	M	S
CO3	S	S	S	M	S	M
CO4	M	S	M	S	M	M
CO5	S	M	S	M	S	M

S- Strong; M- Medium; L- Low

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UNIT-I**4 Hours****DEFINITION OF HUMAN RIGHTS**

Definition of Human Rights-Nature, Content, Legitimacy and Priority-Theories on Human Rights- Historical Development of Human Rights.

UNIT-II**4 Hours****UNIVERSAL DECLARATION OF HUMAN RIGHTS**

International Human Rights –Prescription and Enforcement till World War II – Human Rights and the U.N.O.-Universal Declaration of Human Rights-International Covenant on Civil and Political Rights –International Covenant on Economic, Social and Cultural Rights and Optional Protocol.

UNIT-III**4 Hours****HUMAN RIGHTS DECLARATIONS**

Human Rights Declarations –U.N. Human Rights Declarations – U.N. Human Commissioner.

UNIT-IV**4 Hours****INTERNATIONAL HUMAN RIGHTS IN DOMESTIC COURTS.**

Amnesty International –Human Rights and Helsinki Process-Regional Developments-European Human Rights System-African Human Rights System-International Human Rights in Domestic Courts

UNIT-V**4 Hours**

Issues on Human Rights: Children’s Rights-Women’s Rights– Dalit’s Rights-Bonded Labour and Wages-Refugees-Capital Punishment-Fundamental Rights in the Indian Constitution-Directive Principles of State Policy-Fundamental Duties- National Human Rights Commission.

TEXT BOOKS

S.no	Authors	Title	Publishers	Year Of Publication
1	Paul Willams	The International bill of Human Rights	Entwhistle Books	1981
2	Mausice Cranston	What are Human Rights	Bodley Head	1973
3	A.R. Desai	Violation of Democratic rights in India	Popular prakashan	1986

REFERENCE BOOKS

S.no	Authors	Title	Publishers	Year Of Publication
1	Dr.J.N. Pandy	Constitutional law	Central Law Agency	2018
2	J.C. Johari	Human Rights and new World order	Anmol	1996
3	G.S. Bajwa	Human Rights in India	Anmol	1995

WEB SOURCES:

<https://www.ohchr.org>

<https://www.aaas.org>

SELF STUDY PAPER
VERMICULTURE

Semester	Subject Code	Category	Lecture		Theory		Practical	Credits
			Hrs/week	Total Hours/Semester	Hrs/week	Total Hours/Semester		
II	POCZO2SS	Generic Elective - II	5	-	5	-	Nil	3

COURSE OBJECTIVES

Students should be aware of economic and cultural importance of Vermiculture.

COURSE OUTCOME:

On the successful completion of the course, student will be able to:

CO Number	CO Statement	Knowledge Level (K1-K4)
CO1	To understand the various practices in vermiculture. To know the needs for Vermiculture and the status of India in global market.	K2 & K3
CO2	Able to apply the techniques and practices needed for vermiculture.	K1, K2 & K4
CO3	To know the difficulties in Vermiculture and be able to propose plans against it.	K5 & K6

K1- Remember; K2- Understand; K3- Apply; K4-Analyze; K5-Evaluate; K6- Create

Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	M	L	L	L	L	S	L	L	L
CO2	L	S	S	S	S	S	L	S	S	S
CO3	M	S	S	S	S	S	L	S	S	L
CO4	L	S	S	S	M	S	M	S	S	M
CO5	S	S	M	S	L	L	L	M	L	M

*S - Strong; M - Medium; L- Low

DISTRIBUTION OF MARKS: THEORY 100%

UNIT-I

Earthworms – Classification of Earthworm, external features - shape, size, colour, segmentation, setae & clitellum. Body wall, coelom- locomotion, digestive, circulatory, respiratory, excretory & nervous system. Reproductive system-Male & Female, copulation, cocoon formation & fertilization, development of earth worm. Vermitechnology- Definition, history, growth and development in other countries & India, significance.

UNIT-II

Vermiculture - definition, common species for culture; Environmental parameters; culture methods – wormery - breeding techniques; indoor and outdoor cultures - monoculture and polyculture - merits and demerits.

UNIT-III

Vermicomposting of wastes in field pits, ground heaps, tank method, roof shed method, static pile windrows, top fed windrows, wedges & bin method, harvesting the compost, storage.

UNIT-IV

Applications of vermiculture - Vermiculture Bio-technology, vermicomposting, use of vermicastings in organic farming/horticulture, earthworms for management of municipal/selected biomedical solid wastes; as feed/bait for capture/culture fisheries; forest regeneration.

UNIT-V

Potentials and constraints for vermiculture in India. Marketing the products of vermiculture - quality control, market research, marketing techniques – creating the demand by awareness and demonstration, advertisements, packaging and transport, direct marketing. Economic importance of Earthworms: In sustainable agriculture, organic farming, earthworm activities, soil fertility & texture, soil aeration, water impercolation, decomposition & moisture, bait & food.

TEXT BOOKS

S.NO	AUTHORS	TITLE	PUBLISHERS	YEAR OF PUBLICATION
1	Sultan Ahmed Ismai	The Earthworm Book, Second Revised Edition	Other India Press, Goa, India.	2005
2	Bhatnagar & Patla	Earthworm vermiculture and vermin-composting	Kalyani Publishers, New Delhi	2007
3	Mary Violet Christy	Vermitechnology	MJP Publishers, Chennai.	2008
4	Ismail, S.A.	Vermitechnology	The biology of earthworms, Orient Longman, India.	1997

REFERENCE BOOKS

S.NO	AUTHORS	TITLE	PUBLISHERS	YEAR OF PUBLICATION
1	Sultan Ahmed Ismai	The Earthworm Book, Second Revised Edition	Other India Press, Goa, India.	2005
2	Bhatnagar & Patla	Earthworm vermiculture and vermin-composting	Kalyani Publishers, New Delhi	2007
3	Mary Violet Christy	Vermitechnology	MJP Publishers, Chennai.	2008
4	Aravind Kumar	Verms & Vermitechnology	A.P.H. Publishing Corporation, New Delhi.	2005

SEMESTER –III
CORE-VII-GENETICS

Semester	Subject Code	Category	Lecture		Theory		Practical	Credits
			Hrs/week	Total Hours/Semester	Hrs/week	Total Hours/Semester		
III		Core-VII	6	75	6	75	NIL	5

Course Objectives:

The main objectives of this course are:

1.	Understanding DNA as genetic material, fine structure of DNA & RNA molecules, as well as physico-chemical properties of macromolecules.
2.	Gain insight into sequential events occurs during protein synthesis.
3.	Learn the structure and function of chromosome and chromosomal basis of genetic disorders.
4.	To acquire knowledge about microbial genetics
5.	To provide information about rDNA technology and its application.

