M.SC., ZOOLOGY

SYLLABUS

FROM THE ACADMIC YEAR
2023-24

TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION,

CHENNAI – 600 005

TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION

Programme	**M.Sc., Zoology**
Programme Code	
Duration	**PG-2 years**
Programme Outcomes (Pos)	**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.

Credit Distribution for PG Programme

Semester–I	Credit	Semester-II	Credit	Semester-III	Credit	Semester–IV	Credit
1.1. Core-I	4	2.1. Core-IV	4	3.1. Core-VII	4	4.1. Core-X	4
1.2 Core-II	4	2.2 Core-V	4	3.2 Core-VII	4	4.2 Core-XI	4
1.3 Core – III	4	2.3Core – VI	4	3.3Core – IX	4	4.3Core– XII	4
1.4 Elective (Generic / Discipline Centric)- I	3	2.4 Elective (Generic / Discipline Centric) – III	3	3.4 Elective (Generic / Discipline Centric) – V	3	4.4 Elective (Generic / Discipline Centric) – VI	3
1.5 Elective (Generic / Discipline Centric)-II	3	2.5 Elective (Generic / Discipline Centric)-IV	3	3.5 Core Industry Module	3	4.5 Project with Viva-Voce	3
1.6Ability Enhancement Course- Soft Skill -1	2	2.6 Ability Enhancement Course - Soft Skill -2	2	3.6 Ability Enhancement Course- Soft Skill -3	2	4.6 Ability Enhancement Course- Soft Skill -4	2
Skill Enhancement Course SEC 1	2	2.7 Skill Enhancement Course SEC 2	2	3.7 Skill Enhancement Course – Term Paper and Seminar Presentation SEC 3	2	4.7 Skill Enhancement Course - Professional Competency Skill	2
				3.8 Internship/ Industrial Activity	2	4.8 Extension Activity	1
	22		**22**		**24**		**23**
						Total Credit Points	**91**

Core - Papers	12 x 4 = 48
Elective (Generic / Discipline Centric)	8 x 3 = 24
Ability Enhancement Course- Soft Skill -	8 x 2 = 16
Internship/ Industrial Activity	1 x 2 = 2
Extension Activity	1 x 1 = 1
Total Credits	91

Component wise Credit Distribution

Credits	Sem I	Sem II	Sem III	Sem IV	Total
Part A	18	18	18	18	72
Part B **(i) Discipline – Centric / Generic Skill**	2	2	2	2	8
(ii) Soft Skill	2	2	2	2	10
(iii) Summer Internship / Industrial Training			2		
Part C				1	1
Total	22	22	24	23	91

Method of Evaluation

Internal 25 (Test = 20 marks, Assignment and Seminar 5 marks)

External 75

Total 100

M.Sc Zoology-Syllabus

First Year
Semester-I

Part	List of Courses	Credit	No. of Hours
	Core Course - I	4	6
	Core Course - II	4	6
	Core Course - III	4	6
	Elective Course - I	3	4
	Elective Course - II	3	4
	Professional Competency Course	2	2
	Ability Enhancement Compulsory Course Soft Skill - I	2	2
		22	**30**

Semester-II

Part	List of Courses	Credit	No. of Hours
	Core Course - IV	4	6
	Core Course - V	4	6
	Core Course - VI	4	6
	Elective Course - III	3	4
	Elective Course - IV	3	4
	Skill Enhancement Course [SEC] - I	2	2
	Ability Enhancement Compulsory Course - Soft Skill - II	2	2
	Internship* / Industrial Activity	-	-
		22	**30**

***** Internship during Summer Vacation. The Credits shall be awarded in Semester – III Statement of Marks.

Second Year
Semester-III

Part	List of Courses	Credit	No. of Hours
	Core Course- VII	4	6
	Core Course-VIII	4	6
	Core Course-IX	4	6
	Elective Course - V	3	4
	Core Industry Module	3	4
	Skill Enhancement Course - II	2	2
	Ability Enhancement Compulsory Course - Soft Skill - III	2	2
	Internship / Industrial Activity [Credits]	2	-
		24	**30**

Semester-IV

Part	List of Courses	Credit	No. of Hours
	Core Course-X	4	6
	Core Course-XI	4	6
	Core Course-XII	4	6
	Elective Course - VI	3	4
	Project with VIVA VOCE	3	4
	Skill Enhancement Course-III	2	2
	Ability Enhancement Compulsory Course - Soft Skill - IV	2	2
	Extension Activity	1	
		23	**30**

Credit Distribution for all PG Courses

S.No	Course Details	Credit
1	Core Course [12 Courses X 4 Credits]	48
2	Elective Course [6 Courses X 3 Credits]	18
3	Skill Enhancement Course [3 Courses X 2 Credits]	6
4A	Professional Competency Course & Industry Module	4
4B	Project Work VIVA VOCE	4
5	Ability Enhancement Compulsory Course [4 Courses X 2]	8
6	Internship	2
7	Extension Activity	1
		91

