Thiagarajar College

(An Autonomous Institution Affiliated to Madurai Kamaraj University)
Re-Accredited with 'A' Grade by NAAC

Thirty Ninth Academic Council Meeting

Department of Zoology & Microbiology

Dr. Rm. Murugappan
Dean – Curriculum Development

B.Sc., Zoology

Programme Code - UZO

Programme outcome-PO (Aligned with Graduate Attributes)- Bachelor of Science (B.Sc.,)

Scientific Knowledge and Critical Thinking

Apply the knowledge of Life Science, Physical and Chemical Science, Mathematics, statistics, Computer science and humanities for the attainment of solutions to the problems that come across in our day-to-day life/activities.

Problem Solving

Identify and analyze the problem and formulate solutions for problems using the principles of mathematics, natural sciences with appropriate consideration for the public health, safety and environmental considerations.,

Communication and Computer Literacy

Communicate the fundamental and advanced concepts of their discipline in written and oral form. Able to make appropriate and effective use of information and information technology relevant to their discipline

Life-Long Learning

Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Ethical, Social and Professional Understanding

Commitment to principles, codes of conduct and social responsibility in order to behave consistently with personal respect. Acquire the responsibility to contribute for the personal development and for the development of the community. Respect the ethical values, social responsibilities and diversity.

Innovative, Leadership and Entrepreneur Skill Development

Function as an individual, and as a member or leader in diverse teams and in multidisciplinary settings. Become an entrepreneur by acquiring technical, communicative, problem solving, intellectual skills.

THIAGARAJAR COLLEGE, MADURAI – 9.

(Re-Accredited with 'A' Grade by NAAC)

Department of Zoology and Microbiology

Vision

- To render exemplary quality education in Life Sciences and laboratory skills in order to produce generations of responsible, competent and employable graduates

Mission

- To provide a comprehensive set of courses in biological sciences that enhances the understanding, depth of knowledge and technical competency of the students.
- To prepare the students for entry-level research and teaching Positions in biological sciences.
- To provide an environment that fosters the development of appropriate scientific vocabulary, reasoning skills, effective oral and written communication abilities for students.
- To create a holistic understanding of the allied subjects through interdisciplinary learning.

Programme Educational Objectives (PEO)

The objectives of this programme is to equip/prepare the students to

PEO1	Appraise the taxonomy, diversity, relationship and evolution of animals.
PEO2	Elaborate the importance and interrelationship of basic, applied and advanced fields of life sciences.
PEO3	Create an awareness among the public on the importance and influence of animals on the environment, society, and development.
PEO4	Think methodically, independently and draw a logical conclusion for a biological/environmental problem.
PEO5	A new generation of zoologists, capable of excelling in careers of their choosing and nation building

Programme specific outcomes- B.Sc., Zoology

On the successful completion of B.Sc., Zoology the students will

PSO1	Comprehend the core concepts, methods and recent trends/updates/practices in different disciplines of life sciences.
PSO2	Explain how organisms function at the level of the gene, genome, cell, tissue, organ and organ-system.
PSO3	Interpret the complex evolutionary processes, behavioural pattern, physiological and biochemical processes of various animal
PSO4	Acquire theoretical basis and practical skills in the use of basic tools, technologies and methods common to different disciplines of life sciences like. Taxonomy, Physiology, Ecology, Cell biology, Genetics, Applied Zoology, Clinical science, Biochemistry, biotechnology, Microbiology, Immunology etc.
PSO5	Develops empathy and love towards the animals. Apply the knowledge and understanding of various disciplines of life science to one's own life and work

THIAGARAJAR COLLEGE, MADURAI – 9.

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Department of Zoology and Microbiology

Bachelor of Science (B.Sc.,) Zoology (w.e.f. 2020 batch onwards)

Programme Code-UZO

Semester – I

Course	Code No	Subject	Hrs/ Week	Cred	Total Hrs	Max Mark CA	Max Marks SE	Total
Part I	U20 P111	இக்கால இலக்கியம்	6	3	90	25	75	100
Part II	U20 EN11	English for Comm. I	6	3	90	25	75	100
Core 1	UZO20 C11	Invertebrata	4	4	60	25	75	100
Core 2	U ZO20 C12	Cell Biology	4	4	60	25	75	100
Core lab 1	U ZO20 CL11	Lab in Invertebrata	2	1	30	40	60	100
Generic Elective	UCH20 GE11Z	Chemistry for Life Sciences	4	4	60	25	75	100
Generic Elective lab	UCH20 GL21Z	Bio Chemical Methods Lab	2	-	30	-	-	-
EVS	U20ES11	Environmental Science	2	2	30	15	35	50
TOTAL			**30**	**21**				

Semester – II

Course	Code No	Subject	Hrs/ Week	Cred	Total Hrs	Max Mark CA	Max Marks SE	Total
Part I	U20 P121	பக்தி இலக்கியமும் சிற்றிலக்கியமும்	6	3	90	25	75	100
Part II	U20 EN21	English	6	3	90	25	75	100
Core 3	UZO20 C21	Chordata	4	4	60	25	75	100
Core 4	U ZO20 C22	Evolution	4	4	60	25	75	100
Core lab 2	U ZO20 CL21	Lab in Chordata	2	1	30	40	60	100
Generic Elective	UCH20 GE21Z	Industrial Chemistry	4	4	60	25	75	100
Generic Elective lab	UCH20GL21 Z	Chemistry for Life Sciences and Industrial chemistry – Lab	2	-	30	-	-	-
	UCH20GL21 Z	Bio Chemical Methods Lab	-	2	30	40	60	100
AECC	U20VE21	Value Education	2	1	30	15	35	50
TOTAL			**30**	**22**				

Semester –III

Course	Code No	Subject	Hrs/ Week	Cred	Total Hrs	Max Mark CA	Max Marks SE	Total
Part I	U20 P131	Tamil	6	3	90	25	75	100
Part II	U20 EN31	English	6	3	90	25	75	100
Core 5	U ZO20 C31	Biochemistry	4	4	60	25	75	100
Core 6	U ZO20 C32	Biostatistics	4	4	60	25	75	100
Core lab 3	U ZO20 CL31	Lab in Biochemistry	2	1	30	40	60	100
Generic Elective	UBO20 GE31Z	Plant life forms	4	4	60	25	75	100
Generic Elective lab	UBO20GL 41Z	Plant life forms lab	2	-	30	40	60	100
NME1	UZO20NE 31	Apiculture	2	2	30	15	35	50
TOTAL			**30**	**21**				

Semester – IV

Course	Code No	Subject	Hrs/ Week	Cred	Total Hrs	Max Mark CA	Max Marks SE	Total
Part I	U20P141	Tamil	6	3	90	25	75	100
Part II	U20EN41	English	6	3	90	25	75	100
Core 7	U ZO20 C41	Developmental Biology	4	4	60	25	75	100
Core 8	U ZO20 C42	Genetics	4	4	60	25	75	100
Core lab 4	U ZO20 CL41	Lab in Developmental Biology and Genetics	2	1	30	40	60	100
Generic Elective	UBO20 GE41	Plant Pathology (Bot.)	4	4	60	25	75	100
Generic Elective lab	UBO20 GL41Z	Plant Pathology lab(Bot.)	2	-	-	-	-	-
	UBO20 GL41Z	Plant life forms & Plant Pathology lab(Bot)	-	2	30	40	60	100
NMEII	U ZO20 NE41	Sericulture	2	2	30	**15**	**35**	50
TOTAL			**30**	**23**				

Semester V

Course	Code No	Subject	Hrs/ Week	Cred	Total Hrs	Max Mark CA	Max Marks SE	Total
Core 9	U ZO20 C51	Immunology	5	5	75	25	75	100
Core 10	U ZO20 C52	Molecular biology	6	6	90	25	75	100
Core 11	U ZO20 C53	Animal Physiology	6	6	90	25	75	100
Core lab 5	U ZO20 CL51	Lab in Immunology	2	1	30	40	60	100
Core lab 6	U ZO20 CL52	Lab in Molecular biology	2	1	30	40	60	100
Core lab 7	U ZO20 CL53	Lab in Animal Physiology	2	1	30	40	60	100
Core Elective	U ZO20 CE51	Biophysics/ Wild life biology	5	5	75	25	75	100
SEC I	U ZO20 SE51 A/B/C	Clinical Lab Tech. lab/ Poultry farming/IPR/ Sericulture	2	2	30	15	35	50
TOTAL			**30**	**27**				

Semester VI

Course	Code No	Subject	Hrs/ W	Cred	Total Hrs	Max Mark CA	Max Marks SA	Total
Core 12	U ZO20 C61	Environmental Biology	5	5	75	25	75	100
Core 13	U ZO20 C62	Microbiology	5	5	75	25	75	100
Core 14	U ZO20 C63	Biotechnology	5	5	75	25	75	100
Core lab 8	U ZO20 CL61	Lab in Environmental Biology	2	1	30	40	60	100
Core lab 9	U ZO20 CL62	Lab in Microbiology	2+1*	1	45	40	60	100
Core Lab 10	U ZO20 CL63	Lab in Biotechnology	2+1*	1	45	40	60	100
Core Elective II	U ZO20 CE61	Aquaculture/Entomology	5	5	75	25	75	100
SEC II	U ZO20 SE61 A/B/C/ D	Bioinformatics lab/ Stem Cell Biology/ Forensic Science/Nanotechnology	2	2	30	15	35	50
Part V			**-**	1		**75**	**25**	100
TOTAL			**30**	**26**				

*Chemical preparation

A) Consolidation of contact hours and credits: UG

Semester	Contact Hrs/ Week	Credits
I	30 hrs	21
II	30 hrs	22
III	30 hrs	21
IV	30 hrs	23
V	30 hrs	27
VI	30 hrs	25
Part – V	-	01
Total	180 hrs	140
V	Additional credit (Self study paper)	5

B) Curriculum Credits: Part wise

		No of papers	Credits per paper	Total credits
Part I	**Tamil**	**4**	**3**	**12**
Part II	**English**	**4**	**3**	**12**
Part III	**Core Theory**	**8+6**	**4/5**	**64**
	Core lab	**10**	**1**	**10**
	Core Elective	**2**	**5**	**10**
	Generic Elective Theory	**4**	**4**	**16**
	Generic Elective Theory	**2**	**2**	**4**
Part IV	**AECC**	**2**	**2+1**	**3**
	NME	**2**	**2**	**4**
	SEC	**2**	**2**	**4**
Part V (NSSNCC/Physical Education)				**1**
Grand total				**140**

Thiagarajar College (Autonomous):: Madurai – 625 009

Department of Zoology

(For those joined B. Sc.,zoology on or after June 2020)

Programme Code-UZO

Course Code	Course Title	Category	L	T	P	Credit
UZO20C11	**Invertebrata**	Core-1	4	-	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	25	75	100

Preamble

Invertebrates comprises of fascinating group of animals inhabiting diverse niches across the globe. The diversity and their ecosystem services are of paramount importance and they receive special attention in the medical field too. This course will take the students through the wonderful invertebrate world and make them realize the significance of these tiny spineless creatures.

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Define the fundamental concepts, history and development of invertebrates.	K1
CO2	Outline the taxonomical classification of invertebrates.	K2
CO3	Analyse the structural, functional organization and importance of invertebrates.	K3
CO4	Imparts conceptual knowledge of invertebrate adaptations to their environment	K3
CO5	Recognize the affinities and interaction between different invertebrate groups	K3

K1: Knowledge K2: Understand K3: Apply

Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**L**	**S**	**S**	**L**
CO2	**S**	**S**	**S**	**M**	**L**
CO3	**S**	**S**	**S**	**M**	**L**
CO4	**M**	**L**	**M**	**L**	**S**
CO5	**S**	**S**	**S**	**L**	**M**

Strong –S (+++) Medium-M (++) Low-L (+)

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**S**	**S**	**-**	**S**	**L**	**M**
CO2	**S**	**M**	**-**	**M**	**-**	**L**
CO3	**S**	**M**	**L**	**S**	**-**	**L**
CO4	**S**	**M**	**L**	**S**	**L**	**L**
CO5	**M**	**S**	**L**	**M**	**L**	**L**

Strong –S (+++) Medium-M (++) Low-L (+)

Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Course Title: Invertebrata

Unit I: Phylum Protozoa

Classification of invertebrates upto class level; Types of coelom and symmetry; Binomial nomenclature.
Phylum Protozoa - General characteristics.
Life history and significance of *Amoeba proteus*, *Entamoeba histolytica* and *Plasmodium vivax*- locomotion and feeding in Protozoa.

Unit II: Phylum Porifera and Coelenterata

Phylum Porifera: General characteristics, Life history and significance of Leucosolenia
Spicules and canal system of sponges .
Phylum Coelenterata: General characteristics; Life history and significance of *Hydra vulgaris, Aurelia aurita a*nd *Obelia dicotoma*.
Polymorphism in Coelenterates, Coral reefs and their significance.

Unit III: Phylum Platyhelminthes and Nemathelminthes

General characteristics Life history and significance of *Fasciola hepatica* and *Taeniasolium* parasitic adaptations in Platyhelminthes .
General characteristics *and life history of Ascaris lumbricoides* and *Wuchereria bancrofti*.
Parasitic adaptations in Nemathelminthes

Unit IV: Phylum Annelida and Arthropoda

Phylum Annelida - General characteristics, Life history and significance of Earth worm (*Pheritemia*) and Leech (*Hirudinea*). Metamerism and Types of Nephridia in Annelida .
Phylum Arthropoda: General characteristics,Life history and significance of *Penaeus monodon* and *Periplanata* a*mericana.*
Larval forms of Arthropoda. Mouth parts in Arthropoda, Evolutionary significance of Peripatus and Limulus

Unit V: Phylum Mollusca and Phylum Echinodermata

Phylum Mollusca: General characteristics, Life history and significance of *Pila globosa* and pearl oyster (Pinctada). Torsion, feeding and foot in Molluscus.
Phylum Echinodermata: General characteristics, Life history and significance of star fish (Asterias).Larval forms and water vascular system of Echinodermata; Affinities of echinoderms with hemichordates and chordates.
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Text Books

1. EkambaranathaIyer, M. and Ananthakrishnan, T.N. 2003. A Manual of Zoology, Viswanathan Publications, Chennai.
2. Jordon, E.L. and Verma, P.S. 2005. Invertebrate Zoology, S.Chand& Co. New Delhi

Reference Books

1. Barnes, R.D. 1974. Invertebrate Zoology, W.B. Saunders & Co., Philadelphia.
2. Dhami, P.S. and Dhami, J.K. 2003. Invertebrate Zoology, R.Chand& Co. New Delhi.
3. Hyman, L.H. 2017. The Invertebrates. McGraw Hill publishers, Delhi.
4. Kotpal, R.L. 2005. Invertebrate Zoology, Rastogi Publications, Meerut.

Course Designer: Dr. C. Ravi, Assistant Professor of Zoology

Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Zoology
(For those joined B.Sc Zoology on or after June 2020)
Programme Code-UZO

Course Code	Course Title	Category	L	T	P	Credit
UZO20CL11	**Lab in Invertebrata**	Core Lab-1	-	-	2	1

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	40	60	100

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Able to identify the animals of invertebrate phyla and to recognize their distinguishing features.	K1
CO2	Exhibit theoretical basis and dissection skills	K1
CO3	Elucidate the life history of important invertebrates.	K2
CO4	Appraise the diversity of animals in a phylogenetic context	K3
CO5	Realize the significance of these tiny spineless creatures	K3

K1: Knowledge K2: Understand K3: Apply

Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**L**	**M**	**S**	**L**
CO2	**S**	**M**	**M**	**S**	**M**
CO3	**S**	**L**	**S**	**L**	**L**
CO4	**S**	**L**	**S**	**M**	**L**
CO5	**S**	**M**	**S**	**L**	**L**

Strong –S (+++) Medium-M (++) Low-L (+)

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**S**	**L**	**-**	**S**	**M**	**L**
CO2	**S**	**S**	**-**	**M**	**L**	**-**
CO3	**S**		**-**	**M**	**-**	**L**
CO4	**S**	**L**	**-**	**M**	**-**	**-**
CO5	**S**	**M**	**-**	**S**	**L**	**-**

Strong –S (+++) Medium-M (++) Low-L (+)

Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Course Title: Invertebrata Lab

Dissection and Mounting

1.Earthworm : Mounting of body and pineal setae.
Dissection and display of digestive system.
Dissection and display of nervous system.

2.Mounting of the sting of honey bee.
3.Cockroach: Dissection and display of digestive system.
Dissection and display of nervous system.
4.Mounting of the Aristotle lantern of sea urchin.
5.Mounting of Spicules of fresh water sponges
6.Mounting of Parameium
7.Appendages of Prawn.

Spotters

1.Amoeba, Paramecium, Trypanosoma, Euglena, *Entamoeba histolytica*
2.Canal system in sponges.
3.Taenia solium , Male and Female Ascaris, Liver fluke,Planaria, Radia larva
4. Earth worm, Neries,Arenicola,
5.Centipedes, Millipedes, Scorpion, Peripatus, Stick insect , leaf insect
6.Pila,Octopus,Oyster,Sepia.
7. Star fish, Sea lily, Sea urchin, Sea cucumber.

Larval forms

Nauplius, Zoea, Phyllosoma, Alima, Veliger, Mysin, Megalopa, Bipinnaria, Auricularia.

