HAJEE KARUTHA ROWTHER HOWDIA COLLEGE

(An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai.)
Re-Accredited with A++ Grade by NAAC (3rd Cycle)
Uthamapalayam - 625 533.

DEPARTMENT OF ZOOLOGY

MASTER OF SCIENCE – ZOOLOGY

SYLLABUS

Choice Based Credit System – CBCS

(As per TANSCHE/MKU Guidelines)

with

Outcome Based Education (OBE)

(with effect from Academic Year 2023 -2024 onwards)

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COLLEGE VISION AND MISSION

Vision

Our vision is to provide the best type of higher education to all, especially to students hailing from minority Muslim community, rural agricultural families and other deprived, under privileged sections of the society, inculcating the sense of social responsibility in them. Our college is committed to produce talented duly-bound citizens to take up the challenges of the changing times

Mission

Our mission is to impart and inculcate social values, spirit of service and religious tolerance as envisioned by our beloved Founder President Hajee Karutha Rowther.
The Vision beckons
The Mission continuous forever

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DEPARTMENT VISION AND MISSION

Vision

We aim to attain excellence through high-quality education and research pertaining to local, regional and national requirements, and through collaboration with various researchers and educators across Tamil Nadu and India We look forward to indoctrinate the highest morals of life, respect for Mother Nature and concern for ethical values among students for establishing the sustainable environment

Mission

- To instigate an awareness of the need to explore, identify and conserve biodiversity To create an attractive and enthusiastic department where students want to come and study
- To train students in zoological sciences and to equip them to apply themselves in activities requiring zoological expertise (Certificate course). Ultimately, our mission is to make our students self-employable.
- Our Postgraduate level training aims to provide a clear understanding of the whole animal kingdom, it's systematics, development, physiology, evolution and conservation. At postgraduate level, we strive to maintain a high level of scientific excellence in achieving hands on experience on various techniques (via internship programmes) along with budding research activities (project work)
- To constantly improve the quality of our teaching and promoting research
- To involve the department in community-based and outreach activities, whenever and wherever possible Affordable quality education to weaker part of the society.
- And to elevate the post graduate department of Zoology as the class academic and research Centre of Madurai Kamaraj University.

HAJEE KARUTHA ROWTHER HOWDIA COLLEGE

M.Sc Zoology

(With effect from the academic year 2023-24 onwards)

SCHEME OF EXAMINATIONS AND REGULATIONS

1. *Introduction of the Programme*

The M.Sc. Zoology is expected to be highly beneficial to the student community as per TANSCHE of Tamilnadu Government. The programme introduces new ideas slowly and carefully in such a manner so as to give the students a good feeling for the subject and develops an interest in the subject to pursue their studies or to become an Entrepreneur further. It would also prove to be a great support for those preparing for CSIR- NET, SET and other competitive exams. Amalgamation subjects in the form of Electives and Enhancement courses will lead the students to well equipped with skill ability. From this year onwards 2023-2024 that is in the first year UG and PG Programmes, are upgraded with latest inclusions as Revamped syllabus.

2.. Objectives of the Programme

- To develop knowledge in basic Zoology and Zoological definitions/theories.
- Enable the students to apply Zoological techniques for solving problems and help them to appreciate the depth of Zoological ideas that are useful in other areas
- Students undergoing this course will make them serve as a good teacher, researcher and also to become an entrepreneur
- This PG programme will direct the student to become a self-sustained and self-employed after the completion of this programme

3. Outcome of the Programme

The syllabi for M.Sc. Zoology have been designed in a such a way that the students, when they go out, will be capable of facing the competitive situation prevailing now and getting placement with developed Zoological knowledge

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.

Eligibility:

A candidate who has passed B.Sc., Zoology as major subject with Chemistry / Botany as one allied.

Duration of the Course:

M.Sc., Zoology – 2 years (4 Semesters).

Medium of instruction: English.