Method of Evaluation:

Test I	Test II	Assignment and seminar	End Semester Examination	Total
10	10	5	75	100

M. Sc., Zoology-Syllabus

First Year: Semester-I

Part	List of Courses	Title	Credit	No. of Hours
	Core Course - I	Structure and Function of Invertebrates	5	7
	Core Course - II	Comparative Anatomy of Vertebrates	5	7
	Core Course - III	Lab Course in Invertebrates & Lab Course in Vertebrates	4	6
	Elective Course - I	Molecules and their interaction relevant to Biology	3	5
	Elective Course - II	Biostatistics	3	5
			20	**30**

First Year: Semester-II

Part	List of Courses	Title	Credit	No. of Hours
	Core Course - IV	Cellular and Molecular Biology	5	6
	Core Course - V	Developmental Biology	5	6
	Core Course - VI	Lab Course in Cell Biology & Lab Course in Developmental Biology	4	6
	Elective Course - III	Economic Entomology	3	4
	Elective Course - IV	Research Methodology	3	4
	Skill Enhancement Course [SEC] - I	Poultry Farming	2	4
			22	**30**

Core course I: Structure and function of Invertebrates

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 the students to find out the ancestors or derivatives of any taxon.	
4.	To know the functional morphology of system biology of invertebrates.	
Course	**:**	**Core I**
Course title	**:**	**Structure and Function of Invertebrates**
Credits	**:**	**5**
Pre-requisite:		
Students should know the taxonomical classification of invertebrate animals in relation to their functional morphology.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to**:**		

1.	Remember the general concepts and major groups in animal classification, origin, structure, functions and distribution of life in all its forms.	**K1 & K2**
2.	Understand the evolutionary process. All are linked in a sequence of life patterns.	**K2 & K4**
3.	Apply this for pre-professional work in agriculture and conservation of life forms.	**K3 & K5**
4.	Analyze what lies beyond our present knowledge of life process.	**K4 & K6**
5.	Evaluate and to create the perfect phylogenetic relationship in classification.	**K5 & K6**

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

Units	
I	Structure and function in invertebrates: Principles of Animal taxonomy; Species concept; International code of zoological nomenclature; Taxonomic procedures; New trends in taxonomy
II	Organization of coelom: Acoelomates; Pseudocoelomates; Coelomates: Protostomia and Deuterostomia; Locomotion: Flagella and ciliary movement in Protozoa; Hydrostatic movement in Coelenterata, Annelida and Echinodermata
III	Nutrition and Digestion: Patterns of feeding and digestion in lower metazoan; Filter feeding in Polychaeta, Mollusca, and Echinodermata. Respiration: Organs of respiration: Gills, lungs, and trachea; Respiratory pigments; Mechanism of respiration

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 lnsecta) and Mollusca (Cephalopoda); Trends in neural evolution
V	Invertebrate larvae: Larval forms of free-living invertebrates - Larval forms of parasites; Strategies and Evolutionary significance of larval forms. Minor Phyla: Concept and significance; Organization and general characters

Reading list

1. Barrington, E. J.W. 1979. Invertebrate Structure and Function. The English Language Book Society and Nelson, pp-765.

Recommended texts

1. Barnes, R. D. 1974. Invertebrate Zoology, (Second Edition), Holt-Saunders International Edition, pp-1024.
2. Barnes, R. S. K., P. Calow, P. J. W. Olive, D. W. Golding, J. J. Spicer. 2013. The Invertebrates: A Synthesis. Third Edition. John Wiles & Sons Inc., Hoboken. New Jersey, New Delhi.
3. Dechenik, J. A. 2015. Biology of Invertebrates (Seventh Edition). Published by McGraw Hill Education (India) Private Limited, pp-624.

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

Core Course II: Comparative Anatomy of Vertebrates

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	**:**	**Core II**
Course title	**:**	**Comparative Anatomy of Vertebrates**
Credits	**:**	**5**
Pre-requisite:		
Students with knowledge and comprehension on zoology.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to**:**		

1.	Remember the general concepts and major groups in animal classification, origin, structure, functions and distribution of life in all its forms.	**K1 & K2**
2.	Understand the evolutionary process. All are linked in a sequence of life patterns.	**K2 & K4**
3.	Apply this for pre-professional work in agriculture and conservation of life forms.	**K3 & K5**
4.	Analyze what lies beyond our present knowledge of life process.	**K4 & K6**
5.	Evaluate and to create the perfect phylogenetic relationship in classification.	**K5 & K6**

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

Units	
I	Origin of vertebrates: Concept of Protochordata; The nature of vertebrate morphology; Definition, scope and relation to other disciplines; Importance of the study of vertebrate morphology.
II	Origin and classification of vertebrates; Vertebrate integument and its derivatives. Development, general structure and functions of skin and its derivatives; Glands, scales, horns, claws, nails, hoofs, feathers and hairs.
III	General plan of circulation in various groups; Blood; Evolution of heart; Evolution of aortic arches and portal systems. Respiratory system: Characters of respiratory tissue; Internal and external respiration; Comparative account of respiratory organs.