Reference Books

1. P.S.Verma, 2004 . A Manual of Practical Zoology, S.Chand & Company ltd, New Delhi.
2. S.S.Lal 2013 Practical Zoology, Invertebrate Rastogi Publications, Meerut.
3. Jordon, E.L. and Verma, P.S. 2005. Invertebrate Zoology, S.Chand& Co. New Delhi
4. J.Sinha, A.K.Chatterji and P.Chattopathiya 2019. Advanced Practical Zoology,Books and Allied (PvtP ltd, Kolkata.
5. Jeyasuria et al., 2013. Practical Zoology Vol I Invertebrate-Saras Publications

Course Designer : **Dr.C.Ravi**, Assistant Professor

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Programme Code-UZO

Course Code	Course Title	Category	L	T	P	Credit
UZO20C12	**Cell Biology**	Core-2	4	-	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	25	75	100

Preamble

Students acquire knowledge on the structural organization and function of cells, tissues and organelles. Illustrate cell cycle and its regulation, including the mechanism of mitosis and meiosis.

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Explain the diversity and similarity of different organisms at organization levels.	K1
CO2	Depict the structure of various cell organelles.	K1
CO3	Identify the structural and functional properties of cells, tissues , organelles etc.,	K2
CO4	Portray the various mechanisms of inter and intra cellular communication.	K3
CO5	Appraise the concepts of cells in terms of growth, division, specialisation, motility and interactions.	K2

K1: Knowledge K2: Understand K3: Apply

Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	---	M	M	S
CO2	M	---	---	M	M
CO3	M	M	---	M	S
CO4	L	---	---	M	M
CO5	M	---	---	M	---

Strong –S (+++) Medium-M (++) Low-L (+)

Mapping of Course Outcomes with Programme Outcomes

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

Strong –S (+++) Medium-M (++) Low-L (+)

Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Course Title: Cell Biology

Unit I – Introduction to cell

Cell Theory, Diversity of cell – shape and size, Ultra structure of plant and animal cell, Cell types –epithelial cells, endothelial cells, Plasma membrane-Davison and Danielli model, Fluid mosaic model, Transport of molecules – Membrane Transport.

Unit II - Organelles

Structure, types and functions of: Mitochondria, Chloroplast, Ribosome, Endoplasmic reticulum (rough and smooth), Golgi apparatus, Lysosome, Nucleus, Chromosome, Microfilaments, Microtubules, Cilia and, Flagella.

Unit III – Tools of Cell Biology

Principle, working mechanism and applications of-Compound, Phase Contrast, Fluorescent, Electron (Transmission and Scanning) microscopy; Micrometry, subcellular fractionation- ultra centrifuge, Cytological techniques- Fixation & Sectioning, Staining- H & E, Giemsa, DAPI, Calcein

Unit IV - Cell Communication

Types of cell signalling- signal molecules-Surface membrane and cytoplasmic receptors ; Cell-cell Communication, Intracellular signalling.
Cell –Cell interactions: Extra Cellular Matrix (ECM), Cell Adhesion, Cell migration, Cell Junctions

Unit V- Cell division

Phases of cell cycle, regulation of cell cycle, Phases and significance of Mitosis, Meiosis, Apoptosis, Necrosis , Biology of cancer

Text Books:

1. Power, C.B. 2009. Cell Biology. Himalayan Publishing House, New Delhi.
2. Paul, A. 2009. Cell and Molecular Biology. Books and Allied (P) ltd, India.

References:

1. Alberts, B. *et al.*, 1994. Molecular Biology of the Cell (3rd edition). Garland Publishing, Inc., New York

2. Cooper, GM and Hawman RE. 2013. Cell a Molecular Approach (6th Edition). Sinauer Associates, Inc

3. De Roberties E.D.P and E.M.F.De Roberties. 2011. Cell and Molecular Biology. 8th edition. B.I. Publicatons Pvt. Ltd., India

4. Karp G. 2013. Cell and Molecular Biology Concepts and Experiments. John Wiley & Sons, Inc

5. Lodish et al.2008Molecular Cell Biology.6th Ed., W.H. Freeman & Co.USA

6. Stephen R. B, Jeremy S. H, *et.al.*,2008 Cell Biology a short course, 2nd Edition, a John wiley& sons, Inc., publication – (e- book)

Course Designer: Dr. T S Ramyaa Lakshmi, Assistant Professor in Zoology

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Department of Zoology
(For those joined B.A., B.Sc., B.Com., B.B.A., B.C.A on or after June 2020)

Course Code	Course Title	Category	L	T	P	Credit
U20ES1	**Environmental Studies**	AECC1	2	-	-	2

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	15	35	50

Preamble

Students acquire knowledge on the basic concepts, comonents and importance of environment.

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Define the structure and functions of ecosystem	K1
CO2	Explain the benefits of biodiversity conservation	K2
CO3	Summarise the sources, effects and control measures of various types of Pollutant and pollutants	K1
CO4	Perceive the environment legislations in India for sustainable development.	K3
CO5	Elaborate the impact of environmental problems on life systems	K3

K1: Knowledge K2: Understand K3: Apply

Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**L**	**L**	**M**	**L**	**M**
CO2	**---**	**M**	**M**	**---**	**M**
CO3	**---**	**L**	**M**	**L**	**L**
CO4	**---**	**---**	**L**	**L**	**L**
CO5	**S**	**-**	**L**	**M**	**M**

Strong –S (+++) Medium-M (++) Low-L (+)

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**S**	**S**	**L**	**S**	**S**	**-**
CO2	**S**	**M**	**L**	**M**	**L**	**L**
CO3	**S**	**S**	**L**	**S**	**M**	**L**
CO4	**S**	**S**	**L**	**M**	**S**	**S**
CO5	**S**	**M**	**-**	**S**	**S**	**S**

Strong –S (+++) Medium-M (++) Low-L (+)

Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Course Title: Environmental Studies

Unit I

Definition and Scope of Environmental Studies – Ecology and Ecosystem – Structure of an Ecosystem – Food chains, food webs and ecological pyramids – Causes of Biodiversity Loss – Benefit and Conservation of Biodiversity

Unit II

Environmental problems and Management: Causes, effects and Control measures of : Air Pollution – Water Pollution – Noise pollution – Nuclear Hazards. Solid waste management and Waste Disposal methods. Climate change and Global Warming causes and Measures. Waste and Plastics. Urban environmental problems and measures. Environmental Legislations in India. Sustainable development and Inclusive growth.

Text Book

1. Kanagasabai, C.S. 2005.Environmental Studies. Rasee publishers. Madurai.

Reference Books

1. Yogendra, N. and Srivastava, N. 1998. Environmental Pollution, Ashish Publishing House. New Delhi.
2. Sapru R.K.2001. Environment Management in India, Vol. I & Vol. II Ashish publishers house, New Delhi.

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Programme Code-UZO

Course Code	Course Title	Category	L	T	P	Credit
UZO20C21	**Chordata**	Core-2	4	-	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	25	75	100

Preamble

The course provides a overview of chordate diversity & special characteristics. It outlines the general characteristics, anatomy and adaptations of each class of vertebrates.

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Elaborate the morphology & affinities of prochordates	K1
CO2	Describe Scoliodon and appreciate the special characteristics of order Pisces.	K1
CO3	Comparative studies *Rana hexadactyla* & *Calotes versicolor*	K3
CO4	Explain *Columba livia* with special reference to flight adaptations and mechanism of flight	K2
CO5	Compare different types of Mammals and their adaptation	K3

K1: Knowledge K2: Understand K3: Apply

Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**M**	**---**	**M**	**M**	**S**
CO2	**M**	**---**	**---**	**M**	**M**
CO3	**M**	**M**	**---**	**M**	**S**
CO4	**L**	**---**	**---**	**M**	**M**
CO5	**M**	**---**	**---**	**M**	**---**

Strong –S (+++) Medium-M (++) Low-L (+)

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**M**	**-**	**-**	**M**	**-**	**-**
CO2	**M**	**L**	**-**	**M**	**L**	**-**
CO3	**M**	**L**	**-**	**M**	**L**	**L**
CO4	**M**	**-**	**-**	**M**	**L**	**-**
CO5	**S**	**S**	**-L**	**M**	**L**	**L**

Strong –S (+++) Medium-M (++) Low-L (+)

Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Course Title: Chordata

Unit I: **Prochordates**

General characteristics of chordates- classification upto class level – Prochordates – cephalochordate - *Amphioxus* morphology , feeding mechanism & affinities - Hemichordates- *Balanoglossus* external morphology & affinities – Urochcordata – Ascidian external morphology, affinities & retrogressive metamorphosis.

Unit II: **Pisces**

General characteristics & classification upto orders – Ostacoderm and Placoderms- characters & significance – Petromyzon external morphology & comparison with hagfishes- Type study *Scoliodon* – external morphology , digestion, respiration, blood vascular system , nervous system , urinogenital system – Parental care and Migration in fishes

Unit III: **Amphibia & Reptilia**

Amphibia :General characteristics & classification upto orders – Type study *Rana hexadactyla* - external morphology , digestion, respiration , blood vascular system , nervous system , urinogenital system – Parental care in amphibians

Reptilia: General characteristics & classification upto orders – Type study *Calotes versicolor* - external morphology , digestion, respiration , blood vascular system , nervous system , urinogenital system – Poison apparatus & biting mechanism of snakes – Jacobson's organ

Unit IV : **Aves**

General characteristics & classification upto orders – Type study *Columba livia* - external morphology , digestion, respiration , blood vascular system , nervous system , urinogenital system- Flight adaptations- Mechanism of flight – structure of contour feather – migration in birds.Flightless birds

Unit V : **Mammalia**

General characteristics & classification upto orders – Type study *Oryctolagus*- external morphology , digestion, respiration , blood vascular system , nervous system , urinogenital system- Flying mammals & their adaptations – Aquatic mammals & adaptations - Egg laying mammals- Pouched mammals

Text books:

1. Jordan EL and Verma PS (2013) Chordate Zoology, S.Chand & Co Ltd., New Delhi
2. Ayyar E (1982) Manual of Zoology Vol.II-.S.Viswanathan (Printers & Publishers) Pvt. Ltd., Chennai.

Reference Books:

1. Romer AS (1992) The vertebrate body, 3rd Edition,Vakils, Fefer and Simons Pvt. Ltd, Mumbai.
2. Kotpal RL (2014) Modern textbook of Zoology Vertebrates. 3rd Edition Rastogi Pubications, Meerut.
3. Saxena RK and Saxena S (2008) Comparative anatomy of vertebrates. Viva books Pvt. Ltd., New Delhi.

Course Designer : Mrs. **U.Soundarya** Assistant Professor in Zoology

Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Zoology
(For those joined B.Sc Zoology on or after June 2020)
Programme Code-UZO

Course Code	Course Title	Category	L	T	P	Credit
UZO20CL21	**Chordata Lab**	Core-2		-	2	1

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	40	60	100

Preamble

The course provides a overview of chordate diversity & special characteristics. It outlines the general characteristics , anatomy and adaptations of each class of vertebrates.

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Elaborate the morphology & differentiation of animals	K1
CO2	Proficient in dissection and display of fishes and other chordates	K1
CO3	Efficient in mounting of parts of organs	K3
CO4	Study of different systems using virtual dissection	K2
CO5	Identify the preserved specimens and their importance	K3

K1: Knowledge K2: Understand K3: Apply

Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**M**	**-**	**S**	**S**	**M**
CO2	**S**	**-**	**S**	**S**	**M**
CO3	**S**	**-**	**M**	**S**	**M**
CO4	**S**	**-**	**S**	**S**	**L**
CO5	**M**	**-**	**L**	**S**	**-**

Strong –S (+++) Medium-M (++) Low-L (+)

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**S**	**L**	**-**	**M**	**-**	**L**
CO2	**S**	**S**	**-**	**M**	**S**	**-**
CO3	**S**	**L**	**-**	**L**	**S**	**-**
CO4	**S**	**S**	**S**	**M**	**-**	**M**
CO5	**M**	**M**	**-**	**M**	**L**	**-**

Strong –S (+++) Medium-M (++) Low-L (+)

Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Course Title: Chordata lab

1.Identifiation of
- a. male and female fishes
- b. Poisonous and non poisonous snakes

2. Differentiating sheep from goat., rabbit from hare
3.Morphology of fishes.
4.Dissection and display of digestive system and cranial nerves of fishes.
5. Study of dentition in man and rat.
6.Mounting of scales.
7. Comparitive study: Skeletal system of frog and rat.

Virtual dissection

1.Digestive , nervous and reproductive system of frog.
2.Rat – Digestive, respiratory, circulatory and reproductive system.

Spotters

1. Amphioxus, Balanoglossus, Ascidian
2. Shark, Catla, Gold fish, Electric ray, Echeneis
3. Frog, Toad, Tadpole Axolotyl larva, Hyla
4. Pigeon, Eagle, Kingfisher, Wood pecker, Peacock, Archaeopteryx
5. Cobra, Krait, Russel viper, Python, Calotes, Chameleon.
6.Kangaroo,Pteropos. Echidna

Course Designer : **Dr.C.Ravi** Assistant Professor

Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Zoology
(For those joined B.Sc Zoology on or after June 2020)
Programme Code-UZO

Course Code	Course Title	Category	L	T	P	Credit
UZO20C21	**Evolution**	Core-3	4	-	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	25	75	100

Preamble

The course gives an overview on the various theories of origin of Life & Evolution. It acquaints the students with the concepts of Natural selection & speciation.

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Elaborate the theories of origin of life	K1
CO2	Illustrate how organic evolution occurred and how the various life forms come into existence	K1
CO3	Explain historical periods during the evolution of earth and status of fauna during the particular age	K3
CO4	Explain modes of selection, how speciation occur and reasons for extinction	K3
CO5	Describe the history of life on earth. idea regarding the evolution of horse and man	K2

K1: Knowledge K2: Understand K3: Apply

Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**M**	**---**	**M**	**M**	**S**
CO2	**M**	**---**	**---**	**M**	**M**
CO3	**M**	**M**	**---**	**M**	**S**
CO4	**L**	**---**	**---**	**M**	**M**
CO5	**M**	**---**	**---**	**M**	**---**

Strong –S (+++) Medium-M (++) Low-L (+)

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**S**	**S**	**M**	**M**	**M**	**-**
CO2	**S**	**S**	**L**	**S**	**M**	**-**
CO3	**S**	**S**	**M**	**M**	**M**	**M**
CO4	**M**	**S**	**-**	**M**	**M**	**L**
CO5	**S**	**S**	**S**	**S**	**S**	**M**

Strong –S (+++) Medium-M (++) Low-L (+)

Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Course Title: Evolution

Unit I: Theories on the origin of life

Abiogenesis, Special creation , cosmozoic theory, spontaneous generation, coacervates theory, chemical evolution , Urey – Miller experiment **,** Germplasm theory.

Unit II Evidences for evolution

Evidences from comparative anatomy – homology in vertebrate limbs- Analogy in wings of birds, vestigial organs – Embryological , biochemical, physiological, paleontological evidences, connecting links, living fossils – Geological time scale & extinction

Unit III Theories of Evolution

Lamarckism & Neo Lamarckism -Voyage of Beagle & Darwin's observations on Galapagos Islands- Darwin's Concept of Evolution - Genetic variation & its sources – Neo Darwinism**,** Mutation theory , Modern synthetic theory of evolution.

Unit IV: Natural selection & Speciation

Modes of selection – stabilizing selection, directional selection & disruptive selection- Kin selection , sexual selection & group selection

Adaptation –Colouration and Mimicry

Species concept, types of speciation – mechanisms of geographic and reproductive isolation- prezygotic& post zygotic.

Hardy Weinberg Equilibrium - Genetic drift. Basic outlines of Molecular evolution.

Unit V: Evolution of horse and man

Evolution of horse - Eohippus, Mesohippus, Merychippus, Pliohippus, Equus

Primates classification & Fossil Apes - Human Evolution : Dryopethicus, Australopithecus, , *Homo habilis, Homo erectus*, Neanderthal , *Homo sapiens*.

Text Books

1.Verma PS, & Agarwal VK 2014 *Cell Biology, Genetics, Evolution and Ecology*, S Chand Publishers, New Delhi.

2. Gupta PK, 2016; Cytology, Genetics & Evolution, Rastogi Publications, Meerut.

3. Stebbins GL 1966; Process of Organic Evolution. Prentice Hall, New Delhi.

Reference books

1. Darwin, RC (1859) On the Origin of Species by the means of Natural Selection, John Murrey, Abemarel Street London.

2. Barton NH, Briggs DEG, Eisen JA, Goldstein DB and Patel NH, 2007 *Evolution*. Cold Spring, Harbour Laboratory Press. USA

3. Hall BK &Hallgrimsson B,2013 *Evolution*, Jones and Bartlett Publishers.

4. Dobzansky, T 1976 Genetics and the origin of species. Oxford TBH Publishing Co. New Delhi.

5. Dodson, EO 1960 Evolution: process and product. Affiliated East- West Press, New Delhi.

Course designer :Mrs. U.Soundarya, Assistant professor in Zoology

THIAGARAJAR COLLEGE, MADURAI – 9.

(Re-Accredited with 'A' Grade by NAAC)

Department of Biotechnology

(For those joined B.A., B.Sc., B.Com., B.B.A., B.C.A on or after June 2020)

VALUE EDUCATION

Course Code	Course Title	Category	L	T	P	Credit
U20VE21	**Value Education**	AECC2	2	-	-	1

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	15	35	50

Preamble

Students acquire knowledge on the basic concepts, components and importance of environment.

