

M. SC ZOOLOGY

(based on TANSCHÉ)

SYLLABUS

FROM THE ACADEMIC YEAR

2023-2024



**RAJAH SERFOJI GOVERNMENT COLLEGE (Autonomous)
THANJAVUR 613005**

December 2023

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION			
Programme	M. Sc. Zoology	Programme Code	
Duration	2 years	Level	Post Graduation (PG)
Programme Outcomes (Pos)			
Problem Solving Skill	Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context.		
PO-2: 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.		
PO-4: Communication Skill	Ability to develop communication, managerial and interpersonal skills.		
PO-5: Individual and Team Leadership Skill	Capability to lead themselves and the team to achieve organizational goals		
PO-6: Employability Skill	Inculcate contemporary business practices to enhance employability skills in the competitive environment.		
PO-7: Entrepreneurial Skill	Equip with skills and competencies to become an entrepreneur		
PO-8: 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)			
PSO-1: 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		
PSO-3: Research and	Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards		

Development	growth and development
PSO-4 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.


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Template for P.G., Programmes

Semester-I	Credit	Hours	Semester-II	Credit	Hours	Semester-III	Credit	Hours	Semester-IV	Credit	Hours
1.1. Core-I	5	7	2.1. Core-IV	5	6	3.1. Core-VII	5	6	4.1. Core-XI	5	6
1.2 Core-II	5	7	2.2 Core-V	5	6	3.2 Core-VIII	5	6	4.2 Core-XII	5	6
1.3 Core - III	4	6	2.3 Core - VI	4	6	3.3 Core - IX	5	6	4.3 Project with viva voce	7	10
1.4 Discipline Centric Elective -I	3	5	2.4 Discipline Centric Elective - III	3	4	3.4 Core - X	4	6	4.4 Elective - VI (Industry / Entrepreneurship) 20% Theory 80% Practical	3	4
1.5 Generic Elective-II:	3	5	2.5 Generic Elective -IV:	3	4	3.5 Discipline Centric Elective - V	3	3	4.5 Skill Enhancement course / Professional Competency Skill	2	4
			2.6 NME I	2	4	3.6 NME II	2	3	4.6 Extension Activity	1	
						3.7 Internship/ Industrial Activity	2	-			
	20	30		22	30		26	30		23	30
Total Credit Points -91											

Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF) Guideline Based Credits and Hours Distribution System for all Post – Graduate Courses including Lab Hours

M. Sc. Zoology-Syllabus

First Year: Semester-I

Sl. No.	List of Courses	Title	Credit	Inst. Hrs.	Exam Hrs.	Marks		Total
						Int	Ext	
01	CC-1 T1PZOC1	Structure and Function of Invertebrates	5	7	3	25	75	100
02	CC-2 T1PZOC2	Comparative Anatomy of Vertebrates	5	7	3	25	75	100
03	CC-3 T1PZOC3P	Lab Course in Invertebrates & Vertebrates	4	6	3	25	75	100
04	EC-1 TPZOECA	Molecules and their interaction relevant to Biology	3	5	3	25	75	100
05	EC-2 TPZOECB	Biostatistics	3	5	3	25	75	100
			20	30				500

First Year: Semester-II

01	CC-4 T2PZOC4	Cellular and Molecular Biology	5	6	3	25	75	100
02	CC-5 T2PZOC5	Developmental Biology	5	6	3	25	75	100
03	CC-6 T2PZOC6P	Lab Course in Cell Biology and Developmental Biology	4	6	3	25	75	100
04	EC-3 TPZOEC C	Ecology	3	4	3	25	75	100
05	EC-4 TPZOEC D	Research Methodology	3	4	3	25	75	100
06	SEC 1 T2PZOS1	Poultry Farming	2	4	3	25	75	100
			22	30				600

Second Year: Semester-III

01	CC-7 T3PZOC7	Genetics	5	6	3	25	75	100
02	CC-8 T3PZOC8	Evolution	5	6	3	25	75	100
03	CC-9 T3PZOC9	Animal Physiology	5	6	3	25	75	100
04	CC-10	Medical Laboratory	4	6	3	25	75	100

	TPZOECE	Techniques						
05	EC -5 T3PZOC10 P	Lab Course in Genetics, Evolution and Animal Physiology	3	3	3	25	75	100
06	SEC-2 T3PZOS2	Apiculture	2	3	3	25	75	100
07	Internship / Industrial Activity		2	-				--
			26	30				600
Second Year: Semester-IV								
01	CC-11 T4PZOC11	Immunology	5	6	3	25	75	100
02	CC-12 T4PZOC12P	Lab course in Immunology and Aquaculture	5	6	3	25	75	100
03	CC-13 T4PZOC13	Project with VIVA VOCE	7	10				100
04	EC-6 TPZOECE	Aquaculture	3	4	3	25	75	100
05	SEC-3 T4PZOS3	Intellectual Property Rights	2	4	3	25	75	100
06	Extension Activity		1					
			23	30				500
			91					

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Course		Core I		Code	TIPZOC1
Credits	5	Semester	I	Hours/Week	7
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 to find out the ancestors or derivatives of any taxon				
4	To know the functional morphology of system biology of invertebrates				
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 Malpighian tubules; Mechanisms of excretion: Excretion and osmoregulation. Nervous system: Primitive nervous system: Coelenterata and Echinodermata: Advanced nervous system: Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda); 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


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Course		Core 2		Code	TIPZOC2
Credits	5	Semester	I	Hours/Week	7
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 behaviour				
5	Understanding the origin and efficiency of mammals and evolutionary changes that occurred in the life of vertebrates.				
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	Contents
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

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

Recommended texts

Waterman, A.J. 1972. Chordate Structure and Function, MacMillan Co., New York, pp.587.
 Parker T. J. and W. A. Haswell. 1962. A text book of Zoology, Vol. 2, Vertebrates, 7th Edition, Mac Millan Press, London, pp-750.
 Ekambaranatha Ayyar and T. N. Ananthakrishnan. 2009. Manual of Zoology, Vol – II. S. Viswanathan Pvt. Ltd. Chennai.
 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



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Course		Core 3		Code		TIPZOC3	
Credits	4	Hours/Week	6	Semester	I		
LAB COURSE IN INVERTEBRATES, VERTEBRATES & BIOMOLECULES							
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						
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	
5	develop skills in biochemistry of life					K3	

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

INVERTEBRATES

Dissection

Earthworm	: Nervous system
<i>Pila</i>	: Digestive and nervous systems
<i>Sepia</i>	: 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

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

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 canila* (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

Biochemistry

1. Quantification of Carbohydrates
2. Quantification of Protein
3. Quantification of Lipids

Spotters

Amino Acid Structure, Colorimeter, pH meter,

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. Chatterjee, P. Chattopadhyay, 2011. Advanced Practical Zoology, Arunabha Sen Publishers, pp-1070.

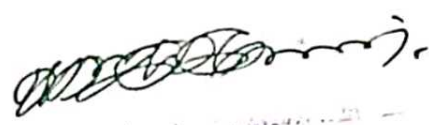

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Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	M	S	M	S
CO2	S	M	L	S	M	S	M	M	M	M
CO3	M	M	L	S	L	S	M	L	M	M
CO4	S	S	L	S	L	S	M	L	M	L
CO5	S	S	M	L	M	S	M	S	M	M

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Course		Elective 1		Code		TPZOECA	
Credits	3	Hours/Week	5	Semester	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						
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:							
1	Learn the structure, properties, metabolism and bioenergetics of biomolecules					K1 & K3	
2	Acquire knowledge on various classes and major types of enzymes, classification, their mechanism of action and regulation					K1 & K2	
3	Understand the fundamentals of biophysical chemistry and biochemistry, importance and applications of methods in conforming the structure of biopolymers					K2 & K3	
4	Comprehend the structural organization of and proteins, carbohydrates, nucleic acids and lipids					K2 & K4	
5	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 and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).
III	Bioenergetics and enzymology: Bioenergetics, glycolysis, Krebs's Cycle, Amino Acid Catabolism. 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


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Course	Elective 2	Code	TPZOEBC
Credits	3	Hours/Week	5
		Semester	I
BIostatISTICS			
Course Objectives:			
The main objectives of this course are:			
Students should know basic concepts in Biostatistics.			
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			
1	Clear understanding of design and application of biostatistics relevant to experimental and population studies.	K2 & K3	
2	Have an idea about data, data types and data collection methods	K3 & K4	
3	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	
4	Able to analysis biological data using different types of statistical tests	K4	
5	Acquired skills to perform various statistical analyses using modern statistical techniques and software	K5	

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: Chi square Test; Student 't' test -Population mean and Sample Mean comparison, Paired Sample and mean difference 't' tests. Correlation: Types - Karl Pearsons Co-efficient, Rank correlation, Significance test for correlation coefficients.
V	Regression analysis: Computation of biological data, calculation of regression co-efficient, graphical representation and prediction. Analysis of variance: one way and two-way. Data analysis with comprehensive statistical software using Statistical Package for the Social Sciences (SPSS).