For Programme Completion

A Candidate shall complete:

- Part III - Core papers in semesters I, II, III and IV respectively
- Part III - Elective papers in semesters I, II, III and IV respectively
- Part IV - Non- Major Elective papers in semester II and III respectively
- Part IV - Skill Enhancement Course papers in semester II, III and IV respectively
- Part V – Extension activity in semester IV respectively

Scheme of Examinations under Choice Based Credit System

Term End Examinations (TEE)	- 75 Marks
Continuous Internal Assessment Examinations (CIAE)	- 25 Marks
Total	- 100 Marks

Pattern of Continuous Internal Assessment Examinations (CIAE)

Average of Two Internal Tests (each 20 marks)	- 20 Marks
Seminar / Quiz / Assignment	- 05 Marks
Total	- 25 Marks

Practical Examination

Internal	– 40 marks
External	– 60 marks
Total	- 100 Marks

Pattern of Term End Examinations

(Max. Marks: 75 / Time: 3 Hours)

External Examinations Question Paper Pattern

Section – A (10 X 1 = 10 Marks)

Answer ALL the questions.

- Questions 1 - 10
- Two questions from each unit

- Multiple choice questions and each question carries Four choices

Section – B (5 X 7 = 35 Marks)

Answer ALL the questions, choosing either a or b.

- Questions 11 - 15
- Two questions from each unit (either…. or…. type)
- Descriptive Type

Section – C (3 X 10 = 30 Marks)

- Answer ALL the questions, choosing either a or b.
- Questions 16 – 18
- Descriptive Type

Passing Marks

A Candidate passes the M.Sc., Zoology degree by scoring a minimum of 50% of Marks (internal + external) in each course of the Programme. No minimum marks for internal assessment.

- Minimum 34 Marks (45%) for External Examination in Theory Courses.
- Minimum 27 Marks (45%) for External Examination in Practical.

ZOOLOGY

Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF) Guideline Based Credits and Hours Distribution System

First Year – Semester – I

Part	Course Code	List of Courses	Credits	No. of Hours
	23PZYCC11	Core – I- Structure and Function of Invertebrates	5	7
	23PZYCC12	Core – II- Comparative Anatomy of Vertebrates	5	7
	23PZYCC1P	Core – III- Lab Course in Invertebrates & Vertebrates	4	6
	23PZYDE11	Elective – I- Molecules and their interaction relevant to Biology	3	5
	23PZYGE11	Elective – II- Biostatistics	3	5
			20	**30**

Semester-II

Part	Course Code	List of Courses	Credits	No. of Hours
	23PZYCC21	Core – IV- Cellular and Molecular Biology	5	6
	23PZYCC22	Core – V- Developmental Biology	5	6
	23PZYCC2P	Core – VI- Lab Course in Cell Biology and Developmental Biology	4	6
	23PZYDE21	Elective – III- Economic Entomology	3	4
	23PZYGE21	Elective – IV- Research Methodology	3	4
	23PZYSE21	Skill Enhancement Course [SEC] – I- Poultry Farming	2	4
			22	**30**

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23PZYCC11	Structure and Function of Invertebrates	Core	5	7	25	75	100

Pre-requisite:		
Students should know the taxonomical classification of invertebrate animals in relation to their functional morphology.		
Learning Objectives		
L1	To understand the concept of classification and their characteristic features of major group of invertebrates.	
L2	To realize the range of diversification of invertebrate animals.	
L3	To enable to find out the ancestors or derivatives of any taxon.	
L4	To know the functional morphology of system biology of invertebrates.	
L5	To understand the phylogenetic relationships of various taxa	
UNIT	**Contents**	**No. of Hours**
I	Structure and function in invertebrates: Principles of Animal taxonomy; Species concept; International code of zoological nomenclature; Taxonomic procedures; New trends in taxonomy	21
II	Organization of coelom: Acoelomates; Pseudocoelomates; Coelomates: Protostomia and Deuterostomia; Locomotion: Flagella and ciliary movement inProtozoa; Hydrostatic movement in Coelenterata, Annelida and Echinodermata	21
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	21
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	21
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	21
	Total	**105**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Remember the general concepts and major groups in animal classification, origin, structure, functions and distribution of life in all its forms.	K1,K2,K3,K4,K5
2	Understand the evolutionary process. All are linked in a sequence of life patterns.	K1,K2,K3,K4,K5