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Define the values, Self assessment and values needed for self development	**K1**
CO2	Explain about the good character and good relationships	**K2**
CO3	Summarise the types of thoughts, developing thought pattern, external influences on thoughts	**K1**
CO4	Find out the causes of Illusions, Symptoms and stages of stress	**K3**

K1: Knowledge K2: Understand K3: Apply

Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**L**	**-**	**M**	**-**	**-**
CO2	**-**	**L**	**M**	**L**	**-**
CO3	**M**	**M**	**S**	**-**	**-**
CO4		**-**	**M**	**L**	**-**

Mapping of Course Outcome with Programme Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5	PO6
CO1	**L**	**-**	**M**	**-**	**-**	**-**
CO2	**-**	**L**	**M**	**L**	**-**	**L**
CO3	**M-**	**M**	**S**	**-**	**-**	**-**
CO4		**-**	**M**	**L**	**-**	**M**

Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Course Title: Value Education

Unit I

Self Development – Introduction - Definition and Types of Values – Self Assessment – Values needed for self development - Values needed for family life –Principles of happy living

Character development- Good character – Good relationships - Legendary people of highest character – The quest for character –Developing character -The key to good character.

Unit II:

Positive Thinking and Self Esteem - Types of thoughts - Areas of thinking - Developing thought pattern - External influences on Thoughts - Methods to keep outlook positive – Meaning of Self Esteem – Self empowerment.

Stress free living – Illusions and causes - Symptoms and stages of stress – Self confidence– Role models and leadership qualities – Critical thinking - Communication skills – Happy and successful life.

Reference:

Study material / Course material

1. Values for Excellence in Life Compiled by then Curriculum Development Cell Thiagarajar College, Madurai, in collaboration with the Education wing, Brahma Kumaris, Madurai.

Generic Elective
(Allied Papers)

Offered by Zoology Department

Generic Elective course Syllabus
For Botany and Chemistry Major Students – w.e.f. 2020 June

Major	Year	Sem	Code	Title of the Paper	Cont Hrs/W	Credit
Botany	I	I	UZO20GE11B/C	Economic Zoology	4	4
		II	UZO20GE21B	Insect Pests and Management	4	4
		II	UZO20GL21B	Lab in Economic Zoology & Insect Pests and Management	2	2
Chemistry	II	III	UZO20GE11B/C	Economic Zoology	4	4
		IV	UZO20GE41C	Clinical Chemistry	4	4
		IV	UZO20GL41C	Lab in Economic Zoology& Clinical Chemistry	2	2

Scheme of Examinarion

Mark Statements:	**Internal (CA)**	**External (Sum)**
Theory:	25	75
Practical:	40	60

Minimum Marks required

	Internal (CA)	**External (Sum)**	**CA + SUM**
Theory	Nil	27 / 75	35%
Practical	Nil	21 / 60	35%

Thiagarajar College (Autonomous) :: Madurai – 625 009
Department of Zoology

(For those joined B.Sc., Chemistry and Botany on or after June 2020)

Course Code	Course Title	Category	L	T	P	Credit
UZO20GE11B/C	Economic Zoology	Generic Elective	4	-	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First Bot. / Second Chem	First for Botany/ Third for Chemisty	25	75	100

Preamble

Elaborates the multidisciplinary nature of zoology. Explain the topics like sericulture, lac culture, apiculture, fisheries,poultry science, and so on.

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Spell the importance of applied biological sciences such as sericulture, apiculture, aquaculture	K1
CO2	Explain rearing methods of beneficial organisms – an economic perspectives	K3
CO3	Spell the different strategies adopted in poultry and aquaculture	K2
CO4	Spell the dos and donots in animal rearing	K2
CO5	Start their own agro based small scale industry business such as poultry, apiculture, sericulture etc.,	K3

K1: Knowledge K2: Understand K3: Apply

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**S**	**M**	**-**	**S**	**S**	**L**
CO2	**S**	**M**	**-**	**S**	**M**	**L**
CO3	**S**	**S**	**-**	**M**	**L**	**L**
CO4	**S**	**S**	**-**	**M**	**M**	**L**
CO5	**M**	**M**	**-**	**S**	**L**	**S**

Strong –S (+++) Medium-M (++) Low-L (+)

Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**---**	**--**	**M**	**S**
CO2	**S**	**L**	**M**	**S**	**M**
CO3	**M**	**---**	**---**	**S**	**M**
CO4	**S**	**M**	**M**	**S**	**S**
CO5	**---**	**---**	**M**	**S**	**S**

Strong –S (+++) Medium-M (++) Low-L (+)

Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Course Title:Economic Zoology

Unit I Sericulture

Importance of sericulture, Sericulture industry in India. Moriculture: Morphology of mulberry plants, methods of propagation. Classification of mulberry silkworm and non-mulberry silkworm, life cycle of mulberry silkworm (*Bombyx mori*), rearing of silkworms, diseases of silkworm (maggot, pebrine, polyhedrosis, flacherie).

Unit II Lac culture

Economic importance, lac industry in India. Life history of lac insect, Host plants, rearing of lac insect, Processing of lac, composition of lac, Enemies of lac cultivation.

Unit III Apiculture

Classification of bee's (rock bee, Indian bee, little bee, European bee, dammer bee), social organization of honey bee, bee dance, life history of *Apis indica*, Composition of honey, bee keeping equipments. Methods of bee keeping: Indigenous and modern (Newton's Bee hive) methods. Economic importance of honey.

Unit IV Poultry

Poultry industry in India, choosing a commercial layers and broilers, poultry house (deep litter and cage systems), rearing of layers and broilers. Nutritional content: egg and flush. Diseases (Ranikhet, pullorum, Aspergillosis, Coccidiosis and their control).

Unit V Aquaculture

Qualities of culturable fishes, Culture of Indian major carps (Catla, Rohu) and cat fishes (Parhin, Tengra), fish farming (Pond, riverine, dam, lake cultures), fish breeding (natural and induced), fish harvesting, preservation of fish, water quality management, ornamental fish culture and its economic importance.

Text Books:

1. Shukla, G.S. and V.B. Upadhyay, 1985.Economic Zoology, First edition, Rastogi publication, Meerut.
2. Arumugam, N. 2001. Applied Zoology, Saras Publication,

Reference Books:

1. David, B.V., and T. Kumaraswami, 2000.Elements of Economic Entomology, Popular Book Depot, Chennai .
2. Ravindranathan, K.R.2005, A text book of Economic Zoology, Dominant publisher and distributors (P) Ltd., New Delhi.
3. Ahsan, J. and S.P. Sinha, 1985 .A hand book on Economic Zoology, Third edition, S. Chand & company (P) Ltd., New Delhi.

4. Kotpal, R.L., S.K. Agrawal and R.P. Khetarpal,1985 Invertebrate Zoology, Sixth edition, Rastogi publication, Meerut .
5. Nayar, K.K., T.N. Ananthakrishnan, and B.V. David,1976 General and applied entomology. McGraw-Hill publishing company (Ltd.), New Delhi.
6. Rathinasamy, G.K., 1999.Medical entomology and elementary parasitology, Viswanathan publication, Chennai.

Course designers
1. Dr. T. RAJAGOPAL Assistant professor in Zoology
2. Dr. P. SURESH, Associate professor in Zoology

Thiagarajar College (Autonomous) :: Madurai – 625 009
Department of Zoology
(For those joined B.Sc Botany on or after June 2020)

Course Code	Course Title	Category	L	T	P	Credit
UZO20GE21B	**Insect and Pest Management**	Generic Elective	4	-	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First Botany	Second	25	75	100

Preamble

The course corroborates the knowledge on pests and their management. Understanding the bionomics of interests will bring innovative ideas to the learners. Provide an idea on the pest of agricultural, cattle, house hold and vectors. Elaborates on different pest control measures

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Classify the types of pests and important insect groups	K1
CO2	List the household pests and interpret disease transmission and control	K2
CO3	Identify cattle pests and analyze their infection and control	K2
CO4	Categorize crop pests and apply management theory and practice	K
CO5	Emphasize biology, infestation, and damage caused by stored product insect pests	K3

K1: Knowledge K2: Understand K3: Apply

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**S**	**L**	**-**	**S**	**M**	**M**
CO2	**S**	**S**	**-**	**S**	**M**	**L**
CO3	**S**	**S**	**-**	**S**	**M**	**L**
CO4	**S**	**S**	**M**	**S**	**S**	**L**
CO5	**S**	**S**	**M**	**S**	**S**	**M**

Strong –S (+++) Medium-M (++) Low-L (+)

Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**L**	**---**	**M**	**---**	**M**
CO2	**M**	**L**	**S**	**L**	**L**
CO3	**M**	**L**	**L**	**M**	**M**
CO4	**M**	**---**	**M**	**M**	**M**
CO5	**---**	**M**	**S**	**S**	**M**

Strong –S (+++) Medium-M (++) Low-L (+)

Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Unit I:

Pest: Definition & types, feeding habits & types of mouth parts. General characters and outline of orders Coleoptera, Lepidoptera, Hemiptera & Hymenoptera.

Unit II:

Biology, disease transmission and control of *Musca domestica* (cholera), *Anopheles stephensii* (malaria), *Culex quinquefasciatus* (elephantiasis) & *Aedes aegypti* (dengue).

Unit III:

Biology, mode of transmission, infestation and control measures of *Hypoderma lineatus*, *Tabanus striatus*, *Hippobosca equine* & *Haematopinus quadripertusus*.

Unit IV

Life history, mode of infection, damage and control methods of major pests of plants such as cotton bollworm (*Helicoverpa armigera*), sugarcane shoot borer (*Chilo infuscatellu*), rice stem borer (*Scirpophaga incertulas*) & Brinjal borer (*Leucinodes orbonalis*). Basic concept & application of integrated pest management (IPM) and Insecticide Resistance Management (IRM).

Unit V

Sorts of insect pests of house hold and stored products, their biology, mode of infestation, damage caused and control methods of cockroach (*Periplaneta americana*), silver fish (*Lepisma saccharina*), red flour beetle (*Tribolium castaneum*) & rice weevil (*Sitophilus oryzae*).

Text Books:

1. David, B.V., and T. Kumaraswami, 2000. Elements of Economic Entomology, Popular Book DePSOt, Chennai.
2. Ravindranathan, K.R., 2005.A text book of Economic Zoology, Dominant publisher and distributors (P) Ltd., New Delhi .

Reference Books:

1. Ahsan, J. and S.P. Sinha, 1985. A hand book on Economic Zoology, Third edition, S. Chand & company (P) Ltd., New Delhi .
2. Fennemore, P.G. and A. Prakash, 1992.Applied Zoology, Wiley Eastern Limited, New Delhi .
3. Kotpal, R.L., S.K. Agrawal and R.P. Khetarpal,1985. Invertebrate Zoology, Sixth edition, Rastogi publication, Meerut.
4. Nayar, K.K., T.N. Ananthakrishnan, and B.V. David,1976. General and applied entomology. McGraw-Hill publishing company (Ltd.), New Delhi.
5. Rathinasamy, G.K., 1999.Medical entomology and elementary parasitology, Viswanathan publication, Chennai.
6. Shukla, G.S. and V.B. Upadhyay, 1985.Economic Zoology, First edition, Rastogi publication, Meerut .

Course designers

1. Dr. T. RAJAGOPAL Assistant Professor 2. Dr. P. SURESH Associate Professor

Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Zoology
(For those joined B.Sc., Botany on or after June 2020)

Course Code	Course Title	Category	L	T	P	Credit
UZO20GL21B	Lab in Economic Zoology and Insect Pests & Management	Generic elective lab	2	-	-	2

Year	Semester	Int. Marks	Ext.Marks	Total
First	First & Second	40	60	100

Preamble

Elaborate about beneficial and harmful insects, their life cycle. Appraise the steps involved in the development of apiary and sericulture unit. Brief description on different pest control strategies.

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Explain the morphology, life history of lac insect, honey bees and silkworm	K1
CO2	Distinguish the different components of bee hives.	K2
CO3	Appraise the quality of water and honey .	K2
CO4	Categorize the different pests of agriculture crops	K3
CO5	Make a field study in an ecosystem	K3

K1: Knowledge K2: Understand K3: Apply

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**S**	**M**	**-**	**S**	**M**	**M**
CO2	**S**	**S**	**L**	**S**	**S**	**M**
CO3	**S**	**S**	**M**	**S**	**M**	**M**
CO4	**S**	**S**	**-**	**S**	**M**	**L**
CO5	**M**	**S**	**L**	**S**	**M**	**M**

Strong –S (+++) Medium-M (++) Low-L (+)

Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**M**	**---**	**L**	**L**	**L**
CO2	**M**	**---**	**---**	**S**	**L**
CO3	**L**	**---**	**M**	**S**	**L**
CO4	**L**	**---**	**---**	**M**	**M**
CO5	**S**	**---**	**M**	**M**	**M**

S-Strong, M-Medium, L-low

Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Economic Zoology

1. External Morphology of *Bombyx mori*
2. Identification of lac insects
3. Identification of type of honey bees
4. Bee hives - Model
5. Broilers and layers- types
6. Estimation of Dissolved oxygen in aquarium/fish pond
7. Estimation of pH & Salinity
8. Estimation of CO_2 in aquarium/fish Pond
9. Honey –Qualitative analyses

Insect Pests & Management

1. Mouthparts of Housefly, cockroach and mosquitoes
2. Life cycle of Housefly and Mosquitoes
3. Identification of pests of cattle, paddy, sugarcane and cotton
4. LC_{50} value of a selected pesticide on mosquito larvae
5. Field study – collection, identification and preservation of insect pests and natural enemies

Reference Books:

1. David, B.V., and T. Kumaraswami, 2000. Elements of Economic Entomology, PSOpular Book Depot, Chennai.
2. Ravindranathan, K.R., 2005, A text book of Economic Zoology, Dominant publisher and distributors (P) Ltd., New Delhi.
3. Nayar, K.K., T.N. Ananthakrishnan, and B.V. David, 1976. General and applied entomology. McGraw-Hill publishing company (Ltd.), New Delhi.
4. Shukla, G.S. and V.B. Upadhyay, 1985, Economic Zoology, First edition, Rastogi publication, Meerut
5. Rathinasamy, G.K., 1999. Medical entomology and elementary parasitology, Viswanathan publication, Chennai.

M.Sc. Zoology

(Programme Code: PZO)

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with 'A' Grade by NAAC)
Curriculum Structure for PG

Semester	Category	No. of Courses	Credit Distribution
I	Core	---	18
	Elective	1	5
II	Core	---	18
	Elective	1	5
III	Core	---	18
	Elective	1	5
IV	Core	---	18
	Project	1	3
Total Credits			90

For Choice Based Credit System (CBCS)

- **Choices should be offered for Elective Courses**
- **Total Credits for Core Courses 72**
- **Total Credits for Elective Courses 18 (3 Electives + 1 Project)**

Programme outcome-PO (Aligned with Graduate Attributes)- Master of Science (M.Sc.,)

Knowledge

Acquire an overview of concepts, fundamentals and advancements of science across a range of fields, with in-depth knowledge in at least one area of study. Develop focused field knowledge and amalgamate knowledge across different disciplines.

Complementary skills

Students will be able to engage in critical investigation through principle approaches or methods and through effective information search and evaluation strategies. Employ highly developed conceptual, analytical, quantitative and technical skills and are adept with a range of technologies;

Applied learning

Students will be able to apply disciplinary or interdisciplinary learning across multiple contexts, integrating knowledge and practice. Recognize the need for information; effectively search for, evaluate, manage and apply that information in support of scientific investigation or scholarly debate;

Communication

Communicate effectively on scientific achievements, basic concepts and recent developments with experts and with society at large. Able to comprehend and write reports, documents, make effective presentation by oral and/or written form.

Problem solving

Investigate, design and apply appropriate methods to solve problems in science, mathematics, technology and/or engineering.

Environment and sustainability

Understand the impact of the solutions in ethical, societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.

Teamwork, collaborative and management skills.

Recognise the opportunities and contribute positively in collaborative scientific research. Engage in intellectual exchange of ideas with researchers of other disciplines to address important research issues

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with 'A' Grade by NAAC)
Department of –Zoology and Microbiology

Vision

- Render exemplary quality education in Life Sciences and laboratory skills to produce generations of responsible, competent and employable graduates

Mission

- To provide a comprehensive set of courses in biological sciences that enhances the understanding, depth of knowledge and technical competency of the students.
- To prepare the students for entry-level research and teaching positions in biological sciences.
- To provide an educational environment that fosters the development of appropriate scientific vocabulary, reasoning skills, effective oral and written communication abilities for students.
- To create a holistic understanding of the allied subjects through interdisciplinary learning.

Programme Educational Objectives (PEO)

The objectives of this programme is to equip/prepare the students

PEO1	Endow with a spirit of resource conservation and love for nature.
PEO2	Explicate the different forms of organisms their structure, physiology and adaptations. Interpret how ecological aspects of biotic and abiotic components are interrelated, their interactions as well as their influence in the functioning of ecosystem.
PEO3	Basics and current updates in the areas of Microbiology, Immunology, Biotechnology, Genetic Engineerinng are included to train the students and also sensitize them to scope for research.
PEO4	The laboratory training in addition to theory will equip the student for careers in the industry, agriculture, and applied research.
PEO5	Perform functions that demand higher competence in national/international organizations.