Reading list

- Arora, P. N. and P. K. Malhan. 1996. Biostatistics, Himalaya Publishing House, Mumbai, pp-447.
- Gurumani, N. 2005. Introduction to Biostatistics, M.J.P. Publishers, Delhi, pp-407.
- Das, D. and A. Das. 2004. Academic Statistics in Biology and Psychology, Academic Publisher, Kolkata, pp-363.
- 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


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CONTROLLER OF EXAMINATIONS-
RAJAH SERFOJI GOVERNMENT COLLEGE (AUTONOMOUS)
THANJAVUR-613 005.

Course		Core 4		Code		T2PZOC4	
Credits	5	Hours/Week		6	Semester	II	
CELLULAR AND MOLECULAR BIOLOGY							
Course Objectives:							
The main objectives of this course are:							
1.	To understand the ultrastructure 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.						
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 communication of cell and the role of hormones and their functional mechanism					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 and deutoplasm - 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 signalling: Membrane- associated receptors for peptide and steroid hormones - signalling 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

Course	PG & Research Dept. of Zoology, Rajah Serfoji Govt. College (Auton), THANJAVUR - 613 005	Core 5	Code	THANJAVUR-613 005 T2PZOC5
Credits	5	Hours/Week	6	Semester II

SUB.CODE : T2PZ0C5

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.	
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, spermatogenesis - 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 capacitation 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, <i>Amphioxus</i> , 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 - <i>Bicoid</i>

	and <i>Nanos</i> 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.										
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


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CONTROLLER OF EXAMINATIONS
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 THANJAVUR-613 005.

Course		Core 6		Code		T2PZOC6P	
Credits	4	Hours/Week	6	Semester	II		
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, genetics and developmental biology into practical understanding.						
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 aware 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 <i>Drosophila</i> 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 polychaete worm *Hydroids elegans*
 - iv. *In vitro* fertilization and development in a polychaete 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

Laboratory Manual

Chaitanya, K. V. 2013. Cell And Molecular Biology: A Lab Manual Pages: 156. Phi Learning. Print Book ISBN: 9788120348004

David Ng. 2022. Molecular Biology Lab Manual 2022. P56.

Jyoti Saxena, Mamta Baunthiyal & Indu Ravi. 2024. Laboratory Manual of Microbiology, Biochemistry and Molecular Biology. ISBN 9788172337667. 380

Laura R. Keller, John Hyde Evans, Thomas C. S. Keller. 1999. Experimental Developmental Biology: A Laboratory Manual. Academic Press. Pp 114.

M.M. Trigunayat & Kritika Trigunayat. 2019. A Manual of Practical Zoology: Biodiversity, Cell Biology, Genetics & Developmental Biology Part 1. Scientific Publishers, India. ISBN

Mary S. Tyler. 2000. Developmental Biology, A Guide for Experimental Study, Second Edition, Sinauer Associates, Inc. Pp 206

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


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CONTROLLER OF EXAMINATIONS
 RAJAH SERFOJI GOVERNMENT COLLEGE (AUTONOMOUS)
 THANJAVUR-613 005.

Course		Elective		Code		TPZOECC	
Credits	3	Hours/Week	4	Semester	II		
ECOLOGY							
Course Objectives:							
The main objectives of this course are:							
1.	Knowing the ecology and climatic changes at world level and its impact on natural resources.						
2.	Understanding the contributing factors for pollution in the environment and the ways in controlling and restoring to natural conditions						
Pre-requisite:							
Students should know about the fundamentals and studied the ecology of living organisms.							
Expected Course Outcome:							
On the successful completion of the course, student will be able to							
1	Learn about the ecosystem, biotic communities and utilizing the energy processing					K2	
2	Study the various community and population and population control					K2 & K3	
3	Understand the fundamentals of climatic conditions and its impact on environment					K2 & K6	
4	Realizing the nature of pollution and the ways for its control/reduction					K4 & K5	
5	Impact of environmental studies on solid waste management					K2 & K6	

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

Units	
I	The Environment: Physical environment; biotic environment; biotic and abiotic interactions. Habitat and niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.
II	Population ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (<i>r</i> and <i>K</i> selection); concept of metapopulation-demes and dispersal, interdemec extinctions, age structured populations -action taken to control population explosion.
III	Species interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis. Community ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Ecological succession: Types; mechanisms; changes involved in succession; concept of climax
IV	Ecosystem: Structure and function; energy flow and mineral cycling (CNP); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine). Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.

V	Applied ecology: Environmental pollution; global environmental change; biodiversity-status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches - Waste management. Conservation biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).									
Reading list										
1. Sharma, P.D. 2009. Ecology and Environment, Rastogi Publication, India, pp-616.										
2. Calabrese, E.J. 1978. Pollutants and High-Risk Groups, John Wiley, pp-286.										
3. Raven, P.H. and L.R. Berg, G.B. Johnson, 1993. Environment, Saunders College Publishing, pp-579.										
4. Cunningham, W. P. and B. W. Saigo, 1999. Environmental Science, McGraw Hill Boston, 5th Edition.										
5. Class central.com/course/Swayam -ecology - and environment – 14021.										
Recommended texts										
1. Odum, E.P. 1893. Basic Ecology, Saunders & Co., Philadelphia, pp-383.										
2. Barthwl, R.R. 2002. Environmental Impact Assessment, New Age International Publishers, New Delhi, India, pp-425.										
3. United Nations Environment Programme (UNEP). 1995. Global Biodiversity Assessment, Cambridge University Press, pp-1140.										
Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	M	S	S	M	S
CO2	S	S	M	M	L	S	S	S	M	M
CO3	S	M	M	L	M	S	L	L	S	L
CO4	M	M	S	S	M	L	L	S	S	S
CO5	M	S	S	M	S	M	L	M	L	S

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


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CONTROLLER OF EXAMINATIONS
 RAJAH SERFOJI GOVERNMENT COLLEGE (AUTONOMOUS)
 THANJAVUR-613 005.

Course	Elective	Code	TPZOECD
Credits	3	Hours/Week	4
		Semester	II
RESEARCH METHODOLOGY			
Course Objectives:			
The main objectives of this course are			
Students understand the basic principle, methodology and applications of widely used instruments in biological sciences.			
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 concept of research and research report writing		K1
2	Learn the quality and quantity indices of research		K2
3	Understand the implications of GLP, learn working principle of the instruments and gain knowledge on histological		K2 K4
4	Acquire knowledge on the basic principle and application of various modules of light and electron microscopy		K3 K5
5	Have knowledge on tracer technology and cell culture techniques		K3

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

Units	
I	Research: Definition-types-selection of problem. Research Report Preparation - Thesis Writing and MS preparation- Proof reading. Journals - types of journals - peer reviewed and non-peer reviewed, paid and unpaid journals - online journals-open access journals - Types and Format of Journal Articles - Short Communication - Review Articles - Research Papers-Plagiarism
II	Bibliometrics and Scientometrics - Impact Factor - Science Citation Index - H-index-I10 index, Scopus - Information Retrieval: access to archives and databases (literature databases), Search Engines: Google Scholar, PubMed, Online database library, Digital Library and Virtual Labs
III	Good laboratory practice (GLP) - pH, Electrodes and pH meter - Colorimeter and Spectrophotometry. Histology, Histochemistry, Bioinformatics and Electron microscopy
IV	Light Microscopy, Bright field, Phase contrast, DIC & Fluorescence microscopy, wide field and Confocal microscopy
V	Centrifuges, Chromatography, Electrophoresis, ELISA and blotting. Principles and Applications of tracer techniques in biology, Animal cell culture techniques.