IV	Skeletal system: Form, function, body size and skeletal elements of the body; Comparative account of jaw suspensorium, Vertebral column; Limbs and girdles; Evolution of Urinogenital system in vertebrate series.
V	Sense organs: Simple receptors; Organs of Olfaction and taste; Lateral line system; Electroreception. Nervous system: Comparative anatomy of the brain in relation to its functions; Comparative anatomy of spinal cord; Nerves-Cranial, Peripheral and Autonomous nervous systems.

Reading list

1. Swayam Prabha https://www.swayamprabha.gov.in/index.php/program/archive/9
2. Yong, J. Z. 1981. The life of Vertebrates, English language Book society, London, pp-645.
3. Romer, A.S. 1971. The Vertebrate body, W.B.S. Saunders, Philadelphia, pp-600.

Recommended texts

1. Waterman, A.J. 1972. Chordate Structure and Function, MacMillan Co., New York, pp.587.
2. Parker T. J. and W. A. Haswell. 1962. A text book of Zoology, Vol. 2, Vertebrates, 7th Edition, Mac Millan Press, London, pp-750.
3. Ekambaranatha Ayyar and T. N. Ananthakrishnan. 2009. Manual of Zoology, Vol – II, S. Viswanathan Pvt. Ltd. Chennai.
4. Kotpal, 2019. R.L. Modern Text Book of Zoology Vertebrates, 4th Edition, Rastogi Publications, Meerut, pp-968.

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

Core Course III: Lab course in Invertebrates & Vertebrates

Course Objectives:		
The main objectives of this course are:		
1.	Understanding the different systems in invertebrates & vertebrates.	
2.	Learning about various animal species, their phylogenetic affinities and their adaptive features	
3.	Imparting conceptual knowledge about the salient features and functional anatomy.	
4.	Developing the skill in mounting techniques of the biological samples.	
5.	Gaining fundamental knowledge on the skeletal system	
Course	**:**	**Core III**
Course title	**:**	**Lab Course in Invertebrates & Vertebrates**
Credits	**:**	**4**
Pre-requisite:		
Basic knowledge on the animals living in different habitats		
Expected Course Outcome:		
On the successful completion of the course, student will be able to**:**		

1.	Understand the structure and functions of various systems in animals	**K2 & K4**
2.	Learn the adaptive features of different groups of animals	**K1 & K2**
3.	Learn the mounting techniques	**K2 & K3**
4.	Acquire strong knowledge on the animal skeletal system	**K2 & K4**

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

INVERTEBRATES

Dissection / Virtual

Earthworm : Nervous system
Pila : Digestive and nervous systems
Sepia : Nervous system
Cockroach : Nervous system
Grasshopper : Digestive system and mouth parts
Prawn : Appendages, nervous and digestive systems
Crab : Nervous system

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

Earthworm : Body setae
Pila : Radula
Cockroach : Mouth parts
Grasshopper : Mouth parts

CHORDATES

Study the nervous system of Indian dog shark – Dissection / Virtual

1. Nervous system of *Scoliodon laticaudatus* – 5^{th} or Trigeminal nerve
2. Nervous system of *Scoliodon laticaudatus* – 7^{th} or Facial nerve
3. Nervous system of *Scoliodon laticaudatus* – 9^{th} and 10^{th} or Glossopharyngeal & Vagus nerve

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)
13. *Dendrophis* sp. (Tree snake)

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 fish

Text Books:

1. Lal, S.S. 2009. Practical Zoology, Rastogi Publications, pp-484.
2. Iuliis G. D. and D. Pulerà, 2007. The Dissection of Vertebrates: A Laboratory Manual. Academic Press, Imprint of Elsevier Publication, pp-416.
3. Verma, P.S. 2000. Manual of Practical Zoology: Chordates, S. Chand Publishing Company, pp-528

Reference Books:

1. Preeti, G., and C. Mridula, 2000. Modern Experimental Zoology, Indus International Publication.
2. Sinha, J., A. K. Chatterjeee, P. Chattopadhya. 2011. Advanced Practical Zoology, Arunabha Sen Publishers, pp-1070.