Programme specific outcomes- M.Sc., Zoology

On the successful completion of M.Sc., Zoology the students will

PSO1	Proficient in core concepts, recent trends in different disciplines of life sciences like microbiology, biochemistry, cell and molecular biiology, genetics and genetic engineering, evolution, entomology, IPR, bioethics, bioethics bioinformatics etc.,
PSO2	Explain how organisms function at gene, genome, cell, tissue, organ and organ-system level of organization.
PSO3	Possess theoretical basis and practical skills in the use of basic and advanced instruments. Further able to create, select and apply appropriate techniques, resources and modern technology in multi-disciplinary environment.
PSO4	Apply theoretical knowledge gained for prominent carrear and for further academic study.
PSO5	Appear for competitive exams like CSIR NET, SET etc and also to write research proposals for grants.

Thiagarajar College, Madurai – 9
An Autonomous Institution Affiliated to Madurai Kamaraj University
Re-Accredited with 'A' Grade by NAAC
M.Sc., Zoology Course Structure (w.e.f. 2020 batch onwards)
Programme code:PZO

I semester

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Core1	PZO20 C11	Biological Chemistry & Biophysics	5	4	75	25	75	100
Core2	PZO20 C12	Microbiology	5	4	75	25	75	100
Core3	PZO20 C13	Genetics & Evolution	5	4	75	25	75	100
Core Elective1	PZO20 CE11	Animal Biology	6	5	90	25	75	100
Lab1	PZO20 CL11	Lab in Biological Chemistry and Biophysics	3	2	45	40	60	100
Lab2	PZO20 CL12	Lab in Microbiology	3	2	45	40	60	100
Lab3	PZO20 CL13	Lab in Genetics & Evolution	3	2	45	40	60	100
		Total	**30**	**23**				

II Semester

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Core4	PZO20 C21	Entomology	5	4	75	25	75	100
Core5	PZO20 C22	Cell & Molecular Biology	5	4	75	25	75	100
Core6	PZO20 C23	Bioinstrumentation	5	4	75	25	75	100
Core Elective2	PZO20 CE21	Biostatistics	6	5	90	25	75	100
Lab4	PZO20 CL21	Lab in Entomology	3	2	45	40	60	100
Lab5	PZO20 CL22	Lab in Cell & Molecular Biology	3	2	45	40	60	100
Lab6	PZO20 CL23	Lab in Bioinstrumentation	3	2	45	40	60	100
		Total	**30**	**23**				

III Semester

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Core7	PZO20 C31	Genetic Engineering and Biotechnology	5	4	75	25	75	100
Core8	PZO20 C32	Animal Physiology	5	4	75	25	75	100
Core9	PZO20 C33	Developmental Biology	5	4	75	25	75	100
Core Elective3	PZO20 CE31	Applied Zoology	6	5	90	25	75	100
Lab7	PZO20 CL31	Lab in Genetic Engineering and Biotechnology	3	2	45	40	60	100
Lab8	PZO20 CL32	Lab in Animal Physiology	3	2	45	40	60	100
Lab9	PZO20 CL33	Lab in Developmental Biology	3	2	45	40	60	100
		Total	**30**	**23**				

IV Semester

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Core10	PZO20 C41	Immunology	5	4	90	25	75	100
Core11	PZO20 C42	Ecology and Biodiversity	5	4	90	25	75	100
Core 12	PZO20 C43	Bioinformatics	5	4	90	25	75	100
Project	PZO20 PJ41	Project	6	3	90	50	50	100
Lab10	PZO20 CL41	Lab in Immunology	3	2	45	40	60	100
Lab11	PZO20 CL42	Lab in Ecology & Biodiversity	3	2	45	40	60	100
Lab12	PZO20 CL43	Lab in Bioinformatics	3	2	45	40	60	100
		Total	**30**	**21**				

Contact hrs and credit distribution

Semester	Contact Hrs/ Week	Credits
I	30 hrs	23
II	30 hrs	23
III	30 hrs	23
IV	30 hrs	21
Total	180 hrs	90

	No of papers	Credit/ paper	Total Credit
Core Theory	12	4	48
Core Lab	12	2	24
Elective	3	5	15
Project	1	3	03
Total			90

Thiagarajar College, Madurai – 625 009
Department of Zoology
(For those joined M. Sc., Zoology on or after June 2020)
Programme code:PZO

Code	Course Title	Category	L	T	P	Credit
PZO20C11	**Biological Chemistry and Biophysics**	Core-1	4	1	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	25	75	100

Preamble

Elaborate the structure and function of biomolecules. Illustrate the metabolic pathways and regulation of biochemical process. Brief about vitamins, enzymes and their regulation.

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Prerequisites

Basic knowledge on the structure and function of biomlecules, metabolic pathways, biochemical processes etc.,

Course Outcomes

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

#	Course Outcome	Knowledge Level
CO1	Summarize the basics of formation of biological compounds and their metabolism.	K1
CO2	Explain and analyze the biosynthesis pathways and structural conformations of carbohydrates,nucleic acids and proteins.	K2
CO3	Interpret fat metabolism and their importance.	K5
CO4	Categorize vitamins, Discuss thet structure & function of vitamins and enzyme kinetics	K4
CO5	Perceive a holistic knowledge on reactions involved in cellular energy synthesis and their application of thermodynamic laws.	K3

K1: Knowledge K2: Understand K3: Apply K4:Analyze K5: Evaluate

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**-**	**L**	**M**	**S**
CO2	**S**	**S**	**S**	**-**	**M**	**L**	**L**
CO3	**-**	**L**	**M**	**-**	**L**	**-**	**-**
CO4	**-**	**M**	**M**	**-**	**L**	**-**	**-**
CO5	**M**	**M**	**M**	**-**	**-**	**-**	**L**

Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**M**	**S**	**----**	**L**	**M**
CO2	**M**	**M**	**M**	**---**	**M**
CO3	**M**	**M**	**M**	**---**	**M**
CO4	**S**	**---**	**M**	**L**	**L**
CO5	**S**	**S**	**M**	**L**	**L**

S- Strong M -Medium L-Low

Blooms taxonomy: Assessment Pattern

Blooms Taxonomy			
	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	15% (9)	15% (9)	15% (20)
Understand -K2	15% (9)	15% (9)	15% (20)
Apply-K3	30% (18)	30% (18)	30% (40)
Analyze-K4	20% (12)	20% (12)	20% (25)
Evaluate-K5	20% (12)	20% (12)	20% (25)
Create-K6	**60**	**60**	**130**

Course Title: Biological Chemistry and Biophysics

Unit I

Water: Molecular structure of water–Non-covalent bonding: Hydrogen bond,electrostatic interaction-Van de Waals forces thermal, solvent properties ionization of water –colligative properties of aqueous solution–Calculations of pH mixture-dissociation of water-pH-dissociation of weak acids–Henderson-Hasselbalch equation – Buffer solutions-Physiological buffers (Carbonate and phosphate buffers)

Carbohydrates: Classification-Structure, properties glucose, fructose, galactose, lactose, maltose, sucrose, starch, glycogen, cellulose and chitin and their biological importance. Metabolism and its regulation: Glycolysis – Kreb's cycle – gluconeogenesis, glycogenesis, glycogenolysis, HMP shunt.

Unit II

Nucleic acid structure: RNA and DNA, synthesis and metabolism (De nova and Salvage Pathway)- Amino acids: Basic structure and classification- Physical and chemical properties-Biosynthesis of amino acids. Proteins: Classification -Levels of organization – primary, secondary (Molecular α-helix and β-pleated sheets, tertiary and quaternary. Ramachandran plot.Metabolism: Transamination, deamination and transmethylation.

Unit III

Lipids: Classification-Structure of triglycerol, waxes, phospholipids, cholesterol and terpenes

Properties and reactions- Biological importance. Biosynthesis of fatty acids and cholesterol

Degradation of fatty acids and cholesterol-Ketone bodies and lipid peroxidation.

Unit IV

Vitamins: Structure, occurrence and biochemical functions

Enzymes: Properties, classification, enzyme action- regulation (Genetc control, Covalent modification, allosteric regulation, compartmentation) , enzyme kinetics: Michaelis-Menten-Lineweaver-Burk plots, enzyme inhibitors/activators Coenzyme, isoenzyme, allosteric enzyme, abzyme and ribozyme

Unit V

Diffusion – Fick's laws, constant laws– osmotic gradient–osmotic coefficient – Gibbs Donnan equilibrium – Active transport-Laws of thermodynamics – Concept of free energy and entropy – exergonic and endergonic reaction – rate of reactions – energy activation – Arrhenius expression-Bioenergetics – Role of ATP – biological oxidation reduction reaction – redox potentials in biological system – respiratory chain and oxidative phosphorylation – high energy compounds.

Text Books

1. Ambika Shanmugam, 1998, Fundamentals of Biochemistry for Medical students, Published by the Author, Madras.
2. Satyanarayana, U. and Chakrapani, U. 2009. Biochemistry, Books and Allied Pvt. Ltd., Kolkata.

Reference Books:

1. Jain, J.L., Sunjay Jain and Nitin Jain. 2010. Fundamentals of Biochemistry, Fifth Edition, S. Chand and Company Ltd, NewDelhi.
2. Rastogi, S.C.2010. Biochemistry, 3rd Edition, Tata McGraw Hill Edition, New Delhi.
3. Nelson, D.L., and M.M.Cox, 2010, Lehninger Principles of Biochemistry, 5th edition, Worth Publishers, New York.
4. Stryer, L., 2000. Fourth edition Biochemistry, W.H. Freeman and Company, New York.
5. Voet, D., and J.G.Voet, 1995, Biochemistry, second edition John Wiley & Sons Inc, New
6. York.
7. Zubay, G. 1993, Biochemistry, third edition Won.C.Brown Communications Inc., Oxford, England.
8. Campbell and Farrell 2008. Biochemistry Cengage Learning India (P) ltd. New Delhi.
9. Ramarao, A.V.S.S. and Suryalakshmi, A 2009. Textbook of Biochemistry for Medical Students, 11th UVS Publishers Distributors Pvt. Ltd., New Delhi.
10. Deb, A.C. 2011. Fundamentals of Biochemistry, 10th Edition, New Central Book Agency Pvt. Ltd., Kolkata.
11. Conn, E.E., P.K.Stumpf, G.Bruening and R.H.Doi, 1999. Outline of Biochemistry, John Wiley & Sons Inc., New York.
12. Bose, S. 1982. Elementary Biophysics. Vijaya Printers, Madurai.
13. Casey, E.J. 1969. Biophysics – Concepts and mechanism. East West Press. New Delhi.
14. Morris, J.G. 1974. A Biologist's physical chemistry. II edition. Edward Arnold – A division of Holder and Stoughton, London.

Course designer : Dr.C. Balasubramanian

Thiagarajar College : Madurai – 625 009
Department of Zoology
(For those joined M. Sc., Zoology on or after June 2020)
Programme Code:PZO

Code	Course Title	Category	L	T	P	Credit
PZO20CL11	**Lab in Biological Chemistry and Biophysics**	Core Lab-1	-	-	3	2

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	40	60	100

Preamble

The course encompasses qualitative and quantitative analyses of biomolecules in the biological samples. Explain the factors influencing enzyme activity.

Prerequsites

Basic laboratory techniques in both chemistry and biology.

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Define the nature of biomolecules present in the samples	K1
CO2	Estimate the amount of biomolecules present in the samples	K3
CO3	Test the various factors that influence enzyme activity	K4
CO4	Demonstrate permeability of cell membrane	K2
CO5	Acquire hands on training needed to work in or start a clinical lab	K3

K1: Knowledge K2: Understand K3: Apply K4:Analyse K5: Evaluate

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**M**	**S**	**-**	**M**	**-**	**M**
CO2	**S**	**S**	**S**	**-**	**S**	**-**	**L**
CO3	**S**	**S**	**S**	**-**	**S**	**-**	**L**
CO4	**S**	**S**	**S**	**-**	**S**	**L**	**L**
CO5	**S**	**S**	**S**	**S**	**S**	**L**	**S**

Strong –S (+++), Medium –M (++), Low-L (+)

Mapping of Course Outcomes with Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	L	M
CO2	S	--	S	S	M
CO3	S	M	S	M	---
CO4	M	M	M	M	---
CO5	M	L	S	S	---

Strong –S (+++), Medium –M (++), Low-L (+)

Title of the Paper: Lab in Biological Chemistry and Biophysics

1. Qualitative analysis of Carbohydrates.
2. Qualitative analysis of Proteins
3. Qualitative analysis of Lipids
4. pH, pKa and pH meter:
   a. Working mechanism & determination of pH.
   b. Titration of weak acid and strong base (titration curve)
5. Colorimeter: a. Principle and working mechanism
   b. Verification of Beer's law
   c. Quantitative estimation of
      i) Carbohydrates
      ii) Proteins
      iii) Lipids
6. Chromatography: i) Paper chromatography
   ii) TLC Thin layer chromatography
   iii) Column chromatography
7. Electrophoresis: – PAGE
8. Centrifuge - Density gradient centrifugation
9. Quantitative estimation of ascorbic acid
10. Enzymes: Analysis of amylase activity
    i) Effect of substrate concentration
    ii) Effect of pH
    iii) Effect of temperature
    iv) Effect of Enzyme concentration
11. Osmosis – Haemolysis and Plasmolysis
12. Demonstration of Hill reaction

Reference Books:

1. D.T.Plummer.2008 An Introdction to Practical Biochemistry, Tata McGraw- Hill Publication, New Delhi
2. Anonymous. Open Universiteit .2004, Netharland Analysis of Amino acids, Proteins and Nucleic acids, Elsevier.
3. Dua, S and N.Garg 2010. Biochemical methods of analysis, Narosa Publishing, New Delhi.

Thiagarajar College : Madurai – 625 009

Department of Zoology

(For those joined M. Sc., Zoology on or after June 2020)

Programme Code:PZO

Code	Course Title	Category	L	T	P	Credit
PZO20C12	**Microbiology**	Core-2	4	1	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	25	75	100

Preamble

The course illustrates the basic concepts ,history and development of microbiology. The main focus of the course is on the classification and biology of microbes -, viruses, bacteria, fungi and algae. Explains the significance of beneficial microbes and methods for the control of pathogenic microbes

Prerequsites

Basic knowledge on microbes, culture media, staining methods.

Course Outcomes

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

	Course outcomes	Level
CO1	Recognize the fundamental concepts, history and development of microbiology.	K1
CO2	Sketch the taxonomical classification of microbes (viruses ,bacteria fungi, and algae).	K2
CO3	Analyse the structural organization and importance of virus, bacteria, fungi,and algae.	K3
CO4	Perceive the theoretical basis and demonstrate the practical skills in the use of tools, technologies and methods common to microbiology.	K4
CO5	Illustrate the methods to be adopted to control microbes.	K5

K1: Knowledge K2: Understand K3: Apply K4:Analyse K5: Evaluate

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**-**	**S**	**L**	**L**
CO2	**S**	**S**	**S**	**-**	**M**	**-**	**L**
CO3	**S**	**S**	**S**	**-**	**L**	**-**	**L**
CO4	**S**	**S**	**S**	**-**	**L**	**-**	**L**
CO5	**S**	**S**	**S**	**-**	**M**	**M**	**M**

Strong –S (+++), Medium –M (++), Low-L (+)

Mapping of Course Outcomes with Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	S	L	S	S	M
CO2	S	S	M	S	M
CO3	S	M	M	M	L
CO4	L	M	S	M	L
CO5	L	L	M	S	---

Strong –S (+++), Medium –M (++), Low-L (+)

Blooms taxonomy: Assessment Pattern

Blooms Taxonomy			
	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	15% (9)	15% (9)	15% (20)
Understand -K2	15% (9)	15% (9)	15% (20)
Apply-K3	30% (18)	30% (18)	30% (40)
Analyze-K4	20% (12)	20% (12)	20% (25)
Evaluate-K5	20% (12)	20% (12)	20% (25)
Create-K6	**60**	**60**	**130**

Title of the Paper: Microbiology

Unit-I

Microbes in our lives

History of Microbiology- Discovery of microorganisms (Robert Hooke & Leeuwenhoek)

Contributions of Francesco Redi, Needham, Splallanzani, Pasteur, Robert Koch, Edward Jenner, Ehrlich, Fleming, Dubos and Winogradsky.

Classification based on–Carolus Linnaeus, Carl Woese and Robert –H. Whittaker (Five Kingdom system)

Unit-II

Microbial Growth – Physical & Chemical requirements; Phases of growth

Prokaryotic cell –ultra structure and functions of bacterial cell wall, plasma membrane, flagella, pili, capsules, nuclear materials and spores.

Structure of enveloped (Morphology and structure of Herpes) and non-enveloped virus (Morphology and structure of Tobacco Mosaic Virus) and bacteriophages (Morphology and structure of T4 Bacteriophage).

Distinguishing characteristics of Fungi –Filamentous, non-filamentous and dimorphic fungi; Morphology and structure of *Aspergillus niger* and *Saccharomyces cerevisiae.*

Unit-III

Metabolic diversity among organisms – Photoautotrophs, Photoheterotrophs, Chemoautotrophs, Chemoheterotrophs. Energy production –oxidation –Reduction reactions, Oxidative and Phosphorylation. Metabolic pathways of energy production – Glycolysis, Entner –Doudoroff pathway, Aerobic and Anaerobic respiration, Photosynthetic metabolisms –Light & Dark reactions.

Unit-IV

Food Microbiology –Types of foods –Spoilage process (souring, putrefaction, rancidity and soft rot) Preservation of foods (Physical and Chemical agents) Food poisoning and Microbial toxins.

Environmental Microbiology – Role of microorganisms in nutrient cycling -Nitrogen, Carbon, Sulphur and Phosphorous.

Unit-V

Applied Microbiology –Sewage Treatment, Biofertilizer (Rhizobium, Azolla) Production of Penicillin and SCP.