3	Apply this for pre-professional work in agriculture and conservation of life forms.	K1,K2,K3,K4,K5,K6
4	Analyze what lies beyond our present knowledge of life process.	K1,K2,K3,K4,K5,K6
5	Evaluate and to create the perfect phylogenetic relationship in classification.	K1,K2,K3,K4,K5,K6
Textbooks		
1	Barrington, E. J.W. 1979. Invertebrate Structure and Function. The English Language Book Society and Nelson, pp-765.	
Reference Books		
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.	
Web Resources		
1.		

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	3	3	2	3	3	3	2	3	3	3
CO 2	3	3	2	2	3	3	2	2	3	3
CO 3	3	2	3	2	3	3	2	2	3	3
CO 4	3	2	3	2	3	3	2	2	3	2
CO 5	3	2	3	2	3	3	2	2	3	2

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23PZYCC12	Comparative Anatomy of Vertebrates	Core	5	7	25	75	100

Pre-requisite:		
Students with knowledge and comprehension on zoology.		
Learning Objectives		
L1	Exemplifying the vertebrate origin and the intermediary position of Prochordates between invertebrates and vertebrates.	
L2	Acquires the knowledge on evolution and adaptive radiation of Agnatha and Pisces.	
L3	Understanding knowledge about the first terrestrial vertebrates and the adaptive radiation of land animals	
L4	Imparting conceptual knowledge about the animal life in the air and their behaviours.	
L5	Understanding the origin and efficiency of mammals and evolutionary changes that occurred in the life of vertebrates.	
UNIT	**Contents**	**No. of Hours**
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.	21
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.	21
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	21
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.	21
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.	21
	Total	**105**
Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	

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

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	3	2	1	3	2	3	2	3	2	3
CO 2	3	1	1	3	2	3	2	2	2	2
CO 3	3	2	1	3	2	3	2	1	2	2
CO 4	3	1	1	3	1	3	2	1	2	1
CO 5	3	2	1	3	3	3	2	3	2	2

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23PZYCC1P	**Lab Course in Invertebrates & Vertebrates**	**Core**	**4**	**6**	**40**	**60**	**100**

Pre-requisite:		
Basic knowledge on the animals living in different habitats		
Learning Objectives		
L1	Understanding the different systems in invertebrates & vertebrates.	
L2	Learning about various animal species, their phylogenetic affinities and their adaptive features	
L3	Imparting conceptual knowledge about the salient features and functional anatomy.	
L4	Developing the skill in mounting techniques of the biological samples.	
L5	Gaining fundamental knowledge on the skeletal system	
UNIT	**Contents**	**No. of Hours**
I	**Invertebrate Dissection** 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	18
II	**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*	18
III	**Mounting** Earthworm : Body setae *Pila* : Radula	18

	Cockroach : Mouth parts Grasshopper: Mouth parts **Chordate Study the nervous system of Indian dog shark - Dissection** 1. Nervous system of *Scoliodon laticaudatus* – 5th or Trigeminal nerve 2. Nervous system of *Scoliodon laticaudatus* – 7th or Facial nerve 3. Nervous system of *Scoliodon laticaudatus* – 9th and 10th or Glossopharyngeal & Vagus nerve	
IV	**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. *IVArius maculatus* (Cat fish) 7. *BVelone 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	18
V	**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	18
	Total	**90**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Understand the structure and functions of various systems in animals	K1,K2,K3,K4,K5
2	Learn the adaptive features of different groups of animals	K1,K2,K3,K4,K5
3	Learn the mounting techniques	K1,K2,K3,K4,K5,K6

4	Acquire strong knowledge on the important animal in chordates	K1,K2,K3,K4,K5,K6
5	Acquire strong knowledge on the animal skeletal system	K1,K2,K3,K4,K5,K6
Textbooks		
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.	
Reference Books		
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.	
Web Resources		
1.		