Course I : **Core VII**

Course title : **Genetics**

Credits : **4**

Pre-requisite:

Basic knowledge on molecular biology and genetics

Expected Course Outcome:

On the successful completion of the course, student will be able to

1.	Explain the organization and functions of genetic material in the living system.	K1 & K2
2.	Understand various sequential processes in protein synthesis	K1 & K2
3.	Explicate the structures and functions of chromosomes and identify the diseases caused by the chromosomal abnormalities.	K2 & K4
4.	Able to distinguish lytic and lysogenic cycle and explain the mechanisms of genetic recombination of the microbes.	K2 & K5
5.	Understand the principle and application of rDNA technology for the welfare of human being.	K2 & K3

K1- Remember; **K2-** Understand; **K3-** Apply; **K4-**Analyze; **K5-**Evaluate; **K6-** Create

Units

I	Structure, properties and functions of genetic materials: DNA as the genetic Materials - Basic structure of DNA and RNA, alternate and unusual forms of DNA - Physical and Chemical properties of nucleic acid, base properties,
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	denaturation and renaturation, T _m and cot values, hybridization.
II	Genetic code - Methods of deciphering the genetic code and general features of the code word dictionary. Chromosomal genetics: Molecular structure of chromosomes - Variation in chromosome number and structure - Chromosome nomenclature - Chromosomal syndromes.
III	Microbial Genetics: Genetics of Virus - Viral chromosome, Lytic cycle, Lysogenic cycle - Bacterial genetics -Bacterial genome - Gene transfer mechanisms in bacteria and virus - conjugation, transduction and transformation
IV	Recombinant DNA technology: Recombinant DNA technology - Overview - Tools for Recombinant DNA Technology – Vectors - types - Techniques used in recombinant DNA technology - generation of DNA fragments - Restriction endonucleases, DNA modifying enzymes, Ligases
V	Introduction of rDNA into host cell - calcium chloride mediated gene transfer - <i>Agrobacterium</i> mediated DNA transfer, electroporation, microinjection, liposome fusion, particle gun bombardment - Selection and screening of transformed cells - Expression of cloned gene; Application of rDNA technology in human welfare - Environment, Medicine and Agriculture

Reading list

1. Gardner, E. J., M. J. Simmons and D.P. Snustad. 2006. Principles of Genetics. 8th Edition, John Wiley & Sons. INC. New York, pp-740.
2. Brooker, R. J. 2014. Genetics: Analysis and Principles. 5th Edition, McGraw Hill Publisher, pp-880.
3. Russell, P.J. 2005. Genetics: A Molecular Approach (2nd Edition). Pearson/Benjamin Cummings, San Francisco, pp-850.
4. https://onlinecourses.swayam2.ac.in/cec21_bt02/preview
5. <https://www.khanacademy.org/science/high-school-biology/hs-molecular-genetics/hs-rna-and-protein-synthesis/a/the-genetic-code>

Recommended texts

1. Griffiths, A. J. F., H. J. Muller, D. T. Suzuki, R. C. Lewontin and W. M. Gelbart. 2012. An Introduction to Genetic Analysis. 11th Edition, W. H. Greeman. New York.
2. Snustad, D.P., Simmons, M.J. 2015. Principles of Genetics, John Wiley Publications, pp-784.
3. Watson, J. D., T. A. Baker, S. P. Bell, Alexander Gann, Michael Levine, Richard Losick. 2003. Molecular Biology of the Gene, (5th Edition). Cold Spring Harbor Laboratory Press, pp-912.
4. Krebs, J. E., E.S. Goldstein, S.T. Kilpatrick. 2018. Lewin's Genes XII, Jones & Bartlet Publisher, pp-613.
5. Watson, J. D., T. A. Baker S. P. Bell, A. Cann, M. Levine and R. Losick, 2014. Molecular Biology of Gene 7th Edition, Pearson Education RH Ltd. India

*S - Strong; M - Medium; L - Low

Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	L	L	S	S	S	L	M	S
CO2	S	M	M	M	S	M	M	M	L	S
CO3	M	S	L	L	M	S	M	L	S	L
CO4	S	M	S	M	M	S	S	S	S	S
CO5	S	S	S	M	E	S	M	S	M	M

EVOLUTION-CORE-VIII

Semester	Subject Code	Category	Lecture		Theory		Practical	Credits
			Hrs/week	Total Hours/Semester	Hrs/week	Total Hours/Semester		
III		Core-VIII	6	75	6	75	NIL	5

Course Objectives:		
The main objectives of this course are:		
1.	To critically analyze the concepts of evolution in order to	
2.	Understand the factors responsible for origin and generation of diversity among living beings and	
3.	To develop strategies for sustenance of life on this planet	
4.	To critically analyze the concepts of evolution in order to	
Course I	:	Core VIII
Course title	:	Evolution
Credits	:	4
Pre-requisite:		
Students shall have basic knowledge on the diversity of animals, biology including morphological, anatomical, physiological and embryological features of various phyla and their environment.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to		
1.	To understand the concept of evolution. It provides a comprehensive account of evidences to support concept of evolution and different theories for exploring the mechanism of evolution.	K1 & K3
2.	Study the origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.	K1 & K2
3.	Understand the major events in the evolutionary time scale; Origins of unicellular and multi-cellular organisms.	K2 & K3
4.	Comprehend the origin of new genes and proteins; Gene duplication and divergence.	K2 & K4
5.	Appreciate the concepts and rate of change in gene frequency through natural selection, migration and random genetic drift	K4 & K5

K1- Remember; **K2-** Understand; **K3-** Apply; **K4-**Analyze; **K5-**Evaluate; **K6-** Create