Microorganisms and Human disease – Causative agent, symptoms, transmission, prevention and control of Tuberculosis, Cholera, Typhoid, AIDS, Hepatitis, Polio and Candidiasis.

Text Books

1. Pelczar, M.J., E.C.S. Chan and N.R. Kreig. 2009. Microbiology, 5th edition. McGraw-Hill. Book Co. Singapore
2. Tortora, G.J., Funke, B.R. and Case, C.L. 2009. Microbiology: An Introduction. 9th edition, Pearson Education, Singapore

Reference Books

1. Alcamo, I.E. 2001. Fundamentals of Microbiology, 6th edition, Addison wesley Longman, Inc. California
2. Alexopoulos, C.J., C.W. Mims and Blackwell, M. 2000. Introductory Mycology. 5th edition, John Wiley & Sons. Chichester.
3. Atlas, R.A. and Bartha, R. 2000. Microbial Ecology. Fundamentals and Application, 4th edition Benjamin Cummings, New York.
4. Black, J.G.2005. Microbiology-principles and explorations, 6th edition. John Wiley & Sons, Inc. New York
5. Dubey, R.C. and Maheswari, D.K. 2010. A Text Book of Microbiology. 3rd edition S. Chand, New Delhi.
6. Frazier, W.C., and Westhoff, D.C. 2005. Food Microbiology,sixth edition, Tata McGraw Hill Publishing Ltd., New Delhi.
7. Johri, R.M., Snehlatha, Sandhya Shrama, 2010. A Textbook of Algae. 2nd edition, Wisdom Press, New Delhi.
8. Kanika Sharma, 2011. Textbook of Microbiology – Tools and Techniques. 1st edition, Ane Books Pvt. Ltd., New Delhi.
9. Madigan, M.T., Martinkl, J.M. and Parker, J. 2009. Brock Biology of Microorganisms, 12th edition, MacMillan Press, England.
10. Prescott, L.M., Harley, J.P. and Klein, D.A. 2008. Microbiology 7th edition, McGraw Hill, New York.
11. Schlegel, H.G. 2008. General Microbiiology, 7th edition, Cambridge University Press,U.K.
12. Stanier, R.Y., Adelberg, E.A. and Ingram, J.L. 1991. General Microbiology, 5th edition, Prentice Hall of India Pvt. Ltd., New Delhi.

Course designers : Dr.RM.Murugappan

Thiagarajar College (Autonomous):: Madurai – 625 009

Department of Zoology

(For those joined M. Sc., Zoology on or after June 2020)

Programme Code:PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO20CL12	**Lab in Microbiology**	Core Lab-2	-	-	3	2

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	40	60	100

Preamble

Provide hands on trainng in microbiology laboratory techniques. The students will learn do and donot's in the laboratory. Students will be trained in preparing different media for culturing microorganisms. Explain different methods to identify, differentiate bacteria and fungi, their growth control methods

Prerequsites

Basic knowledge on sterilization techniques, characteristics of different microbes (Bacteria fungi, yeast and viruses) and types of media.

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Demonstrate an overview of the instruments, glasswares chemicals and media for culturing different types of microbes.	K2
CO2	Prepare various Culture media, brief various physical and chemical means of sterilization Know General bacteriology and microbial techniques for isolation of pure cultures of bacteria, fungi and algae.	K1
CO3	Perform culture handling tasks safely and effectively Comprehend the various methods for identification of unknown microorganisms.	K3
CO4	Interpret the Microbiology techniques in research or internship activities.	K5
CO5	Develops basic skills necessary to work in the microbiology laboratory or start a clinical lab.	K4

K1: Knowledge K2: Understand K3: Apply K4:Analyse K5: Evaluate

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**-**	**L**	**-**	**L**
CO2	**M**	**S**	**S**	**-**	**S**	**L**	**-**
CO3	**S**	**S**	**S**	**-**	**L**	**M**	**L**
CO4	**S**	**S**	**S**	**-**	**L**	**M**	**L**
CO5	**S**	**S**	**S**	**-**	**L**	**L**	**L**

Strong –S (+++), Medium –M (++), Low-L (+)

Mapping of Course Outcomes with Programme Specific Outcomes

.	PO1	PO2	PO3	PO4	PO5
CO1	L	---	S	S	---
CO2	L	---	S	S	---
CO3	M	---	S	S	---
CO4	L	L	S	S	---
CO5	M	---	S	S	---

Strong –S (+++), Medium –M (++), Low-L (+)

Title of the Paper: Lab in Microbiology

General Microbiology

1. Equipments needed for microbiology laboratory,
2. Laboratory safety and precautions.
3. Sterilization methods – moist heat, dry heat, filteration and radiation.
4. Preparation of culture media –solid (Selected and differential)and liquid
5. Aseptic transfer of microorganisms
6. Isolation of single colonies on solid media – Slant, Streak –Simple and Quadrant
7. Enumeration of bacterial numbers by serial dilution plating
8. Isolation of bacteria, actionomycetes and fungi from soil
9. Simple staining-Positive and negative
10. Differential staining –Gram staining
11. Spore staining
12. Slide culture technique and fungal staining –Yeast and filamentous fungi
13. Bacterial motility-Hanging drop method
14. Biochemical test –IMViC TEST, Oxidase and catalase
15. Nitrate Reductase test
16. Methylene Blue Reductase test –Milk quality

Reference Books

1. Cappuccino and Sherman, 2012. Microbiology – A Laboratory Manual. 7th Edition, Dorling Kindersley (India) Pvt. Ltd., New Delhi.

2. Gunasekaran, P. 2008. Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi

3. Harry W. Seeley, J.R., Paul, J.VanDemark and John J.Lee. 1997. Microbes in Action – A Laboratory Manual of Microbiology. W.H.Freeman and Company, New York

4. Kanika Sharma, 2009. Manual of Microbiology – Tools and Techniques. 2nd Edition, Ane Books Pvt. Ltd., New Delhi.

Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Zoology
(For those joined M. Sc., Zoology on or after June 2020)
Programme Code:PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO20C13	**Genetics and Evolution**	Core-3	4	1	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	25	75	100

Preamble

The course is designed to provide a holistic understanding of evolution, as a concept and its process. It educates the students on the patterns of inheritance, concept of linkage and disorders of genetic origin.

Prerequsites

Knowledge in simple Mendelian inheritance and Darwinian theory of Evolution.

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Demonstrate Mendel's laws of inheritance and recognize the deviations from them	K2
CO2	Explain principles of genetic linkage and chromosome mapping.	K4
CO3	Comprehend the nature of various genetic disorders , their diagnosis and origin	K5
CO4	Relate the existing evidences of evolution with the process of evolution.	K3
CO5	Summarize the concept of species, mechanisms of speciation and appreciate the evolution of man	K1

K1: Knowledge K2: Understand K3: Apply K4:Analyse K5: Evaluate

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**L**	**M**	**L**	**M**	**-**	**L**
CO2	**S**	**M**	**S**	**L**	**S**	**-**	**L**
CO3	**S**	**S**	**S**	**L**	**M**	**-**	**L**
CO4	**S**	**S**	**S**	**L**	**M**	**L**	**L**
CO5	**M**	**M**	**M**	**M**	**M**	**-**	**L**

Strong –S (+++), Medium –M (++), Low-L (+)

Mapping of Course Outcomes with Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	M	---	---	S	S
CO2	M	M	---	M	S
CO3	M	L	---	M	M
CO4	S	L	---	M	M
CO5	S	L	---	M	S

Strong –S (+++), Medium –M (++), Low-L (+)

Blooms taxonomy: Assessment Pattern

Blooms Taxonomy			
	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	15% (9)	15% (9)	15% (20)
Understand -K2	15% (9)	15% (9)	15% (20)
Apply-K3	30% (18)	30% (18)	30% (40)
Analyze-K4	20% (12)	20% (12)	20% (25)
Evaluate-K5	20% (12)	20% (12)	20% (25)
Create-K6	**60**	**60**	**130**

Title of the paper: Genetics and Evolution

Unit I: Mendelian genetics

Mendel's study of Heredity ; Monohybrid Cross & Mendel's law of Dominance & Segregation;

Dihybrid cross & Mendel's law of Independent Assortment. Simple Mendelian traits in Humans.

Deviations from Mendelian Inheritance: Incomplete Dominance – Flower color inheritance in snap dragons; Epistasis- Bateson & Punnet's experiment on Cinnabar gene in Drosophila & fruit colour in summer squash plants; Multiple Allelic Inheritance – Blood group inheritance in Humans & Inheritance of coat colour in rabbits. Non –Mendelian Inheritance- polygenic Inheritance, skin colour in man ,Cytoplasmic Inheritance

Unit II : Linkage, crossing over & recombination

Concepts of Linkage, recombination & crossing over ; Autosomal linkage in Sweet pea flowers ; chromosome mapping – determination of distance between genes- two point test cross;

Determination of gene order- Three point test cross.

Sex Linkage - X- Linked Inheritance- White eye trait in Drosophila ; X linked recessive traits in Humans- Haemophilia,Colour blindness ; Y -linkage - hairy pinna in males.

Unit III: Cytogenetics

Chromosomal aberrations- Numerical aberrations- Chromosomal non-disjunction, Euploidy & Aneuploidy; Down syndrome, Turner syndrome, Edward Syndrome , Klinefelter Syndrome. Structural aberrations- Inversion, Translocaion, Deletion, Duplication.

Detection of chromosomal anomalies- Pedigree analysis, Human Karyotyping, Prenatal diagnostics – Amniocentesis, Chorionic Villus sampling. Concepts of Eugenics & Euthenics.

Unit IV: Evolution & Natural Selection

Evidences for evolution- homologous structures, analogous structures, vestigial organs, embryological evidences, physiological,biochemical & paleontological evidences.

Theories of organic evolution: mutation theory, Lamarkism, Neo Lamarckism, Darwinism, Neo-Darwinism.

Concepts of Natural Selection - Modes of Natural Selection- stabilizing, directional & disruptive selection . Selection in action- Industrial Melanism, Adaptive radiation in Darwin's Finches, mimicry & colouration . Sexual Selection , Kin Selection & Group Selection.

Unit V: Population Genetics, Speciation & Human Evolution

Hardy Weinberg equilibrium- allele frequency, genetic drift, founder effect & bottle neck effect.

Species concept- types of speciation; Reproductive isolation – prezygotic & post zygotic isolating mechanisms.

Geological time scale; Evolution of Man – Australopithecus, Homo habilis, Homo erectus, Homo sapiens, Neanderthal & Cro-Magnon.

Textbooks:

1. Peter J. Russell. 2010.Genetics: A Molecular Approach,3rd Ed., Pearson Publications,USA
2. D. Peter Snustad, Michael J. Simmons, 2015. Principles of Genetics, 7th Edition, John Wiley & Sons, Inc.,
3. Verma,P.S and Agarwal,V.K.2012. Cell biology, Genetics and Evolution, S.Chand Publications.New Delhi

References:

1. Peter E. Rosenbaum ,2010. Volpe's understanding evolution, McGraw-Hill, New York.
2. Theodosius Dodzhansky, Francisco J. Ayala, G.Ledyard Stebbins, James W.Valentine,1977 Evolution , W.H.Freeman & company,San Francisco.
3. G.Ledyard Stebbins,1966. The process of organic evolution, Prentice – Hall, New Jersey.
4. Edward O.Dodson,1960.Evolution : Process and Product , Reinhold Publishing Corporation,Newyork .
5. Gardner Eldon.J., D. Peter Snustad 2006, Principles of Genetics 8Ed. John Wiley & Sons,

Course Designer

Mrs. U.Soundarya

Thiagarajar College (Autonomous):: Madurai – 625 009

Department of Zoology

(For those joined M. Sc., Zoology on or after June 2020)

Programme Code: PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO20CL13	**Lab in Genetics and Evolution**	Core Lab-3	-	-	3	2

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	40	60	100

Preamble

The course evaluates the inheritance of genetic characters. Explain students on the intheritance pattern by designing lab experiments.

Prerequsites

Basic idea on inheritance of traits, population genetics and concepts in evolution

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Recognize simple Mendelian traits in human	K1
CO2	Determine the occurrence of sex linked traits in a population	K5
CO3	Demonstrate natural selection and genetic drift	K3
CO4	Examine the application of statistical tools in population genetics	K4
CO5	Interpret the overall human traits inheritance pattern and evolutionary significance	K2

K1: Knowledge K2: Understand K3: Apply K4:Analyse K5: Evaluate

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	M	L	M	-	-
CO2	L	M	M-	M	-	-	-
CO3	S	S	S	-	S	-	M
CO4	M	S	S	-	S	-	L
CO5	S	S	S	-	M	-	-

Strong –S (+++), Medium –M (++), Low-L (+)

Mapping of Course Outcomes with Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	M	---	S	S	M
CO2	S	S	---	M	M
CO3	S	---	M	S	M
CO4	L	---	S	M	---
CO5	S	S	---	M	M

Strong –S (+++), Medium –M (++), Low-L (+)

Title of the paper: Lab in Genetics and Evolution

1. Identification of Colourblindness among the students using Isihara's colour chart.
2. Survey of Mendelian traits among the students.
3. Study of polygenetic inheritance among the students using finger print.
4. Study of Hardy-Weinberg Equilibrium using two different colour beads.
5. Action of Natural Selection in population using colour beads.
6. Genetic drift in a small population using colour beads.
7. Chi-square test using colour beads to demonstrate population genetics.
8. Statistical investigation of continuous variation using seed pods, neem leaf serrations (Mean, Median, Mode, Standard deviation and Standard Error).
9. Coin tossing experiment
10. Demonstration/Models/Spotters:
    (a) Monohybrid and Dihybrid crosses
    (b) Down Syndromes,
    (c) Turner syndrome,
    (d) Edward Syndromes
    (e) Klinefelter Syndromes
    (f) Homologous structure: fore limb skeleton of vertebrates
    (g) Living fossil: Peripatus
    (h) Animal fossil: *Physa princepii*
    (i) Adaptation in beak and feet of birds
    (j) Batesian and mullerian mimicry

Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Zoology
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Prgramme Code :PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO20CE11	**Animal Biology**	Core Elective-1	5	1	-	5

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	25	75	100

Preamble

Animals are a fascinating group of organisms that inhabit every niches across the globe. The course deals with the comparative physiology, morphology and anatomy of animals from protozoa to mammalian. On completion of the course, the students will have clarity on the fundamentals of zoology that facilitate them to understand the subject further to a greater extent.

Prerequsites

The students should have comparative knowledge on invertebrata and choradata.

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Classify the animals upto class level	K1
CO2	Realize the origin of life	K2
CO3	Compare physiology of diverse group of animals	K5
CO4	Distinguish poisonous from non-poisonous snakes	K3
CO5	Differentiate the larval forms of animals.	K4

K1: Knowledge K2: Understand K3: Apply K4:Analyse K5: Evaluate

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	-	L	-	-	-	-
CO2	S	M	M	L	M	-	-
CO3	S	S	S	-	-	L	L
CO4	L	M	S	L	L	L	L
CO5	L	M	S	-	L	L	L

Strong –S (+++), Medium –M (++), Low-L (+)

Mapping of Course Outcomes with Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	S	---	S	S	S
CO2	S	---	---	S	S
CO3	S	S	S	S	S
CO4	L	---	---	M	---
CO5	M	---	M	L	M

Strong –S (+++), Medium –M (++), Low-L (+)

Blooms taxonomy: Assessment Pattern

Blooms Taxonomy			
	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	15% (9)	15% (9)	15% (20)
Understand -K2	15% (9)	15% (9)	15% (20)
Apply-K3	30% (18)	30% (18)	30% (40)
Analyze-K4	20% (12)	20% (12)	20% (25)
Evaluate-K5	20% (12)	20% (12)	20% (25)
Create-K6	**60**	**60**	**130**

Title of the course: Animal Biology

Unit I

Origin of life – unicellular to multicellular organization – significance of metamerism and symmetry – Acoelom, pseudocoelom and eucoelom; Classification of animals up to class level and their general characteristics – Binomial nomenclature - Affinities and systematic position of cephalochordate, hemichordate and urochordata.

Unit II

Types of gills and lungs – tracheal system - respiratory pigments – accessory respiratory organs – types of respiration in frog. Circulatory system – open and closed – two, three and four chambered heart – hemolymph and blood – anatomy of artery, vein and capillary. Excretory organs – flame cells, nephridium, malphigian tubules - renal, rectal, antennal and coxal glands and kidneys.

Unit III

Nerve net in hydra, ladder like structure in flat worms, segmented nervous system in annelids, ganglia in insects, comparison of brain in vertebrates. Locomotion, reproduction and economic importance of protozoa; canal system in sponges – asconoid, syconoid, leuconoid and rhagon types, spicules in sponges.

Unit IV

Comparison of reproduction in Obelia and Aurelia, polymorphism in coelenterates, Peripatus and its evolutionary significance, metamerism in Annelida, foot, torsion and filter feeding in Mollusca, mechanism of pearl formation, Limulus and its significance, Crustacean larval forms – nauplius, metanauplius, zoea, cypris, mysis, megalopa, phyllosoma and alima; affinities of Peripatus and water vascular system in Echinodermates.

Unit V

Feeding in Amphioxus, retrogressive metamorphosis in Ascidian, comparison between Lampreys and Hag fishes, placoid scales of Shark, parental care and migration in Fishes, parental care in Amphibians, poison apparatus and biting mechanism in Snakes, key for identification of poisonous and nonpoisonous Snakes, significance of Archaeopteryx, fight

adaptation and migration in Birds, placentation and adaptive radiation in Mammals, egg laying mammals.