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


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CONTROLLER OF EXAMINATIONS
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THANJAVUR-613 005.

Course		SEC		Code		T2PZOS1	
Credits	2	Hours/Week		4	Semester	II	
POULTRY FARMING							
Course Objectives:							
The main objectives of this course are:							
1.		Students should know basic concepts in Vermiculture.					
Pre-requisite:							
Students should be aware of economic and cultural importance of Poultry farming.							
Expected Course Outcome:							
Upon completion of this course, students are able to:							
1	know the development of poultry farming in India and system						K1
2	understand the various practices in Poultry farming. To know the needs for Poultry farming and the status of India in global market.						K2 K3
3	apply the techniques and practices needed or Poultry farming.						K4 K5
4	identify the disease of poultry and treat them						K4
5	Mange the poultry industry in different season						K4 K5

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. 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. 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*										
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


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CONTROLLER OF EXAMINATIONS
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 THANJAVUR-613 005.

Course		SEC	Code		T3PZOC7
Credits	5	Hours/Week	6	Semester	III
GENETICS					
Course Objectives:					
The main objectives of this course are:					
1	Understanding DNA as genetic material, fine structure of DNA & RNA molecules, as well as physico-chemical properties of macromolecules.				
2	Gain insight into sequential events occurs during protein synthesis.				
3	Learn the structure and function of chromosome and chromosomal basis of genetic disorders.				
4	To acquire knowledge about microbial genetics				
5	To provide information about rDNA technology and its application.				
Pre-requisite:					
Basic knowledge on molecular biology and genetics					
Expected Course Outcome:					
On the successful completion of the course, student will be able to					
1	Explain the organization and functions of genetic material in the living system.				K1 K2
2	Understand various sequential processes in protein synthesis				K1 K2
3	Explicate the structures and functions of chromosomes and identify the diseases caused by the chromosomal abnormalities.				K2 K4
4	Able to distinguish lytic and lysogenic cycle and explain the mechanisms of genetic recombination of the microbes.				K2 K5
5	Understand the principle and application of rDNA technology for the welfare of human being.				K2 K3

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

Units	
I	Introduction to Genetics: Mendel and his experiments, Mendel's laws of inheritance. Interaction of genes: Allelic and nonallelic interaction, Complementary genes, epistasis, pleiotropism. Polygenic action: skin colour in man -Multiple alleles: ABO blood group system, Rh group and its inheritance.
II	Linkage and Crossing, Complete & Incomplete Linkage, Measuring Recombination frequency and linkage map construction using three factor crosses, Interference and coincidence Sex linkage in Drosophila (White eye locus) & Human (Haemophilia)
III	Mutation: Types of gene mutations (Classification), Types of chromosomal aberrations (Classification with one suitable example from Drosophila and Human of each), variation in chromosome number; Nondisjunction of X chromosome in Drosophila; Non-disjunction of Human Chromosome 21. Molecular basis of mutations in relation to UV light and chemical mutagens. Mutation detection in Drosophila by attached X method. Biochemical mutation detection in Neurospora.
IV	Recombinant DNA technology: Recombinant DNA technology - Overview - Tools for Recombinant DNA Technology – Vectors - types - Techniques used in recombinant DNA technology - generation of DNA fragments - Restriction

	endonucleases, DNA modifying enzymes, Ligases
V	Introduction of rDNA into host cell - calcium chloride mediated gene transfer - <i>Agrobacterium</i> mediated DNA transfer, electroporation, microinjection, liposome fusion, particle gun bombardment - Selection and screening of transformed cells - Expression of cloned gene; Application of rDNA technology in human welfare - Environment, Medicine and Agriculture
Reading list	
Gardner, E. J., M. J. Simmons and D.P. Snustad. 2006. Principles of Genetics. 8th Edition. John Wiley & Sons. INC. New York, pp-740.	
Brooker, R. J. 2014. Genetics: Analysis and Principles. 5th Edition, McGraw Hill Publisher, pp-880.	
Russell, P.J. 2005. Genetics: A Molecular Approach (2nd Edition). Pearson/Benjamin Cummings, San Francisco, pp-850.	
https://onlinecourses.swayam2.ac.in/cec21_bt02/preview	
https://www.khanacademy.org/science/high-school-biology/hs-molecular-genetics/hs-rna-and-protein-synthesis/a/the-genetic-code	
Recommended texts	
1. Griffiths, A. J. F., H. J. Muller, D. T. Suzuki, R. C. Lewontin and W. M. Gelbart. 2012. An Introduction to Genetic Analysis. 11th Edition, W. H. Freeman. New York.	
2. Snustad, D.P., Simmons, M.J. 2015. Principles of Genetics, John Wiley Publications, pp-784.	
3. Watson, J. D., T. A. Baker, S. P. Bell, Alexander Gann, Michael Levine, Richard Losick. 2003. Molecular Biology of the Gene, (5 th Edition). Cold Spring Harbor Laboratory Press, pp-912.	
4. Klug, W. S. and M. R. Cummings, C. A. Spencer. 2005. Concepts of Genetics, Benjamin - Cummings Publishing Company.	
5. Harti, D. L. 2002. Essential Genetics, A Genomic Perspective, Jones & Bartlet.	
6. Krebs, J. E., E.S. Goldstein, S.T. Kilpatrick. 2018. Lewin's Genes XII, Jones & Bartlet Publisher, pp-613.	
7. Watson, J. D., T. A. Baker S. P. Bell, A. Cann, M. Levine and R. Losick, 2014. Molecular Biology of Gene 7th Edition, Pearson Education RH Ltd. India.	

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

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


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Course	Core	Code	T3PZOC8		
Credits	5	Hours/Week	6	Semester	III
EVOLUTION					
Course Objectives:					
The main objectives of this course are to appreciate					
1	the concepts of evolution				
2	the factors responsible for origin and generation of diversity among living beings and				
3	Major events in evolutionary time scale				
4	Factors influencing population genetics				
5	the use of molecular tools in studying the evolutionary process				
Pre-requisite:					
Students shall have basic knowledge on the diversity of animals, biology including morphological, anatomical, physiological and embryological features of various phyla and their environment.					
Expected Course Outcome:					
On the successful completion of the course, student will be able to					
1	Understand the concept of evolution. It provides a comprehensive account of evidences to support concept of evolution and different theories for exploring the mechanism of evolution.				K1 & K3
2	Appreciate origin of first cell, organic molecules, experiment to proof abiogenesis, evolution of aerobic and anaerobic metabolism.				K1 & K2
3	Understand evidences of evolution.				K2 & K3
4	Comprehend molecular evolutionary tools and evolutionary history				K2 & K4
5	Appreciate population genetics and patterns of evolution				K4 & K5

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

Units	
I	Concept and theories of evolution: History of evolutionary thoughts – Lamarckism – Neo-Lamarckism – Darwinism – Neo-Darwinism – Mutation theory of De Vries – Modern synthetic theory of evolution.
II	Origin of biological molecules and first cell: Abiotic synthesis of organic monomers and polymers – concept of Oparin and Haldane – experiment of Miller – coacervation – formation of protocell and first cell – evolution of anaerobic and aerobic metabolisms
III	Evidences of evolution: morphological evidences – embryological evidences – geographical evidences – physiological evidences – taxonomical evidences – genetical evidences – palaeontological evidences.
IV	Molecular evolutionary tools and evolutionary history: protein and nucleotide sequence analysis tools and their applications – phylogenetic analysis tools – evolutionary time scale and major events – fossil evidences for human evolution.
V	Population genetics and patterns of evolution - gene pool and gene frequency - Hardy-Weinberg Law and evolution - adaptive radiation - convergent evolution - co-evolution - speciation.
Reading list	