Units	
I	Emergence of evolutionary thoughts: Lamarck and Darwin – concepts of variation, adaptation, struggle, fitness and natural selection – Mendelism - Spontaneity of mutations - The evolutionary synthesis
II	Origin of cells and unicellular evolution: Origin of basic biological molecules - Abiotic synthesis of organic monomers and polymers - Concept of Oparin and Haldane - Experiment of Miller (1953) - The first cell - Evolution of prokaryotes - Origin of eukaryotic cells - Evolution of unicellular eukaryotes - Anaerobic metabolism, and aerobic metabolism.
III	Paleontology and evolutionary history: The evolutionary time scale - Eras, periods and epoch - Major events in the evolutionary time scale - Origins of unicellular and multi cellular organisms - Stages in primitive evolution including <i>Homo sapiens</i>
IV	Molecular evolution: Molecular divergence - Molecular tools in phylogeny, classification and identification - Protein and nucleotide sequence analysis - Origin of new genes and proteins - Gene duplication and divergence
V	The mechanisms: Population genetics - Populations, Gene pool, Gene frequency - Hardy-Weinberg Law - concepts and rate of change in gene frequency through natural selection, migration and random genetic drift- Adaptive radiation - Isolating mechanisms – Speciation - Allopatricity and Sympatricity - Convergent evolution - Sexual selection - Co-evolution - Altruism and evolution
Reading list	
<ol style="list-style-type: none"> 1. Bergstrom, C. T. and L. A. Dugatkin. 2012. Evolution, Second MEDIA Edition. W.W. Norton & Company, International Student Edition, pp-756. 2. Jobling, M., E. Hollox, M. Hurles, T. Kivisild and C. T. Tyler Smith. 2014. Human Evolutionary Genetics. Second Edition. Garland Sciences, London, pp-650. 3. Veer Bala Rostogi, 2018. Organic Evolution (Evolutionary Biology), Thirteenth Edition Vinoth Kumar Jain, Scientific International (Pvt.) Ltd, New Delhi, pp-590. 4. https://www.flipkart.com/books/evolution~contributor/pr?sid=bks 5. http://www.evolution-textbook.org/ 6. https://onlinelibrary.wiley.com/journal/15585646 7. http://darwin-online.org.uk/ 	
Recommended texts	
<ol style="list-style-type: none"> 1. Strickberger. M. W. 2000. Evolution. Third Edition, Jones Bartlett Publishers, pp-722. 2. Hall B. K. and B. Hallgrimsson. 2014. Strickberger’s Evolution. Fifth Edition, Bartlett Learning, An Ascend Learning Company, pp-642. 3. Barton, N.H., D. Briggs, J.A. Eisen David, D.B. Goldstein and N.H. Patel. 2007. Evolution. Cold Spring Harbor Laboratory Press, pp-833. 	

Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	M	S	M	L	S	M	L	M
CO2	S	S	L	S	S	L	S	S	S	S
CO3	S	M	S	S	S	S	S	L	L	M
CO4	S	S	S	S	S	M	S	S	S	L
CO5	S	S	S	M	M	S	S	L	L	M

*S - Strong; M - Medium; L – Low

ANIMAL PHYSIOLOGY- CORE IX

Semester	Subject Code	Category	Lecture		Theory		Practical	Credits
			Hrs/week	Total Hours/Semester	Hrs/week	Total Hours/Semester		
III		Core IX	6	75	6	75	NIL	5

Course Objectives:		
The main objectives of this course are:		
1.	Students acquire the basic knowledge on physiology of different organs in animals and human.	
2.	Understand the functions of different systems such as digestion, excretion, blood circulatory system, respiration and nervous system of animal relating them to structure and functions of various organs.	
Course I	:	Core IX
Course title	:	Animal Physiology
Credits	:	5
Pre-requisite:		
Students should know the fundamentals of structure and functions of organs and organ systems of animals.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to		
1.	Understand the functions of different systems of animals	K1
2.	Learn the comparative anatomy of heart structure and functions	K2
3.	Know the transport and exchange of gases, neural and chemical regulation of respiration	K2 & K4
4.	Acquire knowledge on the organization and structure of central and peripheral nervous systems	K3 & K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Units	
I	Blood and circulation: Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis. Cardiovascular system : Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above
II	Respiratory system: Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural

	and chemical regulation of respiration
III	Nervous system: Neurons, action potential, gross neuro-anatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. Sense organs: Vision, hearing and tactile response
IV	Digestive system: Digestion, absorption, energy balance, BMR. Excretory system: Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance
V	Endocrinology and reproduction: Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation, neuroendocrine regulation. Thermoregulation: Comfort zone, body temperature- physical, chemical, neural regulation, acclimatization: Stress and adaptation

Reading list

1. Prosser C. L. 1991, Comparative Animal Physiology. Part A: Environmental and Metabolic Animal Physiology. Wiley-Liss Publishers, pp-592
2. Hoar, S.W. 1983, General and Comparative Physiology, Prentice Hall Publication, pp-928.
3. Randall, D., W. Burggren, K. French and R. Eckert. 2001, Animal Physiology Mechanisms and Adaptations, New York : W.H. Freeman and Co., pp-
4. Nelson K. S. 1997. Animal Physiology: Adaptation and Environment, Cambridge University Press, pp- 617.
5. Dantzler, W.H. 1997. Comparative Physiology (Handbook of Physiology), Volumes I and II. Edited by William H. Dantzler. pp - 1824 Published for the American Physiological Society by Oxford University Press Inc., New York. Oxford University Press Canada, Toronto.
6. https://swayam.gov.in/nd1_noc20_bt42/preview
7. <https://www.classcentral.com/course/swayam-animal-physiology-12894>
8. https://swayam.gov.in/nd1_noc20_hs33/preview

Recommended texts

1. Shepherd, G. M. 1994. Neurobiology, OUP USA Publisher, pp-774.
2. Hainsworth , F.R. 1981. Animal Physiology: Adaptation in function, Addison Wesley Longman Publishers, pp-669.
3. Mcfarland, D. 1999. Animal Behaviour: Psychobiology, Ethology and Evolution, Longman Publisher, pp-592.
4. Gorden, M.S. *et al.*, 1977. Animal Physiology: Principles and Adaptation, New York, Third Edition.
5. Ahearn, G.A. *et al.*, 1988. Advances in Comparative and Environmental Physiology – 2, Springer Publishers, pp-252.
6. Hill, R.W. 1976. Comparative Physiology of Animals: Environmental Approach, Longman Higher Education Publisher, pp-656.
7. Withers, P.C. 1992. Comparative Animal Physiology, Brooks/Cole Publisher, pp-900.

Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	M	S	M	L	S	M	S	S
CO2	S	S	M	S	S	S	S	M	S	S
CO3	S	M	S	S	S	M	L	S	M	S
CO4	S	S	S	S	S	L	M	S	S	M
CO5	S	S	S	M	M	M	M	L	L	M

*S - Strong; M - Medium; L - Low

LAB COURSE IN ANIMAL PHYSIOLOGY, GENETICS & EVOLUTION

Semester	Subject Code	Category	Practical		Theory	Practical	Credits
			Hrs/week	Total Hours/Semester			
III		Lab course-III	6	60	Nil	60	4

Course Objectives:

The main objectives of this course are:

1.	To provide hands-on training to perform specific lab courses in animal physiology.
2.	Learn the structure and function of chromosome and chromosomal basis of genetic disorders.
3.	To critically analyze the concepts of evolution

Course 1	:	Course - X
Course Title	:	LAB COURSE IN ANIMAL PHYSIOLOGY, GENETICS & EVOLUTION
Credits	:	4

Pre-requisite:

To provide hands-on training to perform specific lab courses in animal physiology.
Learn the structure and function of chromosome and chromosomal basis of genetic disorders.
To critically analyze the concepts of evolution in order to

Expected Course Outcome:

On the successful completion of the course, student will be able to

1.	Understand the functions of different system of animals.	K3 & K4
2.	Explicate the structures and functions of chromosomes and identify the diseases caused by the chromosomal abnormalities.	K2 & K4

3.	To understand the concept of evolution. It provides a comprehensive account of evidences to support concept of evolution and different theories for exploring the mechanism of evolution.	K1 & K3
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K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

COURSE OBJECTIVES:

- To endow practical skills of Animal Physiology, Genetics & evolution in human welfare.