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

Core Course IV: Cellular and Molecular Biology

Course Objectives:		
The main objectives of this course are:		
1.	To understand the ultra-structures 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 ultra-structures and functions of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.	
Course	**:**	**Core IV**
Course title	**:**	**Cellular and Molecular Biology**
Credits	**:**	**5**

Pre-requisite:		
Students should have knowledge of the basic cellular structures and their salient functions in prokaryotic and eukaryotic cells.		
Expected Course Outcome:		
Upon completion of this course, students could		
1.	Understand the general concepts of cell and molecular biology.	**K2**
2.	Visualize the basic molecular processes in prokaryotic and eukaryotic cells, especially relevance of molecular and cellular structures influencing functional features.	**K1 & K2**
3.	Perceive the importance of physical and chemical signals at the molecular level resulting in modulation of response of cellular responses.	**K3 & K4**
4.	Updated the knowledge on the rapid advances in cell and molecular biology for a better understanding of onset of various diseases including cancer.	**K5**
5.	Understand the general concepts of cell and molecular biology.	**K2**

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

Units	
I	General features of the cell: Basic structure of prokaryotic and eukaryotic cells - Protoplasm - cell organelles; cell theory; Diversity of cell size and shapes.
II	Cellular organization: Membrane structure and functions - Structure of model membrane, lipid bilayer and membrane proteins diffusion, osmosis, ion channels, active transport, ion pumps, mechanism and regulation of intracellular transport, electrical properties of membranes. Structure and functions of Intracellular organelles: Nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles and chloroplasts.

III	Cell division and Cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle and control of cell cycle. Molecular biology of cell: Structure of DNA and RNA; Process of DNA replication, transcription, and translation in pro- and eukaryotic cells; Genetic maps.
IV	Cell communication and cell signaling: Membrane- associated receptors for peptide and steroid hormones - signaling through G-protein coupled receptors, signal transduction pathways. General principles of cell communication: extracellular space and matrix, interaction of cells with other cells and non-cellular structures.
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.

Reading list

1. Plopper, G., D. Sharp, and E. Sikorski. 2015. Lewin's Cells (Third Edition), Jones & Bartlett, New Delhi, pp-1056
2. Plopper, G. 2013. Principles of Cell Biology, Jones & Bartlett, Maryland, pp-510

Recommended texts

1. Karp, G. 2010. Cell Biology (Sixth Edition), John Wiley & Sons, Singapore, pp-765.
2. Lodish, H., C. A. Kaiser, A. Bretscher, *et al*., 2013. Molecular Cell Biology (Seventh Edition), Macmillan, England, pp-1154
3. De Robertis, E.D.P. and E. M. F. De Robertis Jr, 1987. Cell and Molecular Biology. Info-Med, Hong Kong, pp-734
4. Abbas, A. K., A. H. Lichtman and S. Pillai, 2007, Cell and Molecular Immunology (Sixth Edition), Saunders, Philadelphia, pp-566
5. Loewy, A.G., P. Siekevitz and J. R. Menninger, *et al*., 1991, Cell Structure and Function
   (Third Edition), Saunders, Philadelphia, pp-947
6. Watson, J. D., N.H. Hopkins, J.W. Roberts, *et al*., 1987, Molecular Biology of the Gene (Fourth Edition), Benjamin/Cummings, California, pp-1163
7. Han, S. S. and J. Holmstedt. 1979, Cell Biology, McGraw Hill, pp-319
8. Alberts, B., A. Johnson, J. Lewis, *et al*., 2015, Molecular Biology of the Cell (Sixth Edition), Garland Science, New York, pp-1342
9. Clark, D.P., 2005. Molecular Biology, Elsevier, China, pp-784
10. Tropp, B. 2008. Molecular Biology Genes to Proteins (Third Edition), Jones & Bartlett, US, pp-1000

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

Core Course V: Developmental Biology

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	**:**	**Core V**
Course title	**:**	**Developmental Biology**
Credits	**:**	**5**
Pre-requisite:		
Students have fundamental knowledge in developmental biology.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to		

1.	Define the concepts of embryonic development	**K1**
2.	Observe various stages of cell divisions under microscope	**K2 & K3**
3.	Understand the formation of zygote	**K4**
4.	Differentiate the blastula and gastrula stages	**K4 & K5**
5.	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

Units	
I	Pattern of animal development: Chief events in animal development; History of thoughts and conceptual developments. Gametogenesis: Origin of germ cells, permatogenesis - Sperm morphology in relation to the type of fertilization, Oogenesis - Oogenesis in insects and amphibians; Composition and synthesis of yolk in invertebrates (insects and crustaceans) and vertebrates; Genetic control of vitellogenin synthesis in amphibians
II	Fertilization: Sperm aggregation, Sperm activation, Chemotaxis, Sperm maturation and capacitaion 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
III	Cleavage and gastrulation: Pattern of embryonic cleavage, mechanisms of cleavage, mid blastula transition - Determinate and regulatory embryos, Factors affecting gastrulation, mechanisms and types of gastrulation in respective animal embryos (Sea urchin, *Amphioxus*, Amphibians, Aves, Mammals); Fate maps - (Amphibian and Chick), Epigenesis and preformation – Formation of primary germ layers
IV	Embryonic Development; Embryonic development of fish and birds, formation of extra embryonic membranes in mammalian – Organogenesis - Development of endodermal, mesodermal and ectodermal derivatives.