Text Books

1. Barnes, R.D. 1982. Invertebrate Zoology, IV Ed., Holt Saunders International Edition.
2. Barrington, E.J.W. 1979. Invertebrate structure and functions, II Ed., ELBS and Nelson.
3. Jordan, E.K. and P.S. Verma, 1995. Chordate Zoology and Elements of Animal Physiology, 10th edition, S. Chand & Co Ltd., Ram Nagar, New Delhi, 1151 pp.
4. Nigam, H.C., 1983. Zoology of Chordates, Vishal Publications, Jalandhar - 144 008, 942.

Reference Books

1. Ayyar, E.K. and T.N. Ananthakrishnan, 1992. Manual of Zoology Vol. II (Chordata), S. Viswanathan (Printers and Publishers) Pvt Ltd., Madras, 891p.
2. Ekambaranatha Iyer, M. and Ananthakrishnan, T.N. 2003. A Manual of Zoology. Viswanathan Publications, Chennai.
3. Hickman, C.P. Jr., F.M.Hickman and L.S. Roberts, 1984. Integrated Principles of Zoology, 7th Edition, Times Merror/Mosby College Publication. St. Louis. 1065 pp.
4. Hyman, G.H. The Invertebrates, Vol. I to VII, McGraw Hill Book Co., Inc., New York.
5. Kotpal, R.L. 2005. Invertebrate Zoology, Rastogi Publications, Meerat.
6. Newman, H.H., 1981. The Phylum Chordata, Satish Book Enterprise, Agra - 282 003, 477 .
7. Parker and Haswell, 1964. Text Book of Zoology, Vol II (Chordata), A.Z.T,B.S. Publishers and Distributors, New Delhi - 110 051, 952 pp
8. Waterman, Allyn J. et al., 1971. Chordate Structure and Function, Mac Millan & Co., New York, 587 pp.

Course Designer Dr. C. Ravi

Thiagarajar College : Madurai – 625 009
Department of Zoology
(For those joined M. Sc., Zoology on or after June 2020)
Programme Code:PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO20C21	**Entomology**	Core-4	4	1	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	25	75	100

Preamble

The course delivers a comprehensive insight on the basic and applied aspects of Entomology. One half of the syllabus offers morphological as well as molecular based taxonomy and systematic of insects; and also their anatomical and functional details. The other half corroborates insects harmful nature and their management, besides having entrepreneurial aspects of entomology.

Prerequsites

Basic knowledge on the morphology and classification of insects.

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Discuss the morphology based variation and diversity among all insect groups	K4
CO2	Emphasize and compare the structural and functional aspects of insects	K5
CO3	Explain the trophic interaction of insects with their host plants their management and tools of control	K1
CO4	Apply/Utilize natural enemies for the control of insect pests	K3
CO5	Appear for competitive examinations and/ or become an entrepreneur,	K2

K1: Knowledge K2: Understand K3: Apply K4:Analyse K5: Evaluate

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**M**	**M**	**S**	**-**	**L**	**-**	**-**
CO2	**S**	**S**	**S**	**-**	**L**	**L**	**M**
CO3	**S**	**S**	**S**	**-**	**L**	**L**	**L**
CO4	**M**	**M**	**M**	**-**	**M**	**-**	**M**
CO5	**S**	**S**	**S**	**-**	**S**	**-**	**S**

Strong –S (+++), Medium –M (++), Low-L (+)

Mapping of Course Outcomes with Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	S	L	S	S	S
CO2	S	L	M	S	S
CO3	S	---	S	S	---
CO4	S	---	S	S	---
CO5	M	---	M	S	S

Strong –S (+++), Medium –M (++), Low-L (+)

Blooms taxonomy: Assessment Pattern

Blooms Taxonomy			
	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	15% (9)	15% (9)	15% (20)
Understand -K2	15% (9)	15% (9)	15% (20)
Apply-K3	30% (18)	30% (18)	30% (40)
Analyze-K4	20% (12)	20% (12)	20% (25)
Evaluate-K5	20% (12)	20% (12)	20% (25)
Create-K6	**60**	**60**	**130**

Title of the Course:Entomology

Unit I

Classification of Insects-General characteristics of class Insecta and classification up to Order level – characteristics of each order with examples. Modern scheme of insect classification: Apterygota- Pterygota: Exopterygota (Hemimetabolous): Paleopteroid, Orthopteriod, Hemipteroid orders -Endopterygota (Holometabolous): Coleopteroid, Neuropteroid, Panorpoid and Hymnopteroid orders-Studies on molecular evolutionary relationship between different groups of insects

Unit II

Anatomy and Physiology of Insects: Respiratory system: Spiracle, tracheal gills, air sacs, trachea and tracheoles -Excretory system: in aquatic and terrestrial insects-Reproductive system: Male – accessory glands – vas efferense, vas difference, aediagus; Female –panoistic, meroistic, telotrophic, polytrophic ovaries, spermatheca, -Endocrine system: Structure of Corpora cardiac(CC), Carpora allata (CA) and neurosecretary cells(NSC); ecdysone, neuropeptides, prothoracicotropic hormone (PTTH), ATH, JH and JH analogues

Unit III

Pests and Pest Management –Economic threshold level, Pests: Pests of Cotton (*Pectinophora gossypiella, Aphis gossypii, and Helicoverpa armigera*) Paddy (*Scirpophaga incertulus, Aphis dorsalis, Nephotettix virescense)*, Sugarcane *Chilo infuscatellus* and *Alerolopus parodonsis*). Ground nut (*Amsacta albistiga, Cnephalocrocis medinalis* and *Aphis craccivora*, Tomato (*Amrasca bigutalla biguttala, Aphis sp.*) Brinjal- (*Leucinodes orbanals, Phemberules affinis)*- IPM concept, methods

and tools (Case study on cotton)-Chemical control: Insecticide – Classification, nomenclature, toxicity, mode of entry, mode of action, synergistic – formulations, repellents, attractants- law and regulations.

Unit IV

Biological Control: Parasitoids (Egg, larval, pupal and adult parasitoids) and predators – Genetic Control - Breeding insect resistance host; Ecological control – Cultural and mechanical; microbial control – Bacteria – *Bacillus thuringiensis*-Fungi – *Metarhizium anisopliae, Beauveria bassiana*- Virus – nuclearpolyhedral virus (NPV) and Granulosis virus (GV)-Protozoans: *Nozema locustae* Nematode: *Stenernema sp*., and *Heterorhbdidis sp*.

Unit V

Bombyx mori –Biology and silk secretion-Grainage technology- Silkworm rearing-Pests and Disease management-Biology and silk production of non-mulberry silkworm: Eri, Muga and Tasar-Silk reeling and marketing

Text books

1. David, B.V.2002 Elements of Economic Entomology. Popular Book Depot, Madras.
2. Tembhare, D.B. 2009 Modern Entomology, Himalaya publishing house, Mumbai.

Reference Books

1. Chapman, R.F. 2008. The insects: Structure and Function. ELBS.
2. Chapman, R.F. and Joern, A. 1990. (eds.). Biology of Grasshoppers. John Wiley & Sons, New York.
3. Romoser,W.S., Stoffolano Jr, J.G .1998, Entomology, fourth edition, WCB Mc Graw Hill Publishing Co.
4. David, B.V and. Ananthakrishnan, T.N. 2004. General and Applied Entomology. Tata Mc Graw Hill Publishing Co.
5. Pedigo, L.P. 2009. Entomology and Pest Management. Prentice Hall of India, New Delhi
6. Regupathy, A., Palanisamy, S., Chandramohan, N. and Gunathilagaraj,K. 1997. A guide on Crop Pests. Sooriya Desktop Publishers, Coimbatore, India.
7. Wigglesworth, V.B. 1972. The principles of Insect Physiology. Chapman & Hall, New York.
8. Dandin, S.B., J.Jayaswal and K.Giridhar 2003. Handbook of Sericulture Technologies. Central Silkboard, Bangalore
9. Ganga, G. and Sulochana chetty,J. 1997. Introduction to Sericulture. II Edn, Oxford and IBH publishing Co Pvt. Ltd.

Course designers : Dr.P.Suresh

Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Zoology
(For those joined M. Sc., Zoology on or after June 2020)
Programme Code:PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO20CL21	**Lab in Entomology**	Core Lab-1	-	-	3	2

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	40	60	100

Preamble

Provide hands-on-training on the collection, identification and preservation of insects. Demonstrate on dissection and display of different parts of insects. Differentitate beneficial and harmful insects.

Prerequisites

Knowledge on the types, classification of insects and their organization.

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Collect, identify and preserve insects	K1
CO2	Dissect and display insects	K3
CO3	List the pest population in the field and determine the threshold level.	K2
CO4	Report suitable pest control measures for the benfit of farmers	K4
CO5	Execute experimental protocols learnt in field studies.	K5

K1: Knowledge K2: Understand K3: Apply K4:Analyse K5: Evaluate

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**-**	**L**	**L**	**L**
CO2	**S**	**S**	**S**	**-**	**L**	**L**	**M**
CO3	**S**	**S**	**S**	**-**	**L**	**M**	**-**
CO4	**S**	**S**	**S**	**-**	**M**	**M**	**M**
CO5	**S**	**S**	**S**	**-**	**S**	**S**	**M**

Strong –S (+++), Medium –M (++), Low-L (+)

Mapping of Course Outcomes with Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	**---**	**M**	**S**	**S**	**---**
CO2	**M**	**S**	**S**	**S**	**---**
CO3	**M**	**---**	**S**	**S**	**---**
CO4	**S**	**L**	**S**	**S**	**---**
CO5	**S**	**M**		**S**	**---**

S- Strong M -Medium L-Low

Title of the Course: Lab in Entomology

1. Collection, preservation and identification of insect pests.
2. Types of antennae, mouthparts
3. Patterns and modification in legs and wings
4. Dissection – Cockroach
    a. Digestive system and salivary apparatus
    b. Spiracle mounting and display of tracheal system
    c. Nervous system
    d. Neuro endocrine system
    e. Malphighian tubules
    f. Wing circulation
5. Digestive enzyme analysis
6. Study of haematocytes
7. Food utilization study in an insect
8. Pest sampling and estimates
9. Pheromone trap methods- Demonstration
10. Study on the development of resistance to pesticides – LC_{50} value
11. Study on the life history of vectors – Mosquitoes and housefly.
12. Isolation of microbial biocontrol agents from soil and cadaver.

Reference books

1. Regupathy, A., Palanisamy, S., Chandramohan, N. and Gunathilagaraj, K. 1997. A guide on Crop Pests. Sooriya Desktop Publishers, Coimbatore, India.

2. Tembhare, D.B. 2009 Modern Entomology, Himalaya publishing house, Mumbai.

Thiagarajar College: Madurai – 625 009
Department of Zoology
(For those joined M. Sc., Zoology on or after June 2020)
Programme Code :PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO20C22	**Cell and Molecular Biology**	Core-5	4	1	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	25	75	100

Preamble

The course is intended to elaborate the different types, structure and functions of cells and biomolecules. Explains the types and stages of cell cycle. Explain cell signaling pathways in normal and cancerous cell. Spell gene expression and protein synthetic machinery.

Prerequsites

Knowledge on prokaryotic and eukaryotic cells, cell organelles, nucleic acids and central dogma of protein synthesis.

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Identify and illustrate the working mechanism of various cell imaging instruments or microscopes	K1
CO2	Distinguish prokaryotes and eukaryotes. Define gene organization, expression & regulation	K2
CO3	Explain the structure and functions of cell, cell organelles, biological membranes and intercellular communication.	K4
CO4	Emphasis the structure, forms, types and function of nucleic acids; mitosis and meiosis, central dogma of protein synthesis and gene regulation	K3
CO5	Demonstrate how biochemistry, genetics and molecular biology are used to elucidate the function of cells and their organization into tissues	K5

K1: Knowledge K2: Understand K3: Apply K4:Analyse K5: Evaluate

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**M**	**S**	**S**	**-**	**M**	**-**	**L**
CO2	**M**	**L**	**M**	**-**	**L**	**-**	**L**
CO3	**S**	**S**	**S**	**-**	**M**	**-**	**L**
CO4	**S**	**S**	**S**	**-**	**-**	**-**	**-**
CO5	**S**	**S**	**S**	**L**	**M**	**-**	**M**

Strong –S (+++), Medium –M (++), Low-L (+)

Mapping of Course Outcomes with Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	M	---	S	S	---
CO2	S	S	S	S	M
CO3	S	S	---	S	S
CO4	S	S	S	S	S
CO5	S	L	---	S	S

Strong –S (+++), Medium –M (++), Low-L (+)

Blooms taxonomy: Assessment Pattern

Blooms Taxonomy			
	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	15% (9)	15% (9)	15% (20)
Understand -K2	15% (9)	15% (9)	15% (20)
Apply-K3	30% (18)	30% (18)	30% (40)
Analyze-K4	20% (12)	20% (12)	20% (25)
Evaluate-K5	20% (12)	20% (12)	20% (25)
Create-K6	**60**	**60**	**130**

Title of the Course: Cell and Molecular Biology

Unit I

Microscopy: Working mechanism and applications of light, phase-contrast, fluorescent, electron (TEM & SEM) and confocal microscopy

Cell theory ; Ultrastructure of plant and animal cells.

Structure and function of organelles - Nucleus, endoplasmic reticulum, golgi complex, mitochondria, ribosomes, lysosomes, cytoskeletal structures

Unit II

The cell membrane & its properties ; Fluid mosaic model of Plasma membrane; Integral & peripheral membrane proteins.

Cell junctions- gap junctions, tight junctions & anchoring junctions

Transport of molecules across the membrane- diffusion & facilitated diffusion & active transport(Sodium Potassium ATPase pumps).

Intracellular Vesicular Trafficking

Structural organization of Eukaryotic Chromosome ; giant chromosomes.

Unit III

Cell signalling- G-protein coupled and TGFβ receptor system
JAK/STAT, Ras and MAP kinase pathway
Cell cycle & its regulation- mitosis and meiosis

Molecular and biochemical characteristics of cancer cells
Cell ageing, Cell death and its regulation

Unit IV

Experimental evidence for DNA as genetic material

DNA- structure, types, replication (both prokaryotes and eukaryotes) and Holliday model of recombination

RNA –structure, types and function

Mutation- types & repair mechanisms

Unit V

Transcription of mRNA prokaryotes and eukaryotes & post transcriptional modification

Translation in prokaryotes and eukaryotes & Post translational modifications

Bacterial Genetics- Regulation of gene expression - prokaryotes: lac and trp operon

Plasmids – types and function

Mechanisms of Gene transfer in bacteria - transformation, conjugation and transduction

Mobile Genetic Elements

Text Books

1. Frifelder, D. 2000. Molecular Biology 2nd edition. Narosa Publishing House, New Delhi.
2. Krebs, J.E., Goldstein, E.S., Kilpatrick, S.T. 2011 Lewin's Genes X, Jones and Bartlett publishers Inc, London UK

Reference Books

1. Alberts, B. et al. 1994. Molecular Biology of the Cell (3rd edition). Garland Publishing, Inc., New York.
2. De Roberties E.D.P and E.M.F.De Roberties 2011. Cell and Molecular Biology. 8th edition. B.I. Publicatons Pvt. Ltd., India
3. Paul, A. 2009. Cell and Molecular Biology, Books and Allied (P) ltd, India.
4. Power, C.B. 2009 Cell Biology Himalayan Publishing House, New Delhi.
5. Prakash S.L. 2007.Cell and Molecular Biology. M.J.P. publishers, Chennai
6. Allison LA. 2007. Fundamental Molecular Biology. Blackwell Publishing Ltd., USA.
7. Cooper, GM and Hawman RE. 2013. Cell a Molecular Approach (6th Edition). Sinauer Associates, Inc.
8. Haddin J. et al. 2011 Becker's World of the Cell (8th Editon). Benjamin Cummings Publishing Company , New York
9. Karp G. 2013. Cell and Molecular Biology Concepts and Experiments. John Wiley & Sons, Inc.
10. Lodish, Berk, Zipursky, Matsudara, Baltimore and Darnell.1999. Molecular Cell Biology, Fourth Edition, W.H.Freeman and Company, Newyork.
11. Watson, J.D., N.H.Hopkins, J.W.Roberts, J.A.Steitz and A.M.Weiner, 1998. Molecular Biology of the Gene, Fourth edition, The Benjamin / Cummings Publishing Company Inc., Tokyo.
12. Wolfe, L.S., 1993. Molecular and Cellular Biology, Wadsworth publishing company.

Course designers: **Mrs. U.Soundarya Assistant Professor**

Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Zoology
(For those joined M. Sc., Zoology on or after June 2020)
Programme Code :PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO20CL22	**Lab in Cell and Molecular Biology**	CoreLab-5	-	-	3	2

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	40	60	100

Preamble

Provides a basic understanding on the organization of different tissues and cells. Helps to visualize the different stages of cell division. Provide hands on training on gene transfer mechanism.