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	3	2	1	3	2	3	2	3	2	3
CO 2	3	1	1	3	2	3	2	2	2	2
CO 3	3	2	1	3	2	3	2	1	2	2
CO 4	3	1	1	3	1	3	2	1	2	1
CO 5	3	2	1	3	3	3	2	3	2	2

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23PZYDE11	**Molecules and their interaction relevant to Biology**	**Elective**	**3**	**5**	**25**	**75**	**100**

Pre-requisite:		
Understanding fundamental properties of elements, atoms, molecules, chemical bonds, linkages and structure, composition, metabolism and functions of biomolecules.		
Learning Objectives		
L1	Students should know the fundamentals of biochemistry	
UNIT	**Contents**	**No. of Hours**
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).	15
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).	15
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	15
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).	15
V	Stabilizing interactions in biomolecules: Stability of protein and nucleic acid structures - hydrogen bonding, covalent bonding, hydrophobic interactions and disulfide linkage.	15
	Total	**75**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Learn the structure, properties, metabolism and bioenergetics of biomolecules	K1,K2,K3,K4,K5
2	Acquire knowledge on various classes and major types of enzymes, classification, their mechanism of action and regulation	K1,K2,K3,K4,K5

3	Understand the fundamentals of biophysical chemistry and biochemistry, importance and applications of methods in conforming the structure of biopolymers	K1,K2,K3,K4,K5,K6
4	Comprehend the structural organization of and proteins, carbohydrates, nucleic acids and lipids	K1,K2,K3,K4,K5,K6
5	Familiarize the use of methods for the identification, characterization and conformation of biopolymer structures	K1,K2,K3,K4,K5,K6
Textbooks		
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.	
Reference Books		
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.	
Web Resources		
1.		

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	2	3	2	3	1	3	2	3	2	2
CO 2	3	3	1	3	3	3	2	2	2	3
CO 3	2	2	2	3	2	3	3	3	3	1
CO 4	3	2	3	2	3	2	3	3	3	2
CO 5	2	3	3	2	2	3	2	1	3	2

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23PZYGE11	**Biostatistics**	**Elective**	**3**	**5**	**25**	**75**	**100**

Pre-requisite:		
Students should be aware of importance of analysis of quantitative and qualitative information from biological studies.		
Learning Objectives		
L1	Students should know basic concepts in Biostatistics.	
UNIT	**Contents**	**No. of Hours**
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.	15
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.	15
III	Probability: Theories and rules; Probability - Addition and multiplication theorem; Probability distribution: Properties and application of Normal, Binomial and Poisson distributions.	15
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.	15
V	Analysis of variance: one way and two way classification. Data analysis with comprehensive statistical software using Statistical Package for the Social Sciences (SPSS).	15
	Total	**75**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Clear understanding of design and application of biostatistics relevant to experimental and population studies.	K1,K2,K3,K4,K5
2	Acquired skills to perform various statistical analyses using modern statistical techniques and software.	K1,K2,K3,K4,K5
3	Knowledge on the merits and limitation of practical problems in biological/ health management study as	K1,K2,K3,K4,K5,K6

	well as to propose and implement appropriate statistical design/ methods of analysis.	
4	Develop skill to analyses the statistical data by various methods	K1,K2,K3,K4,K5,K6
5	Develop skill to handle large data through computational knowledge	K1,K2,K3,K4,K5,K6
Textbooks		
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.	
Reference Books		
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.	
Web Resources		
1.		