	Embryonic Induction and neurulation; Formation and migration of neural crest cells - types of neural crest cells and their patterning - primary and secondary neurulation. Gene and development; Anterior- posterior axis in determination in drosophila, Maternal effect genes - *Bicoid* and *Nanos* proteins; Generation of dorsal - ventral polarity- Genetic control of segmentation – Gap genes; pair rule genes; Homeotic genes
V	Post embryonic development metamorphosis: Endocrine control of metamorphosis in insect and amphibian - Endocrine control of moulting and growth in crustaceans and insects - Neoteny and pedogenesis. Regeneration: Formation of ectodermal cap and regeneration blastema – Types of regeneration in planaria, Regenerative ability in different animal groups, Factors stimulating regeneration – Biochemical changes associated with regeneration. Aging and senescence: Biology of senescence- cause of aging-mechanism involved in apoptosis. Experimental Embryology: Mammalian reproduction: Mammalian reproductive cycle, Hormonal regulation, Endocrine changes associated with normal pregnancy, Induced ovulation in humans – Cryopreservation of gametes/embryos - Ethical issues in cryopreservation

Reading list

1. Balinsky, B. I. 1981. Introduction to Embryology (5th Edition), CBS College Publishers, New York, pp-782.
2. Gilbert. S. F. 2006. Developmental Biology, 8th Edition, INC Publishers, USA, pp-785.
3. Berrill, N.J. 1974. Developmental Biology, Tata Mc-Graw Hill Publications, New Delhi, pp-535.
4. Tyler, M.S. 2000. Developmental Biology - A Guide for Experimental Study, Sunderland, MA, pp-208.
5. Subramoniam, T. 2011. Molecular Developmental Biology (2nd Edition), Narosa Publishers, India, pp-364.
6. www.easybiologyclass.com › developmental-biology-e
7. www.studocu.com › document › lecture-notes › view
8. *ocw.mit.edu* › courses › 7-22-developmental-biology-f.

Recommended texts

1. Wilt, F.H. and N.K. Wessel. 1967. Methods in Developmental Biology, Thomas Y Crowell, New York.
2. Slack J.M.W. 2012. Essential Developmental Biology (3rd Edition), Wily-Blackwell Publications, USA, pp-496.
3. Mari-Beffa, M. and J. Knight. 2005. Key Experiments in Practical Developmental Biology, Cambridge University Press, UK, pp-404.

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

Core Course VI: Lab Course in Cell Biology and Developmental Biology

Course Objectives:		
The main objectives of this course are:		
1.	Practical course aims at demonstrating significant cellular and molecular biological principles, quantitative and analytical approaches that enable the students to translate the theoretical foundation in cell biology, and developmental biology into practical understanding.	
Course	**:**	**Core VI**
Course title	**:**	**Lab Course in Cell Biology and Developmental Biology**
Credits	**:**	**4**
Pre-requisite:		
Students should have acquired basic knowledge relevant to this particular lab course.		
Expected Course Outcome:		
Upon completion of this lab course, students		

1.	Acquire knowledge to differentiate the cells of various living organisms and become awares of physiological processes of cells e.g. cell divisions, various stages of fertilization and embryo development.	**K2**
2.	Understand and observe as well as correctly identify different cell types, cellular structures using different microscopic techniques.	**K3**
3.	Develop handling - skills through the wet-lab course.	**K6**
4.	Learn the method of culturing of *Drosophila* and identification of their wild and mutant strains	**K1 & K2**
5.	Acquire skills to perform human karyotyping and chromosome mapping to identify abnormalities	**K1 & K2**

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

Cell and Molecular Biology

1. Determination of cell size using micrometer
2. Mitosis in root meristematic cells of plants
3. Identification of various stages of meiosis in the testes of grasshopper
4. Detection of polytene chromosome in salivary gland cells of the larvae of the Chironomus
5. Detection of sex chromatin
6. Identification of blood cells in the haemolymph of the of the cockroach
7. Isolation of genomic DNA from eukaryotic tissue

8. Isolation of total RNA from bacterial cells/tissues
9. Agarose gel electrophoresis of DNA
10. SDS-Polyacrylamide gel electrophoresis

Developmental Biology

Gametogenesis - Observation of gametes from gonadal tissue sections

i. Oogenesis:
   - ✓ Section through ovary of shrimp, fish, frog and mammals

ii Spermatogenesis:
   - ✓ Section through testis of shrimp, fish, calotes and mammals

Fertilization

iii Induced spawning in polycheate worm *Hydroids elegans*

iv *In vitro* fertilization and development in a polycheate worm *Hydroids elegans*

v Observation of egg developmental stages in *Emerita emeritus*

Embryogenesis

vi Observation and whole mount preparation of the chick blastoderm - 18 hours of development

vii Chick embryonic stage - 24 hours of development

viii Chick embryonic stage - 48 hours of development

ix Chick embryonic stage - 72 hours of development

x Chick embryonic stage - 96 hours of development

Histological observation: Section through various developmental stages in chick embryo