Prerequsites

Knowledge on tissues, cells, biomolecules etc.,

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Differentiate the types of tissues and cells	K4
CO2	Appraise the different gene transfer methods	K2
CO3	Summarise safe laboratory practices and perform basic molecular biology techniques	K1
CO4	Distinguish mutant and wild bacterial colonies	KK5
CO5	Isolate nucleic acids from cells and quantify.	K4

K1: Knowledge K2: Understand K3: Apply K4:Analyse K5: Evaluate

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**-**	**L**	**-**	**L**
CO2	**S**	**S**	**S**	**-**	**L**	**-**	**L**
CO3	**S**	**S**	**S**	**-**	**M**	**-**	**L**
CO4	**S**	**S**	**S**	**L**	**L**	**-**	**L**
CO5	**S**	**S**	**S**	**L**	**L**	**-**	**L**

Strong –S (+++), Medium –M (++), Low-L (+)

Mapping of Course Outcomes with Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	L	S	S	L
CO3	M	---	S	S	L
CO4	M		S	S	L
CO5	M	S	S	S	---

Strong –S (+++), Medium –M (++), Low-L (+)

Title of the Course : Lab in Cell and Molecular Biology

1. Observation of different types of tissues
2. Observation of Barr body
3. Observation of giant chromosomes
4. Observation of the stages of mitosis
5. Observation of the stages of meiosis
6. Quantitative estimation of nucleic acids
7. Isolation of mutant colonies by Gradient plate method.
8. Isolation of mutant colonies by Replica plate method.
9. UV-irradiation and photoreactivation experiment
10. Bacterial transformation
11. Conjugation experiment
12. Complementation test
13. Phage isolation and titration

Reference Books

1. Brown, T.A. 1998. Molecular Biology Lab; Gene Analysis, Academic Press, London.

2. Malov, S.R. 1990. Experimental Techniques in Bacterial Genetics, Jones and Bartlett Publishers, Boston.

3. Miller, J.H. 1992. A Short Course in Bacterial Genetics: A Lab Manual & Hand Book for *E. coli* and related Bacteria. Cold spring Harbor Lab press, Cole Spring Harbar

4. Rajamanickam, C.2001 Experimental protocols in basic molecular biology, Osho Scientific Publications, Madurai.

5. S.Janarthanan and S.Vincent 2007.Practical Biotechnology, Methods and Protocols. Univerrsity Press, Hyderabad., India

6. Gunasekaran, P. 2008. Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi

Thiagarajar College (Autonomous):: Madurai – 625 009

Department of Zoology

(For those joined M. Sc., Zoology on or after June 2020)

Programme Code:PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO20C23	**Bioinstrumentation**	Core-6	4	1	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	25	75	100

Preamble

The course familiarizes the students with the analyses and design of different instrument.
Explain the principle and working mechanism behind various instruments used in life science.

Prerequsites

Know and identify various instruments. Basic knowledge on chemical preparation methods.

Course Outcomes

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

	Course outcomes	Knowledge
CO1	Explain the principles and applications of the various instruments used in biology	K1
CO2	Portray the schematic representation on the working mechanism of various instruments	K3
CO3	Proficient in use/handling basic and advanced instruments	K2
CO4	Use appropriate instruments for the laboratory and project work	K4
CO5	Interpret the results obtained obtained on analyes after thorough scrutiny .	K5

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	L	M	-	L
CO2	S	S	S	M	M	-	L
CO3	S	S	S	-	M	-	M
CO4S	S	S	S	L	M	-	M
CO5	L	S	S	M	S	-	M

Strong –S (+++), Medium –M (++), Low-L (+)

Mapping of Course Outcomes with Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	M	---	S	M	L
CO2	M	---	M	S	---
CO3	---	---	S	S	L
CO4	M	----	S	S	---
CO5	S	---	S	S	L

Strong –S (+++), Medium –M (++), Low-L (+)

Blooms taxonomy: Assessment Pattern

Blooms Taxonomy			
	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	15% (9)	15% (9)	15% (20)
Understand -K2	15% (9)	15% (9)	15% (20)
Apply-K3	30% (18)	30% (18)	30% (40)
Analyze-K4	20% (12)	20% (12)	20% (25)
Evaluate-K5	20% (12)	20% (12)	20% (25)
Create-K6	**60**	**60**	**130**

Title of the Paper: Bioinstrumetation

Principle, working mechanism and applications of:

Unit I

Basic principles of light rays – Reflection, Refraction, Diffraction, Dispersion and Polarisation.Compound (Dark and Light field), Phase Contrast, Fluorescent, Polarised, Electron (Transmission and Scanning) and Confocal Microscopy; Micrometry.

Unit II

Principle, working mechanism and applications of:

pH meter, Centrifuge (Clinical, Density gradient and Ultra) – preparative and analytical - sedimentation coefficient, RCF, RPM; Incubator, Hot air oven, Autoclave, Quebec colony counter, GM counter, Liquid Scintillation counter, Sonicator, Lyophilizer, Micropipettes and Filters (HEPA, membrane).

Unit III

Principle, working mechanism and applications of:

Colorimeter – Beer & Lamberts law, Spectrophotometer (visible, ultraviolet), FTIR, Flame Photometer, Atomic Absorption and Mass Spectrophotometer. ELISA reader, Sphygmomanometer.

Unit IV

Principle, working mechanism and applications of:

Paper (Ascending and circular), Thin layer, Column, gel filtration, ion exchange, Gas and High Performance Liquid Chromatography. Kjeldahl apparatus

Unit V

Principle, working mechanism and applications of:

SDS-PAGE, Native PAGE, Agarose Gel Electrophoresis, 2D Gel Electrophoresis, Gel Documentation, Southern, Northern and Western blotting, PCR and FACS.

Text Books

1. Jeyaraman, J., 1985. Lab. Manual in Biochemistry, Wiley Eastern Ltd, New Delhi.
2. Roy, R.N. 1996. A Textbook of Biophysics. New Central Book Agency (P) Ltd. Calcutta.
3. Veerakumari, L. 2009. Bioinstrumentation. MJP Publishers, Chennai.

Reference Books

1. Alonso, A., and Arrondo, J.L.R.2006. Advanced Techniques in Biophysics. Springer, UK.
2. Boyer, R.F. 1993. Modern Experimental Biochemistry. The Benjamin Cummings Publishing Company, Inc., New York.
3. Chatwal, G.R and Anand, S.K. 2009. Insturmental Methods of Chemical Analysis. Himalaya Publishing House, New Delhi.
4. Ghatak K.L. 2011.Techniques and Methods in Biology. PHI Learning Pvt. Ltd. New Delhi Gupta A. 2009. Instrumentation and Bio-Analytical Techniques.PragatiPrakashan, Meerut.
5. Mendham, J., Denney, R.C., Barnes, J.D. and Thomas, M.J.K. 2004. Vogel's Textbook of Quantitative Chemical Analysis. Pearson Publishers Pvt. Ltd., New Delhi, India.
6. Palanichamy, S. and Shanmugavelu, M. 2011. Principles of Biophysics, 2nd Edition, Palani Paramount Publications, Palani.
7. Palanivel, P. 2000. Laboratory Manual for Analytical Biochemistry & Separation Techniques. School of Biotechnology, Madurai Kamaraj University, Madurai.
8. Plummer, D.T. 2008. An Introduction to Practical Biochemistry. Tata McGraw Hill Publications, New Delhi.
9. Sandhu, G.S. 1990. Research Techniques in Biological Sciences. Anmol Publications, New Delhi.
10. Sawhney, S.K. and Singh, N. 2000. Introductory Practical Biochemistry. Narosa Publishing House, New Delhi.
11. Warton, D.C. and McCarthy, R.E. 1972. Experiments and Methods in Biochemistry. MacMillan, New York.
12. Williams, B.L. and Wilson, K. 1983. A Biologist's Guide to Principles and Techniques of Practical Biochemistry. Edward Arnold Publishers Ltd., London.
13. Wilson, K. and Walker, J. 2003. Principles and Techniques of Practical Biochemistry, 5th Edition Cambridge University Press, New York.

Course Designers: Dr. C. Ravi, Dr. T.S. Ramyaa Lakshmi

Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Zoology
(For those joined M. Sc., Zoology on or after June 2020)
Programme Code :PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO20CL23	**Lab in Bioinstrumentation**	Core Lab-6	-	-	3	2

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	40	60	100

Preamble

Elaborates the principle and working mechanism of variious instruments used in life sciences. Provide hands-on- training on the use of instruments for lab and project purpose.

Prerequsites

Knowledge on the different components and working principle of different instruments

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Explain the theoretical principle and working mechanism of various instruments used in various disciplines of biology	K1
CO2	Make use of various instruments for their routine practical and project work	K3
CO3	Isolate, separate, purify and analyze nucleic acids and proteins	K4
CO4	Separate, purify and quantify sugars, amino acids and lipids,	K5
CO5	Enumerate and preserve the microbes isolated from the samples	K2

K1: Knowledge K2: Understand K3: Apply K4:Analyse K5: Evaluate

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**L**	**S**	**-**	**M**
CO2	**S**	**S**	**S**	**-**	**S**	**-**	**L**
CO3	**M**	**S**	**S**	**-**	**S**	**-**	**L**
CO4	**S**	**S**	**S**	**-**	**L**	**-**	**L**
CO5	**S**	**S**	**S**	**-**	**S**	**-**	**L**

Strong –S (+++), Medium –M (++), Low-L (+)

Mapping of Course Outcomes with Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	S	---	S	S	M
CO2	M	---	S	S	L
CO3	L	M	S	S	---
CO4	L	M	S	S	---
CO5	---	---	S	S	---

Strong –S (+++), Medium –M (++), Low-L (+)

Title of the Paper: Lab in bioinstrumentation

1. Measurement of pH of various samples using pH meter
2. Verification of Beer's Law
3. Separation of molecules based on density gradient centrifugation principle
4. Measurement of cell using micrometry technique
5. Microbial colony counting with Quebec colony counter
6. Circular Paper Chromatographic separation of amino acids
7. Ascending Paper Chromatographic separation of sugars
8. Thin layer chromatographic separation of lipids
9. Column Chromatographic separation of plant pigments
10. Separation of proteins by SDS-PAGE (Demonstration only)
11. Separation of DNA by agarose gel electrophoresis (Demonstration only)

Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Zoology
(For those joined M. Sc., Zoology on or after June 2020)
Prgramme Code:PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO20CE21	**Biostatistics**	Core Elective-2	5	1	-	5

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	25	75	100

Preamble

The goal of the skill based elective course in Biostatistics is to prepare students to comprehend, develop and apply, quantitative and qualitative techniques in mathematics, statistics, and computing to handle biological data collection and analysis. The course strives to emphasize the understanding of inherent variation, bias, and uncertainty in sampling. Distribution patterns in experimental data generation, probability of results obtained and the required statistical action to arrive at a best possible conclusion.

Prerequsites

A basic knowledge of high school mathematics

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Define variability and uncertainty in sampling and data collection	K1
CO2	Categorize the type of variables, summarize the data and construct graphical and diagrammatic representation of data.	K3,
CO3	Apply probability principles for setting significance levels and testing hypothesis using statistical tests	K5
CO4	Analyse results of statistical test and interpret experimental conclusion	K4
CO5	Perform basic statistical test using MS-Office Excel at ease and independently	K2

K1: Knowledge K2: Understand K3: Apply K4:Analyse K5: Evaluate

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**L**	**M**	**-**	**L**
CO2	**S**	**S**	**S**	**L**	**S**	**-**	**L**
CO3	**S**	**S**	**S**	**-**	**S**	**-**	**L**
CO4	**S**	**S**	**S**	**-**	**S**	**-**	**L**
CO5	**M**	**S**	**S**	**L**	**S**	**L**	**L**

Strong –S (+++) Medium-M (++) Low-L (+)

Mapping of Course Outcomes with Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	M	---	L	S	M
CO2	M	---	M	M	M
CO3	L	---	L	M	M
CO4	---	---	S	S	M
CO5	S	---	M	S	S

Strong –S (+++) Medium-M (++) Low-L (+)

Blooms taxonomy: Assessment Pattern

Blooms Taxonomy			
	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	15% (9)	15% (9)	15% (20)
Understand -K2	15% (9)	15% (9)	15% (20)
Apply-K3	30% (18)	30% (18)	30% (40)
Analyze-K4	20% (12)	20% (12)	20% (25)
Evaluate-K5	20% (12)	20% (12)	20% (25)
Create-K6	**60**	**60**	**130**

Title of the Paper: Biostatistics

Unit I- Descriptive statistics

Statistical population and sample in biological studies, variables – qualitative and quantitative; Types of biological data-ratio, interval, ordinal, nominal, discrete and continuous; Sampling methods – Random and non random sampling methods; Frequency distribution, Representation of data – Tables-Tabulation of data, components of table; histogram, frequency curve and ogives. Diagrammatic representation of data.

Unit II-Summary statistics

Measures of central tendency – mean, median and mode; Measures of dispersion –range, standard deviation, variance, standard error; Quartile Deviation, Range. Probability distribution – binomial, Poisson (definition) and normal distribution(detailed). Symmetry- skewness and kurtosis(definition), proportions of a normal curve- Z scores, assessing normality, confidence limits. Practical training using MS-Office excel.

Unit III-Hypothesis testing-I

Testing of hypothesis – Null and alternate hypothesis, Student 't' distribution, Two tailed and one tailed hypotheses concerning mean, confidence limits for the population mean, variability about the mean; null hypothesis, one sample t-test, paired and unpaired t-tests. Practical training using MS-Office excel.

Unit IV-Hypothesis testing-II

Single factor ANOVA; basic assumptions under ANOVA, loss of replications, ANOVA with two treatments. Tests for Aposteriori comparisons/Multiple comparisons- Tukey test. Practical training using MS-Office excel.

Unit V- Bivariate analysis

Correlation – types, methods of correlation – graphical method, mathematical method; Karl Pearson's Rank; Regression analysis – equation, estimation of unknown value from known value; Mann-Whitney U test,Chi-square test, test of independence; Data transformations. Arcsine, logarithmic and square root transformations.

Text Books

1. Zar, J.H. 1996. Biostatistical Analysis, Prentice – Hall International, USA.
2. Khan., IA, Khanum, A. 2004 Fundamentals of Biostatistics second edition, Ukaaz publications, Hyderabad, Andhra Pradesh

Reference Books

1. Schefler W.C. 1980. Statistics for the biological sciences. Addison-Wesley publishing company, New York.
2. Daniel, W.W 2006 Biostatistics-A foundation for analysis in health sciences, John Wiley (Asia) & sons, Singapore.
3. Gupta S.P. 1987. Statistical Methods. Sultan Chand & Sons Publishers, New Delhi
4. Attwood, T.K. and Parry, D.J – Smith, D.J. 2002. Introduction to Bioinformatics. Pearson Education (Singapore) Pvt. Ltd.
5. Palanichamy, S. Manoharan, M. 1994. Statistical methods for Biologists, Palani Paramount Publications, Tamil Nadu.
6. Arora, P.N and P.K.Malhan 2008. Biostatistics. Himalaya Publications, Mumbai.
7. Sokal, R.R. and Rohif, F.J. 1987. Introduction to Biostatistics. W.H. Freeman and company, New York.
8. Gurumani, N. 2004. An Introduction to Biostatistics. MJP publishers, Chennai.
9. Misra, B.N. and Misra, B. K. 1998. Introductory Practical Biostatistics. Naya Prakash, Calcutta.
10. Pillai, RSN and Bagavathi, V. 1989. Statistics Theory and Practice. S Chand & Company Ltd. New Delhi.Banergi, P.K. 2004 Introduction to Biostatistics, S.Chand& company Ltd. New Delhi.
11. Sundar Rao, P.S.S. and Righard, J. 2002. An Introduction to Biostatistics. III edn. Prentice Hall of India, New Delhi.
12. Mount, W. 2001. Bioinformatics Sequence and Genome Analysis. Cold Spring harbour Laboratory Press, New York
13. Pevsner 2003. Bioinformatics and Functional Genomics. Wiley Dreamtech India Ltd., New Delhi

Course Designer: Dr.C.Binu Ramesh, Assistant professor

M.Phil., Zoology

(Programme Code: MEC)

Programme outcome-PO (Aligned with Graduate Attributes)- Master of Philosophy (M.Phil.,)

Knowledge and critical thinking

Acquire, analyse, evaluate and interpret data using appropriate techniques. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Problem solving

Critically evaluate information and ideas from multiple perspectives. Employ conceptual, analytical, quantitative and technical skills in solving the problems and are adept with a range of technologies

Complementary Skills

Recognize the need for information, effectively search for, retrieve, evaluate and apply that information gathered in support of scientific investigation or scholarly debate.

Communication efficiency

Communicate and disseminate clearly and convincingly the research findings effectively in the academic community and to stakeholders of their discipline in written and or oral form. Elaborate on the ideas, findings and contributions in their field of interest to expert and non-expert audiences.

Environment, Ethical and Social relevance

Apply ethical principles for societal development on environment context. Demonstrate the knowledge of and need for sustainable development.

Life-Long Learning

Recognize the need, and have the ability, to engage in continuous reflective learning in the context of technological advancement.

Team work

Work effectively in teams, both collaboratively and independently to meet a shared goal with people whose disciplinary and cultural backgrounds differ from their own. Engage in intellectual exchange of ideas with researchers of other disciplines to address important research issues

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with 'A' Grade by NAAC)
Department of –Zoology and Microbiology

Vision

- Render exemplary quality education in Life Sciences and laboratory skills to produce generations of responsible, competent and employable graduates

Mission

- To provide a comprehensive set of courses in biological sciences that enhances the understanding, depth of knowledge and technical competency of the students.
- To prepare the students for entry-level research and teaching positions in biological sciences.
- To provide an educational environment that fosters the development of appropriate scientific vocabulary, reasoning skills, effective oral and written communication abilities for students.
- To create a holistic understanding of the allied subjects through interdisciplinary learning.