1. COURSE LEARNING OUTCOMES

2. Estimate the respiratory quotient (RQ) in fish with reference to light and temperature.
3. Gain knowledge on osmoregulation.
4. Estimate the proteins, carbohydrates and lipids in the tissues.
5. Estimate the blood urea and cholesterol
6. Prepare the haemin crystals.
7. Explain the principle and application of sphygmomanometer, kymograph, electrophoresis, haemoglobinometer and ESR.
8. Prepare culture medium to culture drosophila and maintenance. Understand of the mechanism of phenotypic expression in Drosophila
9. Acquire knowledge skill development and observation of blood group identification.
10. Prepare buccal smear and identify squamous epithelial cells.
11. Gain genetic knowledge on the observation of specimens and models. Observe the anatomical pattern of forelimbs and hind limbs of different vertebrates and to trace the common ancestry.
12. Identify the fossils/ adaptations in animals.
13. Understand the role of colouration, natural selection and mimicry in evolution

CO/PO/PSO	PSO				
	1	2	3	4	5
CO1	H	H	H	H	L
CO2	H	H	M	M	H
CO3	H	M	H	H	L
CO4	H	H	H	M	M
CO5	H	M	H	M	L

LOW-L, MEDIUM-M, HIGH- H

ANIMAL PHYSIOLOGY

1. Estimation of RQ in Fish with reference to Light and temperature.
2. Salt loss and salt gain in fish
3. Estimation of Proteins, Carbohydrates and Lipids in the tissues of Fish
4. Blood Clotting Time, Bleeding Time, Rouleaux Formation, Preparation of Haemin Crystal.
5. Principle and Application of Sphygmomanometer, Kymograph, Electrophoresis, Haemoglobinometer, ESR.

GENETICS

1. Preparation of culture medium, Culture of *Drosophila*, Methods of maintenance, Sex identification & Identification of four mutants.
2. Identification of blood groups A, B, ABO and Rh.
3. Preparation of buccal smear to identify squamous epithelial cells.
4. Mounting of salivary glands of *Chironomus* larva & analysis of banding pattern.
5. Karyotyping using human metaphase chromosome plates (Giemsa stained). (Demo)
6. Identification of syndromes (Down, Klinefelter and Turner) from Karyotype photographs showing clinical features of each syndrome case.

EVOLUTION (Slides / Specimens / Charts)

1. Observation of forelimbs and hindlimbs of vertebrates (Frog, Calotes, Bird and Mammal) to study the common pattern of pentadactyl limb and common ancestry of Vertebrates.
2. Observation of fossils to study paleontological evidences of evolution.
3. Observation of leaf insects and stick insects in the museum to study adaptation by cryptic colouration and natural selection.
4. Observation of Monarch and Viceroy butterflies to study Batesian mimicry.

Reading list

1. A Practical Manual on Innovative Animal Physiology- R.P Mali (Author), S.K. Afsar (Author)-JUNE 2005
2. Practical Handbook of Veterinary Physiology- *Bhabesh Mili-2024*
3. Veer Bala Rostogi, 2018. Organic Evolution (Evolutionary Biology), Thirteenth Edition Vinoth Kumar Jain, Scientific International (Pvt.) Ltd, New Delhi, pp-590.
4. Watson, J. D., T. A. Baker, S. P. Bell, Alexander Gann, Michael Levine, Richard Losick. 2003. Molecular Biology of the Gene, (5th Edition). Cold Spring Harbor Laboratory Press, pp-912.
5. Klug, W. S. and M. R. Cummings, C. A. Spencer. 2005. Concepts of Genetics, Benjamin - Cummings Publishing Company.

STEM CELL BIOLOGY- GENERIC ELECTIVE-V

Semester	Subject Code	Category	Lecture		Theory		Practical	Credits
			Hrs/week	Total Hours/Semester	Hrs/week	Total Hours/Semester		
III		Generic Elective-V	4	60	4	60	Nil	3

Course Objectives:		
The main objectives of this course are:		
1.	Students should know understand the basics of stem cells	
Course I	:	Elective V
Course title	:	Stem cell biology
Credits	:	3
Pre-requisite:		
Students should understand the basics of stem cells and its applications		
Expected Course Outcome:		
On the successful completion of the course, student will be able to		
I	Understand the basic knowledge of stem cells and their origin	K1 & K2
II	Differentiating the embryonic and adult stem cells	K3 & K4
III	Understand and apply the current stem cell therapies for their research	K5

K1- Remember; **K2-** Understand; **K3-** Apply; **K4-**Analyze; **K5-**Evaluate; **K6-** Create

Units	
I	Introduction to stem cell biology: Stem cell definition, origin and hierarchy, stem cell properties, Identification and Characterization, potency and differentiation, niche of stem cell, overview of different stem cell types (embryonic stem cells, adult stem cells and induced pluripotent stem cells).
II	Embryonic stem (ES) cell: Characterization and properties of ES cells , pluripotency and self-renewal of ES cells; molecular mechanisms regulating pluripotency and maintenance of the stem state, progressive differentiation of ES cells into ectoderm lineage organs (skin, brain and nerve), mesoderm lineage organs (heart, kidney, muscle, bone and blood), and endoderm lineage organs (lung, liver, stomach, pancreas and intestine).
III	Adult stem cells: Mesenchymal stem cells (MSCs) - sources, properties (plasticity, homing and engraftment), potency and characterization; Haematopoietic stem cells

	(HSCs) - sources, properties, potency and characterization; steps involved in production of induced pluripotent stem cells (iPSCs); role of Yamanaka factor in iPSCs.
IV	Stem cell and aging: aging theory; cell cycle; telomere and telomerase; senescence of stem cell; role of stem cell in aging; tissue repair and regeneration of adult stem cell.
V	Current stem cell therapies: Advantages and disadvantages of ES cells and adult stem cells (MSCs and HSCs) therapy; Ethical concern on stem cell therapy; current stem cell therapy for various diseases; clinical outcome of stem cell therapy; state of clinical trials in adult stem cells for various diseases.