1. Bergstrom, C. T. and L. A. Dugatkin. 2012. Evolution, Second MEDIA Edition. W.W. Norton & Company, International Student Edition, pp-756.
2. Jobling, M., E. Hollox, M. Hurles, T. Kivisild and C. T. Tyler Smith. 2014. Human Evolutionary Genetics. Second Edition. Garland Sciences, London, pp-650.
3. Veer Bala Rostogi, 2018. Organic Evolution (Evolutionary Biology), Thirteenth Edition Vinoth Kumar Jain, Scientific International (Pvt.) Ltd, New Delhi, pp-590.
4. <https://www.flipkart.com/books/evolution~contributor/pr?sid=bks>
5. <http://www.evolution-textbook.org/>
6. <https://onlinelibrary.wiley.com/journal/15585646>
7. <http://darwin-online.org.uk/>

Recommended texts

1. Strickberger. M. W. 2000. Evolution. Third Edition, Jones Bartlett Publishers, pp-722.
2. Hall B. K. and B. Hallgrímsson. 2014. Strickberger's Evolution. Fifth Edition, Bartlett Learning, An Ascend Learning Company, pp-642.
3. Barton, N.H., D. Briggs, J.A. Eisen David, D.B. Goldstein and N.H. Patel. 2007. Evolution. Cold Spring Harbor Laboratory Press, pp-833.

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

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


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Course		Core		Code		T3PZOC9	
Credits	5	Hours/Week	6	Semester		III	
ANIMAL PHYSIOLOGY							
Course Objectives:							
The main objectives of this course are:							
1	Students acquire the basic knowledge on physiology of different organs in animals and human.						
2	Understand the functions of different systems such as digestion, excretion, blood circulatory system, respiration and nervous system of animal relating them to structure and functions of various organs.						
Pre-requisite:							
Students should know the fundamentals of structure and functions of organs and organ systems of animals.							
Expected Course Outcome:							
On the successful completion of the course, student will be able to							
1	Understand the functions of different systems of animals						K1
2	Learn the comparative anatomy of heart structure and functions						K2
3	Know the transport and exchange of gases, neural and chemical regulation of respiration						K2 K4
4	Acquire knowledge on the organization and structure of central and peripheral nervous systems						K3 K5
5	Understand and appreciate the endocrine function						K3 K5

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

Units	
I	Blood and circulation: Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, haemostasis. Cardiovascular system: Comparative anatomy of heart structure, myogenic heart, specialized tissue; ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above
II	Respiratory system: Comparison of respiration in different species, human anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration
III	Nervous system: Neurons, action potential, gross neuro-anatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. Sense organs: Vision, hearing and tactile response
IV	Digestive system: Digestion, absorption, energy balance, BMR. Excretory system: Comparative physiology of excretion, human kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance
V	Endocrinology and reproduction: Endocrine glands, basic mechanism of hormone action, hormones and diseases) Human reproduction: reproductive processes,

	gametogenesis, ovulation, neuroendocrine regulation. Thermoregulation: Comfort zone, body temperature- physical, chemical, neural regulation, acclimatization: Stress and adaptation
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Reading list

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

Recommended texts

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

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

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


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Course		Core		Code		T3PZOC10P	
Credits	4	Hours/Week		6	Semester	III	
LAB COURSE IN GENETICS, EVOLUTION AND ANIMAL PHYSIOLOGY							
Course Objectives:							
The main objectives of this course are:							
To learn the laws of heredity with practical emphasis on inheritance							
Exploration of the process of biological evolution and the fundamental mechanisms and concepts by which evolution works.							
To give students competent lab skills in animal physiology							
Pre-requisite:							
Students should have acquired basic knowledge relevant to this particular lab course.							
Expected Course Outcome:							
Upon completion of this lab course, students are able to:							
1	Learn to culture drosophila, the genetic model organism						K3
2	Know the chromosomal abnormalities and human karyotyping						K1, K2
3	know the evidences of evolution, the fossils						K5
4	Understand the key physiological events of living organisms						K4 K5
5	Differentiate excretory products and their evolutionary pattern						K1 & K2

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

GENETICS

Drosophila-Culture, Mutants, Sex Identification; Blood groups: ABO and Rh-grouping; Human Karyotyping & Chromosomal Abnormalities; Hardy-Weinberg Law & Calculation of Gene frequencies for dominant, recessive and co-dominance traits and multiple alleles.

EVOLUTION

Study of fossils

Study of finger prints

Spotters – homologous and heterologous organs, vestigial organs, mimicry, colouration, living fossils.

ANIMAL PHYSIOLOGY

Estimation of oxygen consumption in fish

Estimation of haemoglobin in human blood

Salt loss and salt gain in fish

Test for urea and sugar in urine sample

Quantitative estimation of amylase activity

Quantitative estimation of ammonia and urea

Spotters: BP apparatus, Stethoscope and ECG

Visit to Ecologically important fossil beds, national parks, bird sanctuary, zoos, museum

Laboratory manual

1. Genetics: A Laboratory Manual. 2015. Gregore Koliantz, Daniel B. Szymanski. ISBN: 978-0-891-18562-8.

2. Genetics Laboratory Manual. 2022. Ernest Brown Babcock and Julius Lloyd Collins. Legare Street Press. Pp 70. ISBN 978-1016036887
3. Organic Evolution Lab Manual. J. Arthur Finger.
4. Laboratory Manual for Animal Physiology. 1983. Don W. Bailey. Tichenor Pub; 2nd edition (1 December 1983)

Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C01	S	M	S	S	S	S	S	L	L	M
C02	S	S	S	S	S	M	M	M	M	M
C03	S	S	M	S	S	L	S	M	L	M
C04	M	M	L	M	L	M	M	S	M	L
C05	S	S	M	L	S	M	L	S	S	S


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Elective Course V	Core Industry Module	Code	TPZOECE
Credits	3	Hours/Week	3
		Semester	III
MEDICAL LABORATORY TECHNIQUES			
Course Objectives:			
The main objectives of this course are:			
Students should understand the different protocols and procedures to collect clinical samples.			
Pre-requisite:			
Students should have a basic knowledge about medical laboratories and the works carried out by them.			
Expected Course Outcome:			
Upon completion of this course, Students would have			
1	acquire knowledge in clinical laboratory science and general education subjects	K1 K2	
2	Understand protocols and procedures to collect clinical samples for blood analysis and to study human physiology.	K3	
3	Explain the characteristics of clinical samples and demonstrate skill in handling clinical equipment.	K3 K4	
4	Evaluate the hematological and histological parameters of biological samples	K3 K4	
5	Adapt to develop expertise in new techniques	K5	

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

Units	
I	Laboratory safety: toxic chemicals and biohazards waste. Biosafety level. Good Laboratory Practices. Hygiene and health issue: physiological effect of alcohol, tobacco, smoking, junk food & its treatment. Biomedical waste management.
II	Composition of blood and their function. Collection of blood & lab procedure-haemopoiesis. Mechanism of blood coagulation: bleeding time, clotting time, determination of hemoglobin, erythrocyte sedimentation rate, packed cell volume (PCV), total count of RBC & WBC. Differential count (DC), blood grouping and typing. Haemostasis-bleeding disorder of man. Haemolytic disease of newborn, Platelet count, reticulocytes count, Absolute Eosinophil count.
III	Computer tomography (CT-Scan), Magnetic Resonance imaging, Flowcytometry, Treadmill test, Positron Emission Tomography (PET)
IV	Cardiovascular system- Blood pressure, Pulse regulation, Heart rate, Cardiac shock. Heart sounds, Electrocardiogram (ECG), significance, ultra sonography, Electroencephalography (EEG).
V	Handling and labelling of histology specimens - Tissue processing - processing of histological tissues for paraffin embedding, block preparation. Microtomes – types of microtomes- sectioning, staining - staining methods - vital staining - mounting- problems encountered during section cutting and remedies - Frozen section techniques- freezing microtome.