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	3	2	1	2	3	3	2	3	2	2
CO 2	3	3	3	3	3	3	3	3	3	3
CO 3	2	3	3	3	3	3	3	3	3	1
CO 4	2	2	3	1	2	2	2	3	1	2
CO 5	2	2	3	1	2	3	2	1	3	2

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23PZYCC21	Cellular and Molecular Biology	Core	5	6	25	75	100

Pre-requisite:		
Students should have knowledge of the basic cellular structures and their salient functions in prokaryotic and eukaryotic cells.		
Learning Objectives		
L1	To understand the ultra structures and functions of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.	
L2	To realize involvement of various cellular components in accomplishing cell division.	
L3	To enable a successful performance in cell biology component of CSIR-UGC NET.	
L4	To understand the ultra structures and functions of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.	
L5	To understand the functioning of cells at molecular level	
UNIT	**Contents**	**No. of Hours**
I	General features of the cell: Basic structure of prokaryotic and eukaryotic cells - Protoplasm and deutroplasm - cell organelles; cell theory; Diversity of cell size and shapes.	18
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.	18
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.	18
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	18

	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.	18
	Total	**90**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Understand the general concepts of cell and molecular biology.	K1,K2,K3,K4,K5
2	Visualize the basic molecular processes in prokaryotic and eukaryotic cells, especially relevance of molecular and cellular structures influencing functional features.	K1,K2,K3,K4,K5
3	Perceive the importance of physical and chemical signals at the molecular level resulting in modulation of response of cellular responses.	K1,K2,K3,K4,K5,K6
4	Updated the knowledge on the rapid advances in cell and molecular biology for a better understanding of onset of various diseases including cancer.	K1,K2,K3,K4,K5,K6
5	Understand the general concepts of cell and molecular biology.	K1,K2,K3,K4,K5,K6

Textbooks

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

Reference Books

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:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	1	1	1	1	3	3	3	2	2	2
CO 2	2	2	2	3	3	3	3	2	3	2
CO 3	3	3	3	2	2	3	2	2	1	3
CO 4	2	2	3	1	3	3	1	2	3	3
CO 5	3	2	2	3	3	3	3	2	3	3

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23PZYCC22	Developmental Biology	Core	5	6	25	75	100

Pre-requisite:		
Students have fundamental knowledge in developmental biology.		
Learning Objectives		
L1	Understand the process of gametogenesis, cleavage and gastrulation, embryonic development, extra embryonic membrane and placenta in various animals and human.	
L2	Learn the principles, methods and applications of cryo-preservation of gametes and embryo.	
UNIT	**Contents**	**No. of Hours**
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	18
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	18
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	18
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	18

	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 assosciated with regeneration. Aging and senescences: Biology of senescences- 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	18
	Total	**90**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Define the concepts of embryonic development	K1,K2,K3,K4,K5
2	Observe various stages of cell divisions under microscope	K1,K2,K3,K4,K5
3	Understand the formation of zygote	K1,K2,K3,K4,K5,K6
4	Differentiate the blastula and gastrula stages	K1,K2,K3,K4,K5,K6
5	Learn the distinguishing features of three different germ layers and formation of various tissues and organs	K1,K2,K3,K4,K5,K6

Textbooks

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

Reference Books

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:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	3	3	2	3	3	1	3	2	1	2
CO 2	3	3	3	3	3	1	3	3	3	3
CO 3	3	2	3	3	3	3	3	1	1	2
CO 4	3	3	3	3	3	2	3	3	3	1
CO 5	3	3	3	2	3	3	3	1	1	2

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23PZYCC2P	**Lab Course in Cell Biology and Developmental Biology**	**Core**	**4**	**6**	**40**	**60**	**100**