Reading list

1. Kiessling, A.A. 2006. Human Embryonic Stem Cells (Second Ed.), Jones & Barlett Publishers.
2. Lanza, R. and A. Atala. 2005. Essentials of Stem Cell Biology. Academic Press, pp-712.
3. Turksen, K. 2004. Adult Stem Cells. Humana Press, Inc, pp-429.
4. Lanza, R. *et al.* 2004. Handbook of Stem Cells: Embryonic/Adult and Fetal Stem Cells (Vol. 1 & 2). Academic Press, pp-1626.
5. Institute of Medicine, 2002. Stem cells and the future of regenerative medicine. National Academy Press, pp-112.
6. Marshak, D., R.L. Gardner and D. Gottlieb. 2001. Stem Cell Biology, Cold Spring Harbour Monograph Series, 40, pp-550.
7. Booth, C. 2003. Stem Cell Biology and Gene Therapy, Cell Biology International, Academic Press.

Recommended texts

1. Quesenberry, P.J., G.S. Stein, B. Forget and S. Weissman. 2001. Stem Cell Biology and Gene Therapy, Wiley Publishers, pp-584.
2. Sell, S. and Totowa, N.J. 2004. Stem Cells Handbook, Humana Press, pp-534.
3. Sullivan, S., C. A. Cowan and K. Eggan. 2007. Human Embryonic Stem Cells: The Practical Handbook, Wiley Publishers, pp-424.
4. Battler, A., and Leo, J. 2007. Stem Cell and Gene-Based Therapy: Frontiers in Regenerative Medicine, Springer Publication, pp-422.

Mapping with Programme Outcomes*

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	M	S	M	S	M	S	M	M
CO2	S	S	M	S	S	S	S	S	S	L
CO3	S	M	S	S	S	S	M	L	S	M
CO4	S	S	S	S	S	M	M	S	L	M
CO5	S	S	S	M	M	S	S	S	S	S

*S - Strong; M - Medium; L-Low

Skill Enhancement II- Dairy Farming

Semester	Subject Code	Category	Lecture		Theory		Practical	Credits
			Hrs/week	Total Hours/Semester	Hrs/week	Total Hours/Semester		
III		Skill Enhancement I	3		3		Nil	2

Course Objectives:		
The main objectives of this course are:		
1.	Students should know basic concepts in Vermiculture	
Course I	:	Skill Enhancement Course [SEC] - II
Course title	:	Dairy Farming
Credits	:	2
Pre-requisite:		
Students should be aware of economic and cultural importance of Dairy farming.		
Expected Course Outcome:		
Upon completion of this course, Students would have		
I	To understand the various practices in Dairy farming. To know the needs for Dairy farming and the status of India in global market.	K2 & K3
II	To be able to apply the techniques and practices needed for Dairy farming.	K1, K2 & K3
III	To know the difficulties in Dairy farming and be able to propose plans against it.	K5 & K6

K1- Remember; **K2-** Understand; **K3-** Apply; **K4-**Analyze; **K5-**Evaluate; **K6-** Create

Units	
I	Introduction to Dairy Farming- Advantages of dairying- Classification of breeds of cattle-Indigenous and exotic breeds- Selection of dairy cattle. Breeding-artificial insemination-Dairy cattle management-General Anatomy.
II	Construction of Model Dairy House - Types of Housing - Different Managerial Parameters - Winter Management - Summer Management
III	Feedstuffs available for livestock- Roughages -Concentrates - Energy rich concentrates - Protein rich concentrates - Mineral Supplements - Vitamin Supplements - Feed additives - Feeding management - Calves Feeding - Feeding of adults - Feeding of pregnant dairy animals - Feeding pregnant heifer.

IV	Milk-Composition of milk-milk spoilage-pasteurization - Role of milk and milk products in human nutrition – Dairying as a source of additional income and employment.
V	Contagious disease - Common Bacterial - Protozoal - Helminth and Viral Diseases - Parasitic Infestation - Vaccination - Biosecurity.

Reading list

1. The Veterinary Books for Dairy Farmers by Roger W. Blowey.
2. Hand Book of Dairy Farming by Board Eiri.
3. Handbook of animal husbandry TATA, S.N ed., ICAR 1990
4. Prabakaran, R. 1998. Commercial Chicken production. Published by P. Saranya, Chennai.
5. Hafez, E. S. E., 1962. Reproduction in Farm Animals, Lea & Fabiger Publisher.

Recommended texts

1. [https://agritech.tnau.ac.in/farm_enterprises/Farm%20enterprises %20Dairy%20unit.html](https://agritech.tnau.ac.in/farm_enterprises/Farm%20enterprises%20Dairy%20unit.html)
2. <https://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Tata,+S.N.,+ed%22>
3. 15. James. N. Marner, 1975. Principles of dairy processing, wiley eastern limited, New Delhi.
4. Baradach, JE. Ryther. JH. and, MC larney WO., 1972. Aquaculture. The farming and Husbandry of Freshwater and Marine Organisms. Wiley InterScience, NewYork.

Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	L	L	S	S	M	S	L	M
CO2	M	S	S	S	M	S	M	L	S	S
CO3	M	S	S	S	S	S	S	S	S	M
CO4	M	S	S	S	M	M	L	L	M	M
CO5	S	S	S	M	S	M	S	L	S	S

*S - Strong; M - Medium; L – Low

SEMESTER-IV
IMMUNOLOGY- CORE XI

Semester	Subject Code	Category	Lecture		Theory		Practical	Credits
			Hrs/week	Total Hours/Semester	Hrs/week	Total Hours/Semester		
IV		Core XI	6	75	6	75	NIL	5

Course Objectives:		
The main objectives of this course are:		
1.	To impart conceptual understanding of functional organization of immune system and its responsiveness in health and disease.	
2.	To enable a successful performance in Immunology component of CSIR-UGC NET.	
Course I	:	Core XI
Course title	:	Immunology
Credits	:	5
Pre-requisite:		
Students would have basic knowledge in animal science, particularly functional anatomy, cell biology and developmental biology.		
Expected Course Outcome:		
Students would have acquired clear knowledge on		
1.	Various basic concepts in immunology and organization of immune systems.	K2
2.	Mechanisms of immune response in health and their defects in various diseases.	K2 & K4
3.	The application of immunological principles in biomedical sciences including blood transfusion, tissue grafting and organ transplantation.	K3 & K5
4.	Vaccinology and its importance in disease management	K3

K1- Remember; **K2-** Understand; **K3-** Apply; **K4-**Analyze; **K5-**Evaluate; **K6-** Create