Reading list

- Godker, P. B. and Darshan, P, Godker, 2011. Text book of medical Laboratory Technology, Mumbai.
- Hall, 2011. Guyton and Hall Textbook of Medical Physiology, 12th edition, Elsevier, New

Delhi.

3. Mukerjee, K.L., 2017. Medical Laboratory Technology- Vol. I, II, III. Tata MC Graw Hill, New Delhi. 3rd Edition
4. Sood, R., 2009. Medical Laboratory technology. Methods and interpretation. Jaypee Brothers Medical Publishers (P) Ltd., 6th edition. Pp. 1696.

Recommended texts

1. Manoharan, A. and Sethuraman, 2003. Essential of Clinical Hematology, Jaypee brothers, New Delhi.
2. Richard, A. McPherson, Mathew, R. Pincus, 2007. Clinical and management by laboratory methods, Elsevier, Philadelphia. Published by Tata McGraw-Hill Education Pvt. Ltd.,
3. Ochei, J., A. Kolliakur (2000). Medical Laboratory science: Theory and practice. Published by Tata McGraw-Hill Education Pvt. Ltd. First edition.

Mapping with Programme Outcomes*

CDs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CD1	S	M	M	M	L	L	M	M	L	M
CD2	S	S	M	S	S	S	L	M	S	S
CD3	M	S	S	S	S	S	S	S	S	L
CD4	S	S	M	M	L	M	L	M	M	S
CD5	M	M	S	S	M	S	L	L	S	S

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



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Course	SEC II	Code	T3PZOS2		
Credits	2	Hours/Week	3	Semester	III
APICULTURE					
Course Objectives:					
The main objectives of this course are:					
1.		Students should know basic concepts in Apiculture.			
Pre-requisite:					
Students should be aware of importance of honey bees and their impacts on the ecosystem.					
Expected Course Outcome:					
Upon completion of this course, Students would have					
1	Knowledge on history, types and social behaviour of honey bees				K1 K2
2	Clear understanding of morphology, life cycle, characteristics of honey bees and bee keeping.				K2 K3
3	Acquired skills to perform bee keeping from managing colonies of bees in order to harvest honey and other Bee related by-products in different setups and as an Entrepreneurial venture.				K3 K4
4	Knowledge on the harvesting, preserving and processing of bee products and identification of the appropriate markets to sell the produce.				K3
5	Knowledge on the use of bee products				K5

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

Units	
I	Introduction to Apiculture, History, classification, types, life Cycle of different species of Honey Bees and their behavioural patterns. Social organization of bee colony
II	Bee-keeping system, tools and equipment's needed for bee keeping. Types of bee hives, structure and functional features. Criteria for site selection for apiculture and factors affecting them.
III	Identification and characteristics and Preventive measures to be taken against of different bee enemies. Diseases affecting honey bees and their control measures. Colony collapse disorder and its management.
IV	Bee products, uses and importance- Honey, Royal jelly, Propolis, Pollen and Bee venom. Harvesting, Processing, Packaging and Marketing of bee products.
V	Apiculture industry around the world and Role of Central Bee Research & Training institute in India. Apiculture as an Entrepreneurial venture.
Reading list	
1. Singh, D., Singh, D. Pratap. 2006. A Handbook of Beekeeping. AGROBIOS (INDIA)	
2. Sharma P.L. and Singh, S.H. Book of Bee keeping.	
3. Cherian and Ramanathan, S. Bee keeping in south India.	
4. Prospective in Indian Apiculture - R.C. Mishra.	
Recommended texts	
1. Caron, D.W. 2013 (revised from 1999). Honey Bee Biology and Beekeeping. Wicwas Press. Cheshire, CT, 368 pp.	

2. Kaspar, R., C. Cook, and M. D. Breed. 2018. Animal Behaviour 142: 69-76.
3. Hendriksma, H. P., A. L. Toth, and S. Shafir. 2019. Individual and Colony Level Foraging decisions of Bumble Bees and Honey Bees in Relation to Balancing of Nutrient Needs. Frontiers in Ecology and Evolution 7: 177.
4. Steinhauer, N. et al. 2018. Drivers of Colony Loss. Current Opinion in Insect Science 26: 142-148.
5. Technology and value addition of Honey - Dr. D. M. Wakhle and K. D. Kamble.
6. ABC & XYZ of Bee culture - A. I. Root.

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

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



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Course		Core		Code		T4PZOC11	
Credits	5		Hours/Week	6		Semester	IV
IMMUNOLOGY							
Course Objectives:							
The main objectives of this course are:							
1	To impart conceptual understanding of functional organization of immune system and its responsiveness in health and disease.						
2	To enable a successful performance in Immunology component of CSIR-UGC NET.						
Pre-requisite:							
Students would have basic knowledge in animal science, particularly functional anatomy, cell biology and developmental biology.							
Expected Course Outcome:							
Students would have acquired clear knowledge on							
1	Various basic concepts in immunology and organization of immune systems.						K2
2	Mechanisms of immune response in health and their defects in various diseases.						K2 K4
3	The application of immunological principles in biomedical sciences including blood transfusion, tissue grafting and organ transplantation.						K3 K5
4	Vaccinology and its importance in disease management						K3
5	Autoimmune, immunodeficiency, and other infectious diseases						K2

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

Units	
I	Introduction to Immunology: Scope of immunology, recognition of self and non-self as a basic functional feature of immune system; Innate immune system: components, distribution, salient functions; Acquired immune system: cellular and humoral immune components- distribution, salient functions-Types of responses; Primary and secondary lymphoid organs, anatomical location, structure, development and functions; Cytokines - Definition and salient features; Interleukins: definition, types and functions. Interferons - Origin, types and functions.
II	Antigens: Definition, characteristic features and classification; Antigenicity versus immunogenicity; Epitopes, Adjuvants: definition, types and applications Antibodies: Structural and functional characteristics of various antibody classes; Generation of diversity; Monoclonal antibodies: definition, production and applications; Antibody engineering and its applications.
III	Major effector components of cellular immune system: Lymphocytes - types, morphology, clones; sub-populations, distribution, Lymphocyte traffic - B and T cell receptors, Toll-like receptors; Antigen presenting cells: antigen processing and presentation
IV	MHC molecules and their immunologic significance: Types, structure and functions Complement system - Components, three major activation pathways, and immune functions including anaphylaxis and inflammation. Hypersensitivity: definition, Types I to IV and immune manifestations.
V	Diseases and immune responses: Auto-immune diseases: onset, spectrum of diseases,

and major immune responses; Immunodeficiency diseases: types including SCID and consequences; Viral (HIV), bacterial (tuberculosis) and parasitic (malaria) diseases: etiology, host immune responses and evasion by pathogens;
Vaccines and types: Inactivated, live, subunit, mRNA and conjugate vaccines; preparations, efficacies and recent developments.

Reading list

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

Recommended texts

1. Weir, D. M and J. Stewart. 1997. Immunology, Churchill Livingstone, London, pp-362
2. Peakman, M and D. Vergani. 1997. Basic and Clinical Immunology, Churchill Livingstone, London, pp-366
3. Parham, P. 2009. The Immune System. Garland Science, USA, Pp-506
4. Weissman, I. Hood, L. Wood, W. 1978. Essential Concepts in Immunology, the Benjamin/Cummings, California, pp-165.
5. Hood, L. Weissman, I. Wood, W. Wilson, J. 1984. Immunology (Second Edition), the Benjamin/Cummings, California, pp-558.
6. Doan, T. Melvold, R. Viselli, S. *et al.*, 2013. Immunology (Second Edition), Lippincott Williams & Wilkins, Maryland, pp-376.
7. Owen, J. A. Punt, J. Stanford, S. A. 2013. Kuby Immunology (7th Edition), Macmillan, England, pp-692.

Mapping with Programme Outcomes*

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

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

HEAD
 PG & Research Dept. of Zoology,
 Rajah Serfoji Govt. College (Auto),
 THANJAVUR - 613 005.