Experimental Embryology: Regeneration in Frog Tadpoles

xi Blastema formation

xii Demonstration of regenerative process in tadpole Metamorphosis

xiii Demonstration of metamorphosis in Frog Tadpole using exogenous Iodine

Cryopreservation

xiv Demonstration of cryopreservation of gametes of fin fish/ shell fish

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

Elective Courses I: Molecules and their interaction relevant to Biology

Course Objectives:		
The main objectives of this course are:		
1.	Students should know the fundamentals of Biochemistry	
Course	**:**	**Elective I**
Course title	**:**	**Molecules and their interaction relevant to Biology**
Credits	**:**	**3**
Pre-requisite:		
Understanding fundamental properties of elements, atoms, molecules, chemical bonds, linkages and structure, composition, metabolism and functions of biomolecules.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to:		
I	Learn the structure, properties, metabolism, and bioenergetics of biomolecules	**K1 & K3**
II	Acquire knowledge on various classes and major types of enzymes, classification, their mechanism of action and regulation	**K1 & K2**
III	Understand the fundamentals of biophysical chemistry and biochemistry, importance, and applications of methods in conforming the structure of biopolymers	**K2 & K3**
IV	Comprehend the structural organization of and proteins, carbohydrates, nucleic acids and lipids	**K2 & K4**
V	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

Units	
I	Basics of biophysical chemistry and biochemistry: Structure of atoms, molecules and chemical bonds - Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).
II	Biomolecular interactions and their properties: Stabilizing interactions (Vander Waals, electrostatic, hydrogen bonding, hydrophobic interaction etc. - Composition, structure, metabolism and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).
III	Bioenergetics and enzymology: Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers - Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isoenzymes
IV	Structural conformation of proteins and nucleic acids: Conformation of proteins (Ramachandran plot, secondary, tertiary, and quaternary structure; domains; motifs and folds) - Conformation of nucleic acids (A-, B-, Z-DNA), t-RNA, micro-RNA).

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

Reading list

1. Berg, J. M., J. L. Tymoczko and L. Stryer 2002. Biochemistry. 5th Ed., W.H. Freeman & Co., New York, pp-1050.
2. Kuchel P.W. and G. B. Ralston. 2008. Biochemistry. McGraw Hill (India) Private Limited, UP, pp-580.
3. McKee T. and J. R. McKee. 2012. Biochemistry: The Molecular Basis of Life. (7th Edition). Oxford University Press, US, pp-793.
4. Nelson D.L. and M.M. Cox. 2012. Lehninger's Principles of Biochemistry. (6th Edition). W. H. Freeman Publishers, New York, pp-1158.
5. Satyanarayana U. and U. Chakrapani, 2006. Biochemistry. (3rd Edition). Books and Allied (P) Ltd. Calcutta, pp-695.

Recommended texts

1. Buchanan, B.B., W. Gruissem and R.L. Jones. 2015. Biochemistry and Molecular Biology of Plants. John Wiley and Sons Ltd., UK, pp-1280.
2. Murray, R.K., D.K. Granner, P.A. Mayes and V.W. Rodwell. 2003. Harper's Illustrated Biochemistry (26th Edition), The McGraw-Hill Companies, Inc., USA, pp-704.
3. Palmer, T. 2004. Enzymes. Affiliated East-West Press Pvt. Ltd., New Delhi, pp-416.
4. Voet D. and J.G. Voet. 2011. Biochemistry. (4th Edition). John Wiley & Sons (Asia) Pvt. Ltd., pp-1428.

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

Elective Course II: Biostatistics

Course Objectives:		
The main objectives of this course are:		
1.	Students should know basic concepts in Biostatistics.	
Course	**:**	**Elective II**
Course title	**:**	**Biostatistics**
Credits	**:**	**3**
Pre-requisite:		
Students should be aware of importance of analysis of quantitative and qualitative information from biological studies.		
Expected Course Outcome:		
Upon completion of this course, Students would have		

I	Clear understanding of design and application of biostatistics relevant to experimental and population studies.	**K2 & K3**
II	Acquired skills to perform various statistical analyses using modern statistical techniques and software.	**K3 & K4**
III	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

Units	
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.
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.
III	Probability: Theories and rules; Probability - Addition and multiplication theorem; Probability distribution: Properties and application of Normal, Binomial and Poisson distributions.
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: Computation of biological data, calculation of regression co-efficient, graphical representation and prediction.