Units	
I	Introduction to Immunology: An overview; Scope of immunology, recognition of self and non-self as a basic functional feature of immune system; Concepts of external and internal defense systems; External (first line / innate) defense system: components, distribution, salient functions; Internal (second line / acquired) immune system: cellular and humoral immune components-

	distribution, salient functions-primary and secondary immune responses; Immune tissues / organs: types, anatomical location, structure and development; lymphocyte traffic during development; Types of immunity: innate and acquired - types, functional features; concept of adaptive immunity
II	Antigens: Definition, characteristic features and classification; Antigenicity versus immunogenicity; Adjuvants: definition, types and applications
III	Major effector components of cellular immune system: Lymphocytes - types, morphology, clones; sub-populations, distribution, B and T cell receptors, Antigen presenting cells: antigen processing and presentation, MHC molecules and their immunologic significance
IV	Major effector components of humoral immune system: Antibodies - Primary structure, classification, variants and antigen-antibody interactions; Structural and functional characteristics of various antibody classes; Generation of diversity; Monoclonal antibodies: definition, production and applications; Antibody engineering and its applications. Complement system - Components, three major activation pathways, and immune functions including anaphylaxis and inflammation. Cytokines - Definition and salient functional features; Interleukins: definition, types (lymphokines and monokines), and functions. Interferons - Origin, types and functions
V	Diseases and immune responses: Hypersensitivity: definition, Types I to IV and immune manifestations; Auto-immune diseases: onset, spectrum of diseases, and major immune responses; Immunodeficiency diseases: types including SCID and consequences; Viral (HIV), bacterial (tuberculosis) and parasitic (malaria) diseases: etiology, host immune responses and evasion by pathogens; Vaccines: types, preparations, efficacies and recent developments

Reading list

1. Kuby, J. 1997. Immunology. W. H. Freeman & Co., New York, pp-670.
2. Male, D. J. Brostoff, D. B. Roth and I. Roitt. 2006. Immunology (7th edition), Mosby / Elsevier, Philadelphia, pp-472
3. Abbas, A. K and A. H. Lichtman. 2007. Cellular and Molecular Immunology (6th edition), W. B. Saunders, Philadelphia, pp-564
4. Coica, R. Sunshine, G. 2015. Immunology (Seventh Edition), Wiley Blackwell, UK, pp-406.

Recommended texts

1. Weir, D. M and J. Stewart. 1997. Immunology, Churchill Livingstone, London, pp-362
2. Janeway, C. A and P. Travers. 1997. Immunology, Garland Publ. Inc., London, pp-904
3. Peakman, M and D. Vergani. 1997. Basic and Clinical Immunology, Churchill Livingstone, London, pp-366

4. Parham, P. 2009. The Immune System (Third Edition), Garland Science, USA, pp-506
5. Weissman, I. Hood, L. Wood, W. 1978. Essential Concepts in Immunology, the Benjamin/Cummings, California, pp-165.
6. Hood, L. Weissman, I. Wood, W. Wilson, J. 1984. Immunology (Second Edition), the Benjamin/Cummings, California, pp-558.
7. Coica, R and Sunshine, G. 2009. Immunology A Short Course (Sixth Edition), John Wiley & Sons, USA, pp-391.
8. Doan, T. Melvold, R. Viselli, S. *et al.*, 2013. Immunology (Second Edition), Lippincott Williams & Wilkins, Maryland, pp-376.
9. Owen, J. A. Punt, J. Stanford, S. A. 2013. Kuby Immunology (7th Edition), Macmillan, England, pp-692.

Mapping with Programme Outcomes*

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	S	S	M	S	S	S
CO2	S	S	M	S	S	S	M	M	S	S
CO3	S	M	M	S	S	S	S	S	S	M
CO4	M	S	M	M	S	S	S	S	S	M
CO5	M	S	S	S	M	S	M	S	S	M

*S - Strong; M - Medium; L – Low

ECOLOGY -CORE XII

Semester	Subject Code	Category	Lecture		Theory		Practical	Credits
			Hrs/week	Total Hours/Semester	Hrs/week	Total Hours/Semester		
IV		Core XII	6	75	6	75	NIL	5

Course Objectives:

The main objectives of this course are:

1.	Knowing the ecology and climatic changes at world level and its impact on natural resources.
2.	Understanding the contributing factors for pollution in the environment and the ways in controlling and restoring to natural conditions

Course I	:	Core XII
Course title	:	Ecology
Credits	:	5

Pre-requisite:

Students should know about the fundamentals and studied the ecology of living organisms.

Expected Course Outcome:

On the successful completion of the course, student will be able to

1.	Learn about the ecosystem, biotic communities and utilizing the energy processing	K2
2.	Study the various community and population and population control	K2 & K3
3.	Understand the fundamentals of climatic conditions and its impact on environment	K2 & K6
4.	Realizing the nature of pollution and the ways for its control/reduction	K4 & K5
5.	Impact of environmental studies on solid waste management	K2 & K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Units

I	The Environment: Physical environment; biotic environment; biotic and abiotic interactions. Habitat and niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.
II	Population ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (<i>r</i> and <i>K</i> selection); concept of metapopulation-demes and dispersal, interdemic extinctions, age structured populations -action taken to control population explosion.

III	Species interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis. Community ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Ecological succession: Types; mechanisms; changes involved in succession; concept of climax
IV	Ecosystem: Structure and function; energy flow and mineral cycling (CNP); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine). Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.
V	Applied ecology: Environmental pollution; global environmental change; biodiversity-status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches - Waste management. Conservation biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

Reading list

1. Sharma, P.D. 2009. Ecology and Environment, Rastogi Publication, India, pp-616.
2. Calabrese, E.J. 1978. Pollutants and High-Risk Groups, John Wiley, pp-286.
3. Raven, P.H. and L.R. Berg, G.B. Johnson, 1993. Environment, Saunders College Publishing, pp-579.
4. Cunningham, W. P. and B. W. Saigo, 1999. Environmental Science, McGraw Hill Boston, 5th Edition.
5. Online courses.nptel.ac.in / noc 19 - g e 23/preview
6. Class central.com/course/swayam -ecology - and environment – 14021.

Recommended texts

1. Odum, E.P. 1893. Basic Ecology, Saunders & Co., Philadelphia, pp-383.
2. Barthwl, R.R. 2002. Environmental Impact Assessment, New Age International Publishers, New Delhi, India, pp-425.
3. United Nations Environment Programme (UNEP). 1995. Global Biodiversity Assessment, Cambridge University Press, pp-1140.