CONTROLLER OF EXAMINATIONS
 RAJAH SERFOJI GOVERNMENT COLLEGE (AUTONOMOUS)
 THANJAVUR-613 005.

Course		Elective VI		Course Code		T4PZOC12P					
Credits		5		Hours/Week		6		Semester		IV	
LAB COURSE IN IMMUNOLOGY*											
Course Objectives:											
The main objectives of this course are:											
1		To provide hands-on training to perform specific lab courses in immunology and research methodology.									
2		To enable clear understanding of the methodology through wet – lab courses.									
Pre-requisite:											
Students should acquire the basic knowledge relevant to a particular lab course											
Expected Course Outcome:											
Upon completion of this lab course, the students											
1		Acquire ability to perform/ demonstrate various basic concepts in immunology								K3	
2		Develop skill in applications of research methods for quantitative/ qualitative analysis of biochemical components.								K2	
3		Identify the different types of immune organs								K3	
4		do basic immunological experiments								K5	
5		Have knowledge on advanced techniques in immunology								K4	

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

*includes elective course

Immunology

1. Identification of various immune tissues and organs in rat
2. Identification of various types of immune cells in peripheral blood smear
3. Agglutination reaction: Qualitative analysis of antigen-antibody reaction using human blood group system
4. Agglutination reactions: Determination of hemagglutination titer of IgM antibodies using human RBC
5. Detection of IgG by precipitation ring test
6. Detection of IgG by Ouchterlony double immuno-diffusion test.
7. Separation of lymphocytes from peripheral blood and identification of T and B cells
8. Concentration of antigen by radial immunodiffusion method.

Spotter: Immune tissues and organs

Aquaculture

1. Estimation of Biochemical Oxygen Demand.
2. Estimation of soil pH using soil pH meter.
3. Estimation of pH in pond water using pH meter.

4. Identification of zooplankton of pond/seawater.
5. Demonstration of Artemia culture.

Spotter: Secchi disc, thermometer, water sampler, pH pen, soil pH meter, catla, rohu, mrigal, tilapia.

Educational Tour:

Visit to vaccine production units, aquaculture research institutes, fish and shrimp ponds and hatcheries, fish processing plants, operation of various fishing gears and crafts.



CONTROLLER OF EXAMINATIONS
RAJAH SERFOJI GOVERNMENT COLLEGE (AUTONOMOUS)
THANJAVUR-613 005.

Course	Elective VI		Course Code	TPZOECF	
Credits	3	Hours/Week	4	Semester	IV
AQUACULTURE					
Course Objectives:					
The main objectives of this course are the learner should know basic concepts in Aquaculture.					
Pre-requisite:					
Students should know the fin fishes and shell fishes of commercially important candidate species.					
Expected Course Outcome:					
Upon completion of this course, Students would					
1	Know the status of fisheries and aquaculture in India and management of fish farms				K1 K2
2	Understand the methods of fish seed and feed production and develops knowledge on hatchery techniques				K3 K4
3	Apply the knowledge about different culture methods in aquaculture and gain knowledge on fish and shrimp breeding techniques and larval culture				K3
4	Identify different fish diseases, their management strategies and value-added fish products.				K5
5	Understand Ornamental fish and central aquaculture organizations				K3 K4

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

Units	Contents
I	Aquaculture status and practices in India - Present status and scope of aquaculture in India; Types of aquaculture; Types of fish culture ponds; Construction of fish pond - site selection, topography, water and soil quality requirements, design and structure of ponds; Water quality management in fish farms.
II	Fish seed and feed: Seed collection from natural resources; Bundh breeding; Induced breeding – mechanism and procedure, substitutes for pituitary extract; Packing and transportation of fish seeds; Fish feed - Artificial feed (types, feed formulation, feeding methods), Live feed –live feed organisms, culture of microalgae and Artemia.
III	Shell fish and seaweed culture: Shrimp hatchery technology - Hatchery design, brood stock management, spawning, larval rearing, packing and transportation of shrimp seeds. Shrimp culture – extensive, semi-intensive and intensive methods; Water quality, feed and disease managements in shrimp ponds; Harvesting, preservation and marketing of shrimp; Biofloc technology; Edible and Pearl oyster culture; Seaweed culture – specie, culture methods, uses.
IV	Fish diseases and their management: Infectious diseases - Bacterial, Fungal, Viral and Protozoan; Non-infectious - Nutritional diseases; Disease diagnosis, prevention and control measures. Value-added fish products.
V	Ornamental Fish Culture: Types and characteristics of important freshwater and marine ornamental fishes; Aquarium types; Requirements of an aquarium; Setting

	and maintenance of freshwater aquarium. Central Government Aquaculture Research Organizations and their activities - CMFRI, CIFRI, CIBA, CIFT, CIFA, CIFE, MPEDA.
Reading list	
1. Pillay, T. V. R. (1990). Aquaculture: Principles and Practices. Blackwell Scientific Publications Ltd. 2. Santhanam, R. (1990). Fisheries Science. Daya Publishing House. 3. Sinha, V.R. P. and Srinivastava, H. C. (1991). Aquaculture Productivity. Oxford and IBH Publications CO., Ltd., New Delhi. 4. Yadav, B. N. (1997). Fish and fisheries. Daya Publishing house, New Delhi.	
Recommended texts	
1. Das M. C. and Patnaik, P. N. (1994) Brackish water culture. Palani paramount Publications, Palani, T. N. 2. Day, F (1958). Fishes of India, Vol I and Vol. II. William Sawson and Sons Ltd., London. 3. Jhingran, V. G. (1991). Fish and Fisheries of India. Hindustan Publishing Co., India 4. Maheswari. K. (1983) Common fish disease and their control. Institute of Fisheries Education, Powarkads (M.P).	

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

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




CONTROLLER OF EXAMINATIONS
 RAJAH SERFOJI GOVERNMENT COLLEGE (AUTONOMOUS)
 THANJAVUR-613 005,

Course	Professional Competency		Course Code		T4PZOS3
Credits	2	Hours/Week	4	Semester	IV
INTELLECTUAL PROPERTY RIGHTS					
Course Objectives:					
The main objectives of this course are:					
1.	Students should gain basic knowledge intellectual property.				
Pre-requisite:					
Students should be aware of importance of analysis of quantitative and qualitative information from biological studies.					
Expected Course Outcome:					
On the successful completion of the course, student will be able to					
1	basic knowledge on the various branches of Intellectual Property Law				K1
2	holistic understanding of the legalities of Intellectual Property Rights				K2 K3
3	discuss contemporary issues in Intellectual Property Laws				K1 K2
4	understanding intricacies involved in drafting filings for Intellectual Property registration				K3
5	analyzing steps of development of Intellectual Property				K4

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

Units	
I	Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad - Genesis and Development - the way from WTO to WIPO - TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations - Important examples of IPR.
II	Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad
III	International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.
IV	Digital Innovations and Developments as Knowledge Assets - IP Laws, Cyber Law and Digital Content Protection - Unfair Competition - Meaning and Relationship between Unfair Competition and IP Laws - Case Studies.
V	Infringement of IPRs, Enforcement Measures, Emerging issues - Case Studies.
Reading list	
1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.	
2. Prabuddha Ganguli, "Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011.	
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.	

Recommended texts

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India Pvt Ltd, 2012
2. S.V Satakar Intellectual Property Rights and Copy Rights, Ess Publication, New Delhi, 2002.

Mapping with Programme Outcomes*

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

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




CONTROLLER OF EXAMINATIONS
 RAJAH SERFOJI GOVERNMENT COLLEGE (AUTONOMOUS)
 THANJAVUR-613 005.