Pre-requisite:		
Students should have acquired basic knowledge relevant to this particular lab course.		
Learning Objectives		
L1	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, genetics and developmental biology into practical understanding.	
UNIT	**Contents**	**No. of Hours**
I	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	18
II	1. Isolation of genomic DNA from eukaryotic tissue 2. Isolation of total RNA from bacterial cells/tissues 3. Agarose gel electrophoresis of DNA 4. SDS-Polyacrylamide gel electrophoresis	18
III	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	18
IV	Embryogenesis vi Observation and whole mount preparation of the chick blastoderm - 18 hours of development vii Chick embryonic stage - 24 hours of development	18

	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	
V	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	18
	Total	**90**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Acquire knowledge to differentiate the cells of various living organisms and the important physiological aspects.	K1,K2,K3,K4,K5
2	Develop analytical skill to understand cells at molecular level	K1,K2,K3,K4,K5
3	Develop analytical skill in the field of developmental biology	K1,K2,K3,K4,K5,K6
4	Develop skills to perform experimental level embryology	K1,K2,K3,K4,K5,K6
5	Understand cryopreservation techniques	K1,K2,K3,K4,K5,K6

Textbooks

1	Dr. Renu Gupta, Cell biology practical manual, Prestige publication, ISBN 108193651219, Jan1 2018.
2	Chaitanya K.V, Cell and molecular biology a lab manual, Printico Hall- India learning private limited, Jan 2013.
3	Wilson and Walkers, Principles and techniques of Biochemistry and Molecular biology, Cambridge University press, Jan 2018, 8 Edition
4	Mari- Beffa, Key experiment in practical Developmental biology manual, Cambridge university press, 2005.
5	Laura R Keller, Experimental developmental biology A laboratory manual, Academic press 1998, 1 Edition.
6	A laboratory manual of vertebrate embryology anatomy of selected embryos· of the frog, chick, and F. B. ADAMSTONE, Ph.D. Assistant Professor of Zoology, University of Illinois & WALDO SHUMWAY, Ph.D. Professor of Zoology, University Of Illinois

Web Sources

1.	https://www.bjcancer.org/Sites_OldFiles/_Library/UserFiles/pdf/Cell_Biology_Laboratory_Manual.pdf

2.	https://www.deanza.edu/faculty/heyerbruce/b6b_pdf/Bio6B-Manual_W19.pdf
3.	https://egyankosh.ac.in/bitstream/123456789/82024/1/BBYEL-142%20%28English%29.pdf

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	3	2	3	3	3	3	3	1	1	2
CO 2	3	3	3	3	3	2	2	2	2	2
CO 3	3	3	2	3	3	1	3	2	1	2
CO 4	2	2	1	2	1	2	2	3	2	1
CO 5	3	3	2	1	3	2	1	3	3	3

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23PZYDE21	Economic Entomology	Elective	3	4	25	75	100

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.		
Learning Objectives		
L1	Students should acquire a fairly good understanding about the life of insects and their classification.	
UNIT	**Contents**	**No. of Hours**
I	Overview of insects and insect taxonomy: Insects and their biological success - Man and insects; Basic concepts in Insect Taxonomy and classification.	12
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.	12
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.	12
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 an12d practice.	12
V	Vector biology: Vectors of veterinary and public health importance - Mosquitoes as potential vectors of human diseases-control measures	12
	Total	**60**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Understand taxonomy, classification and life of insects in the animal kingdom.	K1,K2,K3,K4,K5
2	Know the life cycle, rearing and management of diseases of beneficial insects.	K1,K2,K3,K4,K5

3	Know the type of harmful insects, life cycle, damage potential and management of pests including natural pest control	K1,K2,K3,K4,K5,K6
4	Recognize insects which act as vectors causing diseases in animals and human.	K1,K2,K3,K4,K5,K6
5	Overall understanding on the importance of insects in human life.	K1,K2,K3,K4,K5,K6
Textbooks		
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.	
Reference Books		
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:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	2	3	2	3	2	2	2	3	1	2
CO 2	3	3	2	3	3	3	3	3	3	1
CO 3	3	2	3	3	3	3	3	3	3	3
CO 4	3	3	3	3	3	3	2	3	2	2
CO 5	3	3	3	2	2	3	2	1	3	2