Mapping with Programme Outcomes*

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	M	S	S	M	S
CO2	S	S	M	M	L	S	S	S	M	M
CO3	S	M	M	L	M	S	L	L	S	L
CO4	M	M	S	S	M	L	L	S	S	S
CO5	M	S	S	M	S	M	L	M	L	S

*S - Strong; M - Medium; L – Low

ELECTIVE-VI- AQUACULTURE

Semester	Subject Code	Category	Lecture		Theory		Practical	Credits
			Hrs/week	Total Hours/Semester	Hrs/week	Total Hours/Semester		
III		Elective-VI	4	60	4	60	Nil	3

Course Objectives:		
The main objectives of this course are:		
1.	Students should know basic concepts in Aquaculture.	
Course I	:	Elective VI
Course title	:	Aquaculture
Credits	:	3
Pre-requisite:		
Students should know the fin fishes and shell fishes of commercially important candidate species.		
Expected Course Outcome:		
Upon completion of this course, Students would have		
I	To develop knowledge on the fish farm and their maintenance. Understand the methods of fish seed and feed production and develops knowledge on hatchery techniques	K1 & K2
II	To apply the knowledge about different culture methods in aquaculture and gain knowledge on fish and shrimp breeding techniques and larval culture	K3 & K4
III	Identifies the different fishes diseases, diagnosis and their management strategies. Understands Ornamental fishes and central aquaculture organizations	K5 & K6

K1- Remember; K2- Understand; K3- Apply; K4-Analyze; K5-Evaluate; K6- Create

Units	
I	Importance of aquaculture- Present status, prospects and scope in India. Freshwater aquaculture- Brackishwater aquaculture- Mariculture - Metahaline culture in India. Types of fish culture -Types of fish ponds for culture practice. Topography, site selection - water quality - soil condition and quality – structure and construction design and layout - inlet and outlet. Water quality management for aquaculture. Control of parasites, predators and weeds in culture ponds. Fish farm implements - Secchi disc - aerator - pH meter - tools for hypophysation - feeding trays – Fishing gears used in aqua farming.

II	Procurement of seed from natural resources- collection methods and segregation. Hatchery technology for major carps and freshwater prawn. Artificial seed production – Breeding under control conditions, induced breeding technique, larval rearing, packing and transportation Commercial substitute for pituitary extracts. Classification of fish feed- Artificial feeds Types, Feed - formulation - feeding methods. Live feed- Microalgae, Rotifer, Artemia and their culture.
III	Shrimp hatchery technology - Hatchery design, brood stock management, spawning, larval rearing, Shrimp developmental stages, algal culture, packing and transportation. Shrimp culture technology - extensive culture methods semi- intensive - intensive culture methods - Biofloc technology - Culture operations (water quality, feed and health management) - harvesting, preservation and marketing. Brackish water fish culture. Edible and Pearl oyster culture - pearl production. Crab culture. Economic importance of Lobster, Sea urchin and Sea cucumber - their by-products. Types of Seaweeds - species and methods of culture – by-products
IV	Fish and Shrimp diseases and health management – infectious diseases - Bacterial, Fungal, Viral, Protozoan; Non-infectious - environmental and nutritional diseases. Diseases diagnosis, prevention and control measures.
V	Types of ornamental fishes (freshwater and marine), their breeding behavior and biology. Oviparous, Ovo-viviparous and Viviparous fishes. Setting and maintenance of freshwater Aquarium tanks. Central aquaculture research organizations- CMFRI, CIBA, CIFT, CIFA, CIFE, MPEDA and its activities.
Reading list	
<ol style="list-style-type: none"> 1. Pillay, T. V. R. (1990). Aquaculture: Principles and Practices. Blackwell Scientific Publications Ltd. 2. Santhanam, R. (1990). Fisheries Science. Daya Publishing House. 3. Sinha, V.R. P. and Srinivastava, H. C. (1991). Aquaculture Productivity. Oxford and IBH Publications CO., Ltd., New Delhi. 4. Yadav, B. N. (1997). Fish and fisheries. Daya Publishing house, New Delhi. 	
Recommended texts	
<ol style="list-style-type: none"> 1. Das M. C. and Patnaik, P. N. (1994) Brackish water culture. Palani paramount Publications, Palani, T. N. 2. Day, F (1958). Fishes of India , VoL I and Vol. II. William Sawson and Sons Ltd., London. 3. Jhingran, V. G. (1991). Fish and Fisheries of India. Hindustan Publishing Co., India 4. Maheswari. K. (1983) Common fish disease and their control. Institute of Fisheries Education, Powarkads (M.P). 	

Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	S	S	M	M	S
CO2	S	S	S	M	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	S	S	M
CO4	S	S	M	S	S	S	S	M	M	S
CO5	S	S0	M	S0	M	S	M	L	S	S

*S-Strong; M-Medium; L-Low

SKILL ENHANCEMENT III- ANIMAL BEHAVIOUR

Semester	Subject Code	Category	Lecture		Theory		Practical	Credits
			Hrs/week	Total Hours/Semester	Hrs/week	Total Hours/Semester		
IV		Skill Enhancement III	4		4		Nil	2

Course Objectives:

The main objectives of this course are:

1. Students should understand basic concepts in Animal behaviour.

Course I : **Skill Enhancement Course [SEC] - III**

Course title : **Animal behaviour**

Credits : **2**

Pre-requisite:

Students should be aware of ecology and the animals in their respective environments.

Expected Course Outcome:

Upon completion of this course, Students would have

I	Recall and record genetic basis and evolutionary history of behaviour.	K1 & K2
II	Analyse and identify innate, learned and cognitive behaviour and differentiate between various mating systems.	K3 & K4
III	Classify movement and migration behaviours and explain environmental influence upon behaviour.	K1, K4 & K5

K1- Remember; **K2-** Understand; **K3-** Apply; **K4-**Analyze; **K5-**Evaluate; **K6-** Create

Units

I	Genetic material, Genes and chromosomes, Genetic variation, Single and Polygenic inheritance of behaviour, Heritability of behaviour, Natural selection and behaviour, Frequency distribution of phenotypes, Darwinian fitness, Evolution of adaptive strategies.
II	Sexual selection, Altruism, Sexual strategy and social organisation, Animal perception, Neural control of behaviour, Sensory processes and perception, Visual adaptations to unfavourable environments.
III	Coordination and Orientation, Homeostasis and Behaviour, Physiology and Behaviour in changing environments, Animal Learning, Conditioning and Learning, Biological aspects of learning, Cognitive aspects of learning.

IV	Instinct and learning, Displacement activities, Ritualization and Communication, Decision making behaviour in Animals, Complex behaviour of honey bees, Evolutionary optimality, Mechanism of Decision making. The mentality of Animals: Languages and mental representation, non-verbal communication in human, mental images, Intelligence, tool use and culture, Animal awareness and Emotion.
V	Organization of circadian system in multicellular animals; Concept of central and peripheral clock system; Circadian pacemaker system in invertebrates with particular reference to Drosophila; Photoreception and photo-transduction; Molecular bases of seasonality; The relevance of biological clocks for human welfare - Clock function (dysfunction); Human health and diseases - Chronopharmacology, chronomedicine, chronotherapy.