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

Reading list

1. Arora, P. N. and P. K. Malhan. 1996. Biostatistics, Himalaya Publishing House, Mumbai, pp-447.
2. Gurumani, N. 2005. Introduction to Biostatistics, M.J.P. Publishers, Delhi, pp-407.
3. Das, D. and A. Das. 2004. Academic Statistics in Biology and Psychology, Academic Publisher, Kolkata, pp-363.
4. Palanichamy, S. and Manoharan, M. 1990. Statistical Methods for Biologists, Palani Paramount Publications, Tamil Nadu, pp-264.

Recommended texts

1. Bailey, N. T. J. 1959. Statistical in Biology, English Universities Press, London, pp-48.
2. Sokal, R. R. and F. J. Rohlf, 1973. Introduction to Biostatistics, W.H. Freeman, London, pp-467.
3. Sokal, R.R. and F.J. Rohlf. 1981. Biometry: The principles and practice of statistics in biological research, San Francisco: W.H. Freeman, London, pp-859.
4. Zar, J.H. 1998. Biostatistical Analysis, Pearson Education (Singapore) Pvt. Ltd., Delhi, India, pp-660.
5. Bailey, N. T. J. 1994. Statistical Methods in Biology (Third Edition), Cambridge University Press, Cambridge, pp-255.
6. Wayne W. Daniel. Biostatistics: A Foundation for Analysis in the Health Sciences, John Wiley & Sons Inc, USA, pp-443.
7. Snedecor, G. W. and W. G. Cochran. 1967. Statistical Methods (Sixth Edition), Oxford & IBH Publishing Co., New Delhi, pp-593.
8. Pagano, M. and K. Gauvreau. 2008. Principles of Biostatistics (Second Edition), Cengage Learning, New Delhi, pp-525.

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

Elective Course III: Economic Entomology

Course Objectives:		
The main objectives of this course are:		
1.	Students should acquire a good understanding about the life of insects and their classification.	
Course	**:**	**Elective III**
Course title	**:**	**Economic Entomology**
Credits	**:**	**3**
Pre-requisite:		
The students with a basic background in biological sciences with a special emphasis on the study of insects including systematic, beneficial insects, destructive insects, integrated pest management and insects of medical and veterinary importance.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to		

I	Understand taxonomy, classification, and life of insects in the animal kingdom.	**K1 & K2**
II	Know the life cycle, rearing and management of diseases of beneficial insects.	**K2 & K3**
III	Know the type of harmful insects, life cycle, damage potential and management of pests including natural pest control	**K2 & K3**
IV	Recognize insects which act as vectors causing diseases in animals and human.	**K2 & K4**
	Overall understanding on the importance of insects in human life.	**K2 & K6**

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

Units	
I	Scope and history of Entomology - branches of Entomology - Principle of insect classification. Classification of insects up to order - key Characteristics with Indian examples. Insects and their biological success. Collection and preservation of insects.
II	Beneficial insects: Silkworms - types, life history, disease management and rearing methods - Types of honeybees, life history, social organization (colonies and caste system), honeybee care and management of beehive - Lac insects-life history, lac cultivation; Pollinators, predators, parasitoids, scavengers, weed killers, soil-builders.
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, brinjal vegetables, coconut, stored grains and cereals.
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 - Development and uses of pest resistant plant varieties - Integrated pest

	management - Concepts and practice.
V	Vector biology: Vectors of veterinary and public health importance - Mosquitoes as potential vectors of human disease-control measures. Man, and insects: The value of insects – insects as protein sources of human and animal feeds. Medical Entomology: Medicinal use of insects. Forensic Entomology.

Reading list

1. Ayyar, L.V. R. 1936. Hand book of Economic Entomology for South India. Narendra Publishing House. New Delhi, pp- 528.
2. Vasantharaj David, B. and V.V. Ramamurthy. 2016. Elements of Economic Entomology, Eighth Edition, Brillion Publishing, New York, pp-400.
3. Ross. H.H. 1965. A Text Book of Entomology, John Wiley & Sons Inc., New York, pp-746.

Recommended texts

1. Chapman, R.F., S.J. Simpsonand A.E.Douglas. 2012. The Insects: Structure and Function, Fifth Edition, Cambridge University Press, pp-959.
2. Imms, A.D., O.W.Richards and R.G. Davies (Eds.) IMMS' General Textbook of Entomology, Volume I: Structure, Physiology and Development, pp-418; Volume 2: Classification and Biology, pp-934, Springer Netherlands.
3. Daly, H.V., J.T. Doyen and P.R. Ehrlich. 1978. Introduction to Insect Biology and Diversity. Mc Graw-Hill Kogakusha Ltd., Tokyo, pp-564.
4. Hill, D.S. 1974. Agricultural Insect Pests of the Tropics and Their Control. Cambridge University Press, New York, pp-746.
5. Krishnaswami, S. 1973. Sericulture Manual, Vol. I & II, Silkworm rearing, FAO Agricultural Science Bulletin, Rome.
6. Mani, M.S. 1982. General Entomology. Oxoford & IBH Publishing Co., pp-912.
7. Wigglesworth, V.B. 1972. The Principles of Insect Physiology, ELBS & Chapman and Hall, London, pp-827.