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23PZYGE21	**Research Methodology**	**Elective**	**3**	**4**	**25**	**75**	**100**

Pre-requisite:		
Students should know the fundamentals of basic methods employed in experimental biology.		
Learning Objectives		
L1	Students understand the basic principle, methodology and applications of widely used instruments in biological sciences.	
UNIT	**Contents**	**No. of Hours**
I	Good laboratory practice (GLP) - pH, Electrodes and pH meter - Colorimeter and Spectrophotometry.	12
II	Histology, Histochemistry, Bioinformatics and Electron microscopy.	12
III	Light Microscopy, Bright field, Phase contrast, DIC & Fluorescence microscopy, wide field and Confocal microscopy.	12
IV	Centrifuges, Chromatography, Electrophoresis, ELISA and blotting.	12
V	Principles and Applications of tracer techniques in biology, Animal cell culture techniques.	12
	Total	**60**
Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Understand the implications of GLP	K1,K2,K3,K4,K5
2	Gain the knowledge on techniques of histology and histochemistry	K1,K2,K3,K4,K5
3	Acquire knowledge on the basic principle and application of various modules of light and electron microscopy	K1,K2,K3,K4,K5,K6
4	Learn the working principles of different instruments	K1,K2,K3,K4,K5,K6
5	Learn the techniques on animal cellculture	K1,K2,K3,K4,K5,K6
Textbooks		
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.	
Reference Books		
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:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	3	3	3	3	3	2	3	2	3	2
CO 2	3	3	3	3	3	3	3	2	2	3
CO 3	3	3	3	2	3	2	2	3	3	3
CO 4	3	3	2	2	3	2	2	3	3	2
CO 5	3	2	3	3	3	2	3	2	2	3

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23PZYSE21	Poultry Farming	SEC	2	4	25	75	100

Pre-requisite:		
Students should be aware of economic and cultural importance of Poultry farming.		
Learning Objectives		
L1	Students should know basic concepts in Vermiculture.	
UNIT	**Contents**	**No. of Hours**
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	12
II	Management of chicks - growers and layers - Management of Broilers. - Preparation of project report for banking and insurance.	12
III	Poultry feed management-Principles of feeding, Nutrient requirements for different stages of layers and broilers - Feed formulation and Methods of feeding.	12
IV	Poultry diseases-viral, bacterial, fungal and parasitic (two each); symptoms, control and management; Vaccination programme.	12
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.	12
	Total	**60**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	To understand the various practices in Poultry farming.	K1,K2,K3,K4,K5
2	To know the needs for Poultry farming and the status of India in global market.	K1,K2,K3,K4,K5
3	To be able to apply the techniques and practices needed or Poultry farming.	K1,K2,K3,K4,K5,K6
4	To know the difficulties in Poultry farming and be able to propose plans against it.	K1,K2,K3,K4,K5,K6
5	Acquire the knowledge about the different methods of hatching.	K1,K2,K3,K4,K5,K6
Textbooks		
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"
Reference Books	
1.	Ismail, S.A., 1997. Vermitechnology, The biology of earthworms, Orient Longman, India.
2.	http://www.asci-india.com/BooksPDF/Small%20Poultry%20Farmer.pdf
3.	https://nsdcindia.org/sites/default/files/MC_AGR-Q4306_Small-poultry-farmer-.pdf
4.	http://ecoursesonline.iasri.res.in/course/view.php?id=335
5.	https://swayam.gov.in/nd2_nou19_ag09/preview

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	3	3	3	3	3	2	3	2	3	2
CO 2	3	3	3	3	3	3	3	2	2	3
CO 3	3	3	3	2	3	2	2	3	3	3
CO 4	3	3	2	2	3	2	2	3	3	2
CO 5	3	2	3	3	3	2	3	2	2	3

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1