Extra Credit Courses

Course	Skill Enhancement Course	
Course title	Dairy Farming	T323PZOECA
Credits	2	
Course Objectives:		
The main objectives of this course are:		
	Students should know basic concepts in Dairy Farming	
Pre-requisite:		
Students should be aware of economic and cultural importance of Dairy farming.		
Expected Course Outcome:		
Upon completion of this course, Students would		
1	know the needs for dairy farming and the status of India in global market.	K1
2	understand the various breeds and practices in Dairy farming.	K2
3	able to apply the techniques and practices needed for Dairy farming.	K3
4	know the difficulties in dairy farming and be able to propose plans against it. Quality and nutritional aspects of milk	K4 K5
5	diagnose the diseases of poultry	K3 K4

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

Units	
I	Introduction to Dairy Farming- Advantages of dairying- Classification of breeds of cattle-Indigenous and exotic breeds- Selection of dairy cattle. Breeding-artificial insemination-Dairy cattle management-General Anatomy.
II	Construction of Model Dairy House - Types of Housing - Different Managerial Parameters - Winter Management - Summer Management
III	Feedstuffs available for livestock- Roughages -Concentrates - Energy rich concentrates - Protein rich concentrates - Mineral Supplements - Vitamin Supplements - Feed additives - Feeding management - Calves Feeding - Feeding of adults - Feeding of pregnant dairy animals - Feeding pregnant heifer.
IV	Milk-Composition of milk-milk spoilage-pasteurization - Role of milk and milk products in human nutrition – Dairying as a source of additional income and employment.
V	Contagious disease - Common Bacterial - Protozoal - Helminth and Viral Diseases - Parasitic Infestation - Vaccination - Biosecurity.
Reading list	
1. Roger W. Blowey. 2016. The Veterinary Books for Dairy Farmers. Old Pond Publishing Ltd. 2. Board Eiri. Hand Book of Dairy Farming. Engineers India Research Institute. Pp 176 3. Handbook of animal husbandry TATA, S.N ed., ICAR 1990 4. Prabakaran, R. 1998. Commercial Chicken production. Published by P. Saranya, Chennai.	

5. Hafez, E.S.E. 1962. Reproduction in Farm Animals, Lea & Fabiger Publisher.

Recommended texts

https://agritech.tnau.ac.in/farm_enterprises/Farm%20enterprises_%20Dairy%20unit.html

<https://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Tata.+S.N.,+ed%22>

15. James. N. Marner, 1975. Principles of dairy processing, wiley eastern limited, New Delhi.

Baradach, JE. Ryther. JH. and, MC larney WO., 1972. Aquaculture. The farming and Husbandry of Freshwater and Marine Organisms. Wiley InterScience, NewYork.

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

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




CONTROLLER OF EXAMINATIONS
RAJAH SERFOJI GOVERNMENT COLLEGE (AUTONOMOUS)
THANJAVUR-613 005.

Course	Skill Enhancement Course	
Course title	Animal Behaviour	T323PZOECB
Credits	2	
Course Objectives:		
The main objectives of this course are:		
1.	Students should understand basic concepts in Animal behaviour.	
Pre-requisite:		
Students should be aware of ecology and the animals in their respective environments.		
Expected Course Outcome:		
Upon completion of this course, Students would have		
1	Recall and record genetic basis and evolutionary history of behaviour.	K1 & K2
2	Analyse and identify innate, learned and cognitive behaviour and differentiate between various mating systems.	K3 & K4
3	Classify movement and migration behaviours and explain environmental influence upon behaviour.	K1, K4 & K5
4	Knowledge on different types of behaviour in different animals	K2
5	Know the concept of biological clock and its application	K3

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

Units	
I	Genetic material, Genes and chromosomes, Genetic variation, Single and Polygenic inheritance of behaviour, Heritability of behaviour, Natural selection and behaviour, Frequency distribution of phenotypes, Darwinian fitness, Evolution of adaptive strategies.
II	Sexual selection, Altruism, Sexual strategy and social organisation, Animal perception, Neural control of behaviour, Sensory processes and perception, Visual adaptations to unfavourable environments.
III	Coordination and Orientation, Homeostasis and Behaviour, Physiology and Behaviour in changing environments, Animal Learning, Conditioning and Learning, Biological aspects of learning, Cognitive aspects of learning.
IV	Instinct and learning, Displacement activities, Ritualization and Communication, Decision making behaviour in Animals, Complex behaviour of honey bees, Evolutionary optimality, Mechanism of Decision making. The mentality of Animals: Languages and mental representation, non-verbal communication in human, mental images, Intelligence, tool use and culture, Animal awareness and Emotion.
V	Organization of circadian system in multicellular animals; Concept of central and peripheral clock system; Circadian pacemaker system in invertebrates with particular reference to Drosophila; Photoreception and photo- transduction; Molecular bases of seasonality; The relevance of biological clocks for human welfare - Clock function (dysfunction); Human health and diseases – Chrono pharmacology, chrono medicine,

chronotherapy.
Reading list
1. David McFarland, 1985. Animal Behaviour, Longman Scientific & Technical, UK. 576pp. 2. HarjindraSingh, 1990. A TextBook of Animal Behaviour, AnomolPublication, 293pp. 3. Hoshang S.Gundevia and Hare Goving Singh, 1996. Animal Behaviour, S.Chand&Co, 280pp. 4. Shukla, J. P 2010, Fundamentals of Animal Behaviour, Atlantic, 587pp. 5. Vinod Kumar, 2002. Biological Rhythms. Narosa Publishing House, Delhi.
Recommended texts
1. Michael D. Breed and Janice Moore, 2012. Animal Behaviour, Academic Press, USA, 359pp. 2. Aubrey Manning and Martin Stamp Dawkins, 2012. An Introduction to Animal Behaviour, 6th Edition, Cambridge University Press, UK. 458pp. 3. Davis E.Davis, 1970. Integral Animal Behaviour, Mac Millan Company, London, 118pp. 4. Jay, C. Dunlap, Jennifer, J. Loros, Patricia J. De Coursey (ed). 2004. Chronobiology Biological time Keeping, Sinauer Associates Inc, Publishers, Sunderland, MA.

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

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




CONTROLLER OF EXAMINATIONS
 RAJAH SERFOJI GOVERNMENT COLLEGE (AUTONOMOUS)
 - THANJAVUR-613 005.

Course I	Elective V	
Course title	Stem Cell Biology	T323PZOECC
Credits	2	
Course Objectives:		
The main objectives of this course are:		
1.	Students should know understand the basics of stem cells	
Pre-requisite:		
Students should understand the basics of stem cells and its applications		
Expected Course Outcome:		
On the successful completion of the course, student will be able to		
1	Understand the basic knowledge of stem cells and their origin	K1 & K2
2	Differentiating the embryonic and adult stem cells	K3 & K4
3	Understand and apply the current stem cell therapies for their research	K5
4	Know aging, process of aging and reversal, cell death	K2
5	Know the application and advantages of cell therapy	K3

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

Units	
I	Introduction to stem cell biology: Stem cell definition, origin and hierarchy, stem cell properties, Identification and Characterization, potency and differentiation, niche of stem cell, overview of different stem cell types (embryonic stem cells, adult stem cells and induced pluripotent stem cells).
II	Embryonic stem (ES) cell: Characterization and properties of ES cells, pluripotency and self-renewal of ES cells; molecular mechanisms regulating pluripotency and maintenance of the stem state, progressive differentiation of ES cells into ectoderm lineage organs (skin, brain and nerve), mesoderm lineage organs (heart, kidney, muscle, bone and blood), and endoderm lineage organs (lung, liver, stomach, pancreas and intestine).
III	Adult stem cells: Mesenchymal stem cells (MSCs) - sources, properties (plasticity, homing and engraftment), potency and characterization; Haematopoietic stem cells (HSCs) - sources, properties, potency and characterization; steps involved in production of induced pluripotent stem cells (iPSCs); role of Yamanaka factor in iPSCs.
IV	Stem cell and aging: aging theory; cell cycle; telomere and telomerase; senescence of stem cell; role of stem cell in aging; tissue repair and regeneration of adult stem cell.
V	Current stem cell therapies: Advantages and disadvantages of ES cells and adult stem cells (MSCs and HSCs) therapy; Ethical concern on stem cell therapy; current

stem cell therapy for various diseases; clinical outcome of stem cell therapy; state of clinical trials in adult stem cells for various diseases.