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

Elective Course IV: Research Methodology

Course Objectives:		
The main objectives of this course are:		
1.	Students understand the basic principles, methodology and applications of widely used instruments in biological sciences.	
Course	**:**	**Elective IV**
Course title	**:**	**Research Methodology**
Credits	**:**	**3**
Pre-requisite:		
Students should know the fundamentals of basic methods employed in experimental biology.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to		

1.	Understand the implications of GLP	**K1**
2.	Learn the working principles of different instruments	**K2**
3.	Gain the knowledge on techniques of histology and histochemistry	**K2 & K4**
4.	Acquire knowledge on the basic principle and application of various modules of light and electron microscopy	**K3 & K5**

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

Units	
I	Microscopy: Compound (Dark and Light field), Phase Contrast, Fluorescent, Polarized, Electron (Transmission and Scanning), AFM and Confocal Microscope - Micrometry.
II	Histology- Sectioning, fixation and staining of tissues. Centrifuge Clinical, Density gradient and Ultra - sedimentation coefficient. GM counter, Liquid Scintillation counter, Lyophilizer, Spectrophotometer (visible, ultraviolet), ELISA Reader. FTIR, NMR, XRD, Atomic Absorption and Mass Spectrophotometer.
III	Chromatography: Paper, Thin layer, Column, gel filtration, ion exchange, Gas and HPLC, PAGE, Agarose Gel Electrophoresis, 2D Gel Electrophoresis, Western blotting, and PCR.
IV	Identification of research problems - Steps in formulating a research problem. Thesis writing - Introduction, Review of literature, Methodology, Results - illustrations and tables, Discussion, Bibliography.
V	Publication of research and review articles – choosing the right journal; refereed journals, open access journals, Journal metrics, citation, impact factor, SCI, H index, i10 index, software for paper formatting MS Office, Software for detection of Plagiarism.

Reading list

1. Pearse, A.G. 1968. Histochemistry: Theoretical and Applied, Vol. I, Third Edition, J & A Churchill Ltd, pp-758.
2. Lillie, R.D. 1954. Histopathologic Technic and Practical Histochemistry, Second Edition, Blakiston, New York, pp-715.

3. Hoppert, M. 2003. Microscopic Techniques in Biotechnology, Wiley-VCH GmbH, Weinheim, Germany, pp-330.

Recommended texts

1. Chandler, D.E. and Roberson R.W. 2009. Bioimaging: Current Concepts in Light and Electron Microscopy, Jones and Bartlet Publishers, Sudbury, MA, USA, pp440.
2. Engelbert, B. 1960. Radioactive Isotopes in Biochemistry, Elsevier Applied Science, pp-376.
3. Wolf, G. 1964. Isotopes in Biology, Academic Press, pp-173.
4. Srivastava, B. B. 2005. Fundamentals of Nuclear Physics, Rastogi Publications, pp-500.
5. Pantin, C. F. A. 1948. Microscopical Techniques, Cambridge University Press, London.

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

Skill Enhancement Courses (SEC) I: Poultry Farming

Course Objectives:		
The main objectives of this course are:		
1.	Students should know basic concepts in Poultry Farming.	
Course I	**:**	**Skill Enhancement Course [SEC] - I**
Course title	**:**	**Poultry Farming**
Credits	**:**	**2**
Pre-requisite:		
Students should be aware of economic and cultural importance of Poultry farming.		
Expected Course Outcome:		
Upon completion of this course, Students would have		

I	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**
II	To be able to apply the techniques and practices needed or Poultry farming.	**K1, K2 & K3**
III	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

Units	
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
II	Management of chicks - growers and layers - Management of Broilers. - Preparation of project report for banking and insurance.
III	Poultry feed management-Principles of feeding, Nutrient requirements for different stages of layers and broilers - Feed formulation and Methods of feeding.
IV	Poultry diseases-viral, bacterial, fungal and parasitic (two each); symptoms, control and management; Vaccination programme.
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.

Reading list

1. Sreenivasaiah., P. V., 2015. Textbook of Poultry Science. 1st Edition. Write & Print Publications, New Delhi 2.
2. Jull A. Morley, 2007. Successful Poultry Management. 2nd Edition. Biotech Books, New Delhi"
3. Hurd M. Louis, 2003. Modern Poultry Farming. 1st Edition. International Book Distributing Company, Lucknow."
4. Life and General Insurance Management"

Recommended texts

1. http://www.asci-india.com/BooksPDF/Small%20Poultry%20Farmer.pdf
2. https://nsdcindia.org/sites/default/files/MC_AGR-Q4306_Small-poultry-farmer-.pdf
3. http://ecoursesonline.iasri.res.in/course/view.php?id=335
4. https://swayam.gov.in/nd2_nou19_ag09/preview

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