Reading list

1. David McFarland, 1985. Animal Behaviour, Longman Scientific & Technical, UK. 576pp.
2. Harjindra Singh, 1990. A Text Book of Animal Behaviour, Anomol Publication, 293pp.
3. Hoshang S. Gundevia and Hare Govind Singh, 1996. Animal Behaviour, S. Chand & Co, 280pp.
4. Shukla, J. P 2010, Fundamentals of Animal Behaviour, Atlantic, 587pp.
5. Vinod Kumar, 2002. Biological Rhythms. Narosa Publishing House, Delhi.

Recommended texts

1. Michael D. Breed and Janice Moore, 2012. Animal Behaviour, Academic Press, USA, 359pp.
2. Aubrey Manning and Martin Stamp Dawkins, 2012. An Introduction to Animal Behaviour, 6th Edition, Cambridge University Press, UK. 458pp.
3. Davis E. Davis, 1970. Integral Animal Behaviour, Mac Millan Company, London, 118pp.
4. Jay, C. Dunlap, Jennifer, J. Loros, Patricia J. De Coursey (ed). 2004. Chronobiology Biological time Keeping, Sinauer Associates Inc, Publishers, Sunderland, MA.

Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	L	L	M	M	L	L
CO2	S	M	L	L	S	L	M	M	L	M
CO3	M	L	M	L	S	S	M	S	M	S
CO4	S	S	S	S	M	S	L	L	L	M
CO5	S	L	L	L	M	L	L	S	M	S

*S - Strong; M - Medium; L- Low

SCHEME OF VALUATION

CORE PAPERS

THEORY :100 MARKS

CREDITS : 05

ELECTIVE PAPERS

THEORY :100MARKS

CREDITS :03

MARKS DISTRIBUTION

INTERNAL: 25 MARKS

EXTERNAL:75 MARKS

SECTION	QUESTION PATTERNS	MARKS
PART-A	EITHER OR PATTERN (a or b)	5x6=30
PART-B	ANSWER ANY THREE	3x15=45
	TOTAL	75

PRACTICAL

INTERNAL: 25 MARKS

EXTERNAL:75 MARKS

CREDITS : 4

SECTION	MARKS
PART-I	15(Major practical)
PART-II	15(Major practical)
PART-III	10 (Minor practical)
PART-IV	5X3=15(Spotters)
PART-V	05 (Viva-Voce)
PART-VI	15 (Record)
Total	75 Marks

PROJECT WITH VIVA-VOCE

INTERNAL :25 MARKS (15 MARKS PRESENTATION, 10 MARKS-VIVA VOCE)

EXTERNAL :75 MARKS (PROJECT-50 MARKS , VIVA VOCE-25 MARKS)

INTERNSHIP : 2 CREDITS

EXTENSION ACTIVITY : 2 CREDITS

**QUESTION PATTERN FOR PRACTICAL PAPERS-I YEAR
COMPONENTS OF INTERNAL ASSESSMENT & EXTERNAL
(PRACTICAL)**

MARK DISTRIBUTION (PRACTICAL-INTERNAL) Maximum- 25 Marks

Practical Assessment Exam - 50 Marks

Observation and Viva - 25 Marks

QUESTION PAPER PATTERN (PRACTICAL-EXTERNAL)

SEMESTER -I PRACTICAL I INVERTEBRATES AND VERTEBRATES

Time: 3 hrs Maximum-**75 Marks**

I- MAJOR PRACTICAL

A . INVERTEBRATES - Dissect and Display – 15 Marks

B. VERTEBRATES-Dissect and Display – 15 Marks

II.-MINOR PRACTICAL-MOUNTING -Draw & Comment - 10 Marks

III. SPOTTERS (5x3) -15 Marks

A)

B)

C)

D)

E)

IV. RECORD -15 Marks

V. VIVA - 5 Marks

**QUESTION PATTERN FOR PRACTICAL PAPER-I YEAR
COMPONENTS OF INTERNAL ASSESSMENT & EXTERNAL
(PRACTICAL)**

MARK DISTRIBUTION (PRACTICAL-INTERNAL) Maximum-25 Marks

Practical Assessment Exam - 50 Marks

Observation and Viva - 25 Marks

**QUESTION PAPER PATTERN (PRACTICAL-EXTERNAL)
SEMESTER II, PRACTICAL – II-CELL AND MOLECULAR BIOLOGY
AND DEVELOPMENTAL BIOLOGY**

Time: 3 hrs Maximum-75 Marks

I MAJOR PRACTICALS -15 Marks

Measure the given spotter using Micrometer. Write the procedure and comment on the results.

II MINOR PRACTICALS. -15 Marks

A. Mitosis in Onion Root Tip-Squash Preparation

B.- Give a detailed descriptive account in relation to the development of the given spotter. Eg: CHICK EMBRYO -10 Marks

III. SPOTTERS (5x3) -15 Marks

A. Cell biology

B. Cell Biology

C. Cell Biology

D. Developmental Biology

E. Developmental Biology

IV. RECORD - 15 Marks

V. VIVA - 5 Marks

**QUESTION PATTERN FOR PRACTICAL PAPER- II YEAR
COMPONENTS OF INTERNAL ASSESSMENT & EXTERNAL
(PRACTICAL)**

MARK DISTRIBUTION (PRACTICAL-INTERNAL) Maximum-25 Marks

Practical Assessment Exam - 50 Marks

Observation and Viva - 25 Marks

**QUESTION PAPER PATTERN (PRACTICAL-EXTERNAL)
SEMESTER III, PRACTICAL – III-ANIMAL PHYSIOLOGY, GENETICS
AND EVOLUTION**

Time: 3 hrs Maximum-75 Marks

I MAJOR PRACTICALS -15 Marks

Estimate the respiratory quotient in fish

Estimate the salt loss and salt gain in fish

Estimate the Protein, Carbohydrate and Lipids in fish tissues.

II MINOR PRACTICALS. -15 Marks

Blood Smear Preparation

Blood clotting Time, Blood bleeding time, Rouleaux Formation and Preparation of Heam Crystal.

Identification of Blood Group

Preparation of Buccal Smear

Identification of fore limb and Hind limb .

III. SPOTTERS (5x3) -15 Marks

A. Animal Physiology

B. Genetics

C. Genetics

D. Evolution

E. Evolution

IV. RECORD - 15 Marks

V. VIVA - 5 Marks