Reading list

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

Recommended texts

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

Mapping with Programme Outcomes*

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

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

Signature

Signature
CONTROLLER OF EXAMINATIONS
 RAJAH SERFOJI GOVERNMENT COLLEGE (AUTONOMOUS)
 THANJAVUR-613 005.

Course Objectives:		
The main objectives of this course are:		
1	Students should know basic concepts and techniques in Sericulture.	
Course I	Ability Enhancement Compulsory Course Soft Skill - I	
Course title	SERICULTURE	T423PZOECA
Credits	2	
Pre-requisite:		
Students should be aware of economic and cultural importance of sericulture.		
Expected Course Outcome:		
Upon completion of this course, Students would have		
1	To understand the various practices in sericulture. To know the needs for sericulture and the status of India in global market.	K2 K3
2	Able to apply the techniques and practices needed for sericulture.	K1 K2
3	To know the difficulties in sericulture and be able to propose plans against it.	K5 K6
4	Have laboratory and field skills in mulberry cultivation and silkworm rearing with an emphasis on technological aspects.	K3 K4
5	Competent to transfer the knowledge and technical skills to the Seri-farmers.	K5

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

Units	
I	Introduction to textile fibers; types- natural and synthetic fibers; sources of silk fiber- Tasar, Muga, Anaphe, Gonometa, Fagara, spider and mussel; properties and importance of silk fiber. History, development, status, characteristics and advantages of sericulture in India.
II	Host plants; Moriculture- distribution, morphology, propagation- seedling, cutting, grafting, layering and micropropagation methods, maintenance- irrigation, manuring and pruning, pests and diseases of mulberry.
III	<i>Bombyx mori</i> - morphology, anatomy, life cycle, geographical locations, larval moults, voltinism, indigenous and commercial races. Diapause. Egg-storage and transportation.
IV	<i>Bombyx mori</i> - morphology, anatomy, life cycle, geographical locations, larval moults, voltinism, indigenous and commercial races. Diapause. Egg-storage and transportation. Rearing houses and equipment. Rearing operations- disinfection, brushing, feeding and spacing. Moulting and spinning. Harvest. Rearing methods- chawki, lasso, showa, shelf-rearing, floor-rearing and shoot rearing. Diseases of <i>Bombyx mori</i> - protozoan, bacterial, viral and fungal. Pests of silkworm- Uzi fly, desmestids, mites, ants, nematodes, aves and mammals.
V	Physical and commercial characteristics of cocoons. Cocoon harvesting and marketing. Cocoon sorting, stifling, deflossing, riddling, cooking, brushing, reeling and re-reeling. Weaving. By-products of sericulture industry.

Reading list
1. G. Ganga and J. Sulochana Chetty. 2019. An introduction to sericulture, 2 nd edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. M. Johnson and M. Kesary. 2019. Sericulture, Saras publication, Tamilnadu.
3. Singh, Amardev & Ravinder Kumar. 2013. Sericulture handbook Vol 1, Biotech.
4. M. Madan Mohan Rao. An Introduction to Sericulture, 2 nd edition, BS Publications.
Recommended websites
1. https://agritech.tnau.ac.in/sericulture/
2. https://csb.gov.in/

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

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




CONTROLLER OF EXAMINATIONS
 RAJAH SERFOJI GOVERNMENT COLLEGE (AUTONOMOUS)
 THANJAVUR-613 005.

Course I	Ability Enhancement Course		
Course title	VERMICULTURE	Course Code	T423PZOEBC
Credits	2		
Course Objectives:			
The main objectives of this course are:			
1.	Students should know basic concepts in Vermiculture.		
Pre-requisite:			
Students should be aware of economic and cultural importance of Vermiculture.			
Expected Course Outcome:			
Upon completion of this course, Students would have			
1	To understand the various practices in vermiculture. To know the needs for Vermiculture and the status of India in global market.	K2 & K3	
2	Able to apply the techniques and practices needed for vermiculture.	K1, K2 & K4	
3	To know the difficulties in Vermiculture and be able to propose plans against it	K5 & K6	
4	The ability to apply this technique for organic waste management	K3 & K4	
5	Knowledge on the marketing of this technique	K3	

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

Units	
I	Earthworms - Taxonomic position, external features - shape, size, colour, segmentation, setae & clitellum. Body wall, coelom- locomotion, digestive, circulatory, respiratory, excretory & nervous system. Reproductive system-Male & Female, copulation, cocoon formation & fertilization, development of earth worm. Vermitechnology- Definition, history, growth and development in other countries & India, significance.
II	Vermiculture - definition, common species for culture; Environmental parameters; culture methods – wormery - breeding techniques; indoor and outdoor cultures - monoculture and polyculture - merits and demerits.
III	Vermicomposting of wastes in field pits, ground heaps, tank method, roof shed method, static pile windrows, top fed windrows, wedges & bin method, harvesting the compost, storage.
IV	Applications of vermiculture - Vermiculture Bio-technology, vermicomposting, use of vermicastings in organic farming/horticulture, earthworms for management of municipal/selected biomedical solid wastes; as feed/bait for capture/culture fisheries; forest regeneration.
V	Potentials and constraints for vermiculture in India. Marketing the products of vermiculture - quality control, market research, marketing techniques – creating the demand by awareness and demonstration, advertisements, packaging and transport, direct marketing. Economic importance of Earthworms: In sustainable agriculture, organic farming, earthworm activities, soil fertility & texture, soil aeration, water impercolation, decomposition & moisture, bait & food.

Reading list

1. Sultan Ahmed Ismail, 2005. The Earthworm Book, Second Revised Edition. Orient Longman, India.
2. Bhatnagar, R.K. & R.K. Palla. 2007. Earthworm vermiculture and vermin-composting, Kalyani Publishers, New Delhi. Pp 175. ISBN 9327268695
3. Mary Violet Christy, 2008. Vermitechnology, MJP Publishers, Chennai. Pp 132. ISBN
4. Aravind Kumar, 2005. Verms & Vermitechnology, A.P.H. Publishing Corporation, New Delhi. Pp 200.

Recommended texts

1. <https://agritech.tnau.ac.in/sericulture/>
2. <https://www.agrifarming.in/vermiculture-process-techniques-worm-farming>
3. 11. Edwards, C.A., and Bother, B., 1996. Biology of earthworms, Chapman Hall Publication company.

Mapping with Programme Outcomes*

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

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




CONTROLLER OF EXAMINATIONS
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Course I	Ability Enhancement Compulsory Course	
Course title	Biocomposting	T423PZOECC
Credits	2	
Course Objectives:		
The main objectives of this course are:		
1.	To highlight the importance of biocomposting in waste management.	
2.	To enable students for setting up biocompost units and bins for waste reduction.	
Pre-requisite:		
Students should have a basic understanding of biological process of decomposition.		
Expected Course Outcome:		
Upon completion of this course, Students would		
1	gain knowledge on the process of biocomposting	K1, K2
2	Have knowledge on biocomposting types	K3, K4
3	Able to generate biocomposting from waste.	K3, K5
4	Apply the bicompost for reclamation of land, restoration of soil fertility	K3
5	Able to establish biocomposting facility	K5

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

Units	
I	Biocomposting - Definition, types and ecological importance.
II	Types of biocomposting technology - Field pits/ground heaps/ tank/large-scale/batch and continuous methods.
III	Preparation of biocompost pit and bed using different amendments.
IV	Applications of biocompost in soil fertility maintenance, promotion of plant growth, value added products, waste reduction, etc.
V	Establishments of small biocompost unit - project report proposal for Self Help Group (Income and employment generation).

Reading list

1. Bikas R. Pati & Santi M. Mandal (2016). Recent trends in composting technology.
2. Van der Wurff, A.W.G., Fuchs, J.G., Raviv, M., Termorshuizen, A.J. (Editors). 2016. Handbook for Composting and Compost Use in Organic Horticulture.
3. Bio Greenhouse COST Action FA 1105,

Recommended websites

www.biogreenhouse.org

Mapping with Programme Outcomes*

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

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

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