Programme Educational Objectives (PEO)

The objectives of this programme is to equip/prepare the students

PEO1	Engage in critical intellectual enquiry
PEO2	Demonstrate a thorough understanding of research methodologies and techniques at an advanced level
PEO3	Conduct innovative, high-impact and leading edge research
PEO4	Provide novel solutions to complex problems
PEO5	Work with others and make constructive contributions. Demonstrate leadership and advocacy skills

Programme specific outcomes- M.Phil Zoology

On the successful completion of M.Phil., Zoology the students will

PSO1	Design , write and execute research proposal Demonstrate practical fieldwork skills (e.g. ecological survey techniques, species identification and ecological impact assessments)
PSO2	Develop research orientation and familiar/acquaint with the principle, working mechanism and application of biological instruments
PSO3	Identify and define emerging problems in the field concerned. Offer innovative and original solutions to problems and issues Further able to apply appropriate techniques in multi-disciplinary research environment.
PSO4	Engage in intellectual exchange with researchers from other disciplines to address important research issues Collaborate effectively with researchers
PSO5	Appear for competitive exams like CSIR NET, SET etc and also to write research proposals for grants.

THIAGARAJAR COLLEGE, MADURAI – 9.

(Re-Accredited with 'A' Grade by NAAC)

Department of –Zoology and Microbiology

Master of Philosophy (M.Phil.,) Zoology (w.e.f. 2020 batch onwards)

Programme Code-MZO

Course Structure

Course	Code No	Subject	Hrs/ Week	Cred	Total Hrs	Max Mark CA	Max Marks SE	Total
First Semester								
Core 1	MZO20 C11	Research Methodology I	6	6	90	25	75	100
Core 2	MZO20 C12	Applied Entomology	6	6	90	25	75	100
Core 3	MZO20 C13	Research Methodology I I	6	6	90	25	75	100
Second Semester								
Core 4	MZO20 PJ21	Project		6		100	100	200
				24				

Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Zoology
(For those joined M.Phil., Zoology on or after June 2020)
Programme Code MZO

Course Code	Course Title	Category	L	T	P	Credit
MZO20C11	**Research Methodology I**	Core-1	6	-	-	6

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	25	75	100

Preamble

Research Methodology is a hands-on training course designed to impart knowledge in the foundational methods and techniques of academic research in various disciplines of Life sciences. The course imparts a research orientation among the scholars and to acquaint them with fundamentals of research methods.

Prerequsites

Basic idea about principle, working mechanism and application of biological instruments

Course Outcomes

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

	Course outcomes	Level
CO1	Comprehend the working principle and applications of various analytical instruments.	K2
CO2	Spell the importance of animal cell culture techniques	K1,K5
CO3	Apply various nucleic acid analyses techniques	K4
CO4	Make use of the techniques learnt for execution of the project work	K3
CO5	Work in an educational institution or to pursue doctoral studies.	K6

K1: Knowledge K2: Understand K3: Apply K4: Analyse K5: Evaluate K6: Create

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**-**	**-**	**S**	**L**
CO2	**S**	**S**	**S**	**-**	**-**	**S**	**L**
CO3	**S**	**S**	**S**	**-**	**L**	**S**	**L**
CO4	**S**	**S**	**S**	**-**	**-**	**-**	**L**
CO5	**-**	**-**	**M**	**S**	**S**	**S**	**S**

Strong –S (+++), Medium –M (++), Low-L (+)

Mapping of Course Outcomes with Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	---	S	S	S	S
CO2	---	S	S	S	M
CO3	---	S	M	S	M
CO4	---	S	S	S	S
CO5	----	M	L	S	L

Strong –S (+++), Medium –M (++), Low-L (+)

Blooms taxonomy: Assessment Pattern

Blooms Taxonomy			
	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	20	20	40
Understand -K2	20	20	40
Apply-K3	20	20	40
Analyze-K4	20	20	40
Evaluate-K5	20	20	20
Create-K6	20	20	20

Title of the Course: Research Methodology I

Unit I

Working principle and applications of: Compound, Phase Contrast, Fluorescent, Polarised, Electron (Transmission and Scanning) and Confocal Microscopy; Micrometry, cytophotometry and flow cytometry; live cell imaging Principles and techniques involved in histological and histochemical staining of animal tissues Microbial staining techniques – simple, differential, spore and capsule staining.

Unit II

Working principle and applications of: pH meter, Centrifuge (Density gradient and Ultra) - preparative and analytical - sedimentation coefficient, RCF, RPM; GM counter, Liquid Scintillation counter, Sonicator, Lyophilizer and Micropipettes. Colorimeter, Spectrophotometer (visible, ultraviolet), FTIR, Flame Photometer, Atomic Absorption and Mass Spectrophotometer.

Unit III

Chromatographic techniques: Paper, Thin layer, Column, Gel filtration, Ion exchange, Gas and High Performance Liquid Chromatography. Electrophoretic techniques: SDS-PAGE, Native PAGE, Agarose Gel Electrophoresis, 2D Gel Electrophoresis, Gel Documentation Blotting techniques: Southern, Northern and Western blotting

Unit IV

Animal cell culture techniques: Media types, primary and secondary culture, cell lines, types of culture, culture of mammalian cells, tissues and organs, somatic cell cloning and hybridization, transfection and transformation of cells, commercial scale production of animal cells, application of animal cell culture - *in vitro* testing of drugs and toxicity of pollutants - production of vaccines and pharmaceutical products; Stem cells – types – isolation - culture and applications

Unit V

PCR – working principle, types and applications; DNA sequencing methods – Maxam and Gilbert, Sanger and automation methods, next generation sequencing; protein sequencing; DNA and protein microarray

Immunotechniques: Agglutination and precipitation assays – immunoelectrophoresis – immunoflouresence – immunohistochemistry – ELISA – RIA - Hybridoma technology – Antibody engineering – Phage display techniques **Report submission: Protocols pertained to the above techniques**

Reference Books

1. Boyer, R.F. 1993. Modern Experimental Biochemistry. The Benjamin Cummings Publishing Company, Inc., New York.

2. Chatwal, G.R and Anand, S.K. 2009. Insturmental Methods of Chemical Analysis. Himalaya Publishing House, New Delhi.

3. Jeyaraman, J., 1985. Lab. Manual in Biochemistry, Wiley Eastern Ltd, New Delhi.

4. Kuby, J. 2003, Immunology 5th edition , W.H. Freeman and Company, Newyork.

5. Lincoln PJ & Thomson J. 1998. Forensic DNA Profiling Protocols. Humana Press.

6. Mendham, J., Denney, R.C., Barnes, J.D. and Thomas, M.J.K. 2004. Vogel's Textbook of Quantitative Chemical Analysis. Pearson Publishers Pvt. Ltd., New Delhi, India.

7. Palanivel, P. 2000. Laboratory Manual for Analytical Biochemistry & Separation Techniques. School of Biotechnology, Madurai Kamaraj University, Madurai.

8. Plummer, D.T. 2008. An Introduction to Practical Biochemistry. Tata McGraw Hill Publications, New Delhi.

9. Portner R. 2007. Animal Cell Biotechnology. Humana Press.

10. Primrose. S.B., Twyman R.M., Old. R.W. 2001. Pricinciples of Gene Manipulation. Blackwell Science Limited.

11. Spinger TA. 1985. Hybridoma Technology in Biosciences and Medicine. Plenum Press.

12. Warton, D.C. and McCarthy, R.E. 1972. Experiments and Methods in Biochemistry. MacMillan, New York.

13. Williams, B.L. and Wilson, K. 1983. A Biologist's Guide to Principles and Techniques of Practical Biochemistry. Edward Arnold Publishers Ltd., London.

14. Wilson, K. and Walker, J. 2003. Principles and Techniques of Practical Biochemistry, 5th Edition Cambridge University Press, New York.

Course Designer Dr. C. Ravi

Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Zoology
(For those joined M. Phil., Zoology on or after June 2020)
Programme Code MZO

Course Code	Course Title	Category	L	T	P	Credit
MZO20C12	**Applied Entomology**	Core-2	6	-	-	6

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	25	75	100

Preamble

It provides the detailed information on economically important insect orders, including their characteristic feature. Applied entomology elaborate the impact of insects (both positive and negative) on human health, agriculture, and the environment. Disuss the techniques and methods that are useful for the management of harmful insects that cause significant damage to the crops. It also explain the detailed account on the management of harmful insects by adopting various methods, including IPM.

Prerequsites

The student should identify common insect in the crop fields and should posses knowledge on common pest control measures.

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Classify and identify the insects on agricultural crops	K1
CO2	Plan and implement plant protection and pest control measures according to the IPM principles in different crop ecosystem	K2,K4
CO3	Elaborate on Insect host relationship	K3
CO4	Demonstrate practical fieldwork skills (e.g. ecological survey techniques, species identification and ecological impact assessments)	K2,K5
CO5	Implement the theoretical knowledge learnt in the farm. Lab- to-land approach	K5,K6

K1: Knowledge K2: Understand K3: Apply K4: Analyse K5: Evaluate K6: Create

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**L**	**S**	**L**	**S**	**S**	**M**
CO2	**S**	**S**	**S**	**M**	**S**	**S**	**M**
CO3	**M**	**M**	**S**	**-**	**M**	**S**	**M**
CO4	**S**	**S**	**S**	**M**	**S**	**S**	**M**
CO5	**S**	**S**	**S**	**M**	**S**	**S**	**S**

Strong –S (+++), Medium –M (++), Low-L (+)

Mapping of Course Outcomes with Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	M
CO2	S	M	S	S	L
CO3	S	M	S	M	L
CO4	S	M	S	M	L
CO5	S	S	S	S	---

Strong –S (+++), Medium –M (++), Low-L (+)

Blooms taxonomy: Assessment Pattern

Blooms Taxonomy			
	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	20	20	40
Understand -K2	20	20	40
Apply-K3	20	20	40
Analyze-K4	20	20	40
Evaluate-K5	20	20	20
Create-K6	20	20	20

Title of the Course: Applied Entomology

Unit: I An outline classification and taxonomy of Class Insecta down to order level

Unit: II

Helpful insects Productive insects – Honey bee and lac insect-Insect pollinators-Predators and parasites-Weed killers-Soil builders-Scavengers- Aesthetic and scientific values of insects **Harmful insects** - Insects pests of crops and control measures Pests of rice-Pests of cotton-Pests of sugarcane- Pests of stored products - Insect pest in relation to public heath and household with reference to Mosquito and Housefly.

Unit: III

The idea of insect population Ecosystem and agro ecosystems-The ecological role of insect outbreak-Regulation of insect population Economic decision levels for Insect Pest-populations, Economic damage, Economic injury level, Economic threshold, Calculation of economic decision level. Insect pest management - theory and practice The concept and development of insect pest management-Ecological management of the crop environment.

Unit: IV

Plant resistance and insects: Insect and host relationships.-Mechanism of resistance; Non – preference, antibiosis, tolerance -Factors mediating the expression of resistance - physical and biological pest control: Methods and principle of pest control.-Natural control Application of artificial or direct method-Biological control Integrated control-Role in juvenile mimics and pheromones in the management of insect pests-Recent advances in using plant products in the management of insect pests-Microbial bio insecticides- IPM in cotton.

Unit: V

Insecticides classification of Insecticides

Classification based on mode of entry-Classification based on mode of action Classification based on chemical nature Plant production appliances: Dusting and dusters-Aerosols-Spraying and sprayers- Vaporisers

Reference books:

1. Ananthakrishnan, T.N. 1982. Recent advances in Entomology in India. S. Viswanathan Publishers.

2. Busvine, J.R. 1980. Insect and Hygiene. III edition, Chapman& Hall, New York.

3. Chapman, R.F. and Joern, A.1990. (eds.). Biology of Grasshoppers. John Willy & Sons, NewYork.

4. Chapman, R.F. 1982. The insect: Structure and Function. ELBS.

5. David, B.V. and Kumarasamy,T.2002. Elements of Economic Entomology. Popular Book Depot, Madras.

6. Mani,M.S.1982.General Entomology. Oxford and IBH Publishing, New Delhi.

7. Nayar,K.K. , Ananthakrishnan,T.N. and David, B.V.1976.General and Applied Entomology. Tata McGraw Hill Publishing Co.

8. Pedigo, L.P.1996.Entomology and Pest Managment.Prentice Hall of India, New Delhi.

9. Regupathy, A., Palanisamy, S., Chandramohan, N. and Gunathilagaraj, K. 1997. A guide on Crop Pests. Sooriya Desktop Publishers, Coimbatore, India.

10. Richards, O.W. and Davies, R.G.1977. Imm‘s General Text Book of Entomology. X edition. Chapman & Hall, London.

11. Wigglesworth, V.B.1972. The Principles of Insect Physiology. Chapman & Hall, NewYork.

Course Designers Dr.C.Balasubramanian

Thiagarajar College (Autonomous):: Madurai – 625 009
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Programme Code MZO

Course Code	Course Title	Category	L	T	P	Credit
MZOC13	**Research Methodology II**		4	2	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	25	75	100

Preamble

Research scholars will be exposed to the main components of a research framework i.e., problem definition, research design, data collection, ethical issues in research, report writing, and presentation.Specifically, the course introduce them to the basic concepts used in research. It includes discussions on sampling techniques, research designs and techniques of analysis.

Prerequsites

Basic idea on research design, thesis writing and data analyses

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Identify, design and execute research problems suggested.	K2,K3
CO2	Spell and collect relevant literature from various sources	K1,K3
CO3	Elaborate their findings in conferences.	K5,K6
CO4	Analyse and Prepare research report and thesis	K4,K5,
CO5	Placed in a research institute to conduct disciplined research under supervision in an area of their choosing.	K3

K1: Knowledge K2: Understand K3: Apply K4: Analyse K5: Evaluate K6: Create

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**-**	**M**	**S**	**M**
CO2	**S**	**M**	**S**	**M**	**-**	**S**	**M**
CO3	**S**	**S**	**S**	**S**	**L**	**S**	**S**
CO4	**L**	**M**	**S**	**S**	**-**	**S**	**S**
CO5	**-**	**M**	**S**	**S**	**M**	**S**	**S**

Strong –S (+++), Medium –M (++), Low-L (+)

Mapping of Course Outcomes with Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	---	S	M	S	---
CO2	M	S	S	S	M
CO3	---	L	M	M	M
CO4	---	L	M	S	M
CO5	M	M	S	S	M

Strong –S (+++), Medium –M (++), Low-L (+)

Blooms taxonomy: Assessment Pattern

Blooms Taxonomy			
	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	20	20	40
Understand -K2	20	20	40
Apply-K3	20	20	40
Analyze-K4	20	20	40
Evaluate-K5	20	20	20
Create-K6	20	20	20

Title of the Course: Research Methodology II

Unit I

Objectives and significance of research, types of research - descriptive vs. analytical, applied vs. fundamental, quantitative vs. qualitative, conceptual vs. empirical; literature review - various sources of information; identification, defining and devising of research problem.

Unit II

Hypothesis - null and alternate hypothesis - hypothesis testing; Exploratory and descriptive research design - concept, types and uses; Concept of independent and dependent variables; Sampling methods - sample, sampling frame, sampling error, sample size, non-response, simple random sample, systematic sample, stratified random sample and multi-stage sampling, determining size of the sample - practical considerations in sampling and sample size; Sample collection, transport, handling and preservation of microorganisms, planktons, insects, animals from natural and lab bred population; Biological models

Unit III

Observation and collection of data - methods of data collection; data Processing and analysis strategies - univariate analysis (frequency tables, bar charts, pie charts, percentages), measures of central tendency and dispersion; bivariate analysis - cross tabulations and chi-square test including testing hypothesis of association; Correlation, Regression, ANOVA – one and two way, DMRT, Tukey test; R software.

Unit IV

Thesis writing - Introduction, Review of literature, Methodology, Results - illustrations and tables, Discussion, Bibliography, Foot notes and proof correction. Oral presentation - planning and preparation - use of visual aids - importance of effective communication; Publication of research articles – plagiarism – copyright violation – choosing the right journal; refereed journals, open access journals, citation, impact factor, SCI, H index, i10 index, referencing software

Unit V

Impact of research on environment - GMO; Biosafety measures – risk assessment and management - Institutional biosafety - ethical and animal welfare committee; Ethical, legal and social issues related to research; Ethical implications of biotechnological products and techniques; IPR - copy right - patent - patent law – patenting of biological process and products in India – trademark - WIPO; Reproduction of published material - Plagiarism - Acknowledgement

Reference Books

1. Day, R.A., 1992. How to Write and Publish a Scientific Paper, Cambridge University Press.
2. Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications.
3. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An Introduction to Research Methodology, RBSA Publishers.
4. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
5. Leedy, P.D. and Ormrod, J.E., 2004 Practical Research: Planning and Design, Prentice Hall.
6. Martin. M.W. and Schinzinger.R. 2003. Ethics in engineering, III Edition, Tata McGraw-Hill, New Delhi.
7. Satarkar, S.V., 2000. Intellectual Property Rights and Copy right. Ess Ess Publications.
8. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
9. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, AtomicDog Publishing. 270p.
10. Wadehra, B.L. 2000. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing.

Course Designer Dr. C. Ravi

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Programme Code : MZO

Course Code	Course Title	Category	L	T	P	Credit
MZO20PJ21	**Project**		-	-	6	6

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	100	100	200

Preamble

Learn to collect and read literature pertaining to their proect work. Train the students to do lab exercise individually under the guidance of their project guide. Design an experient to meet the objective of the project.

Prerequsites

Basic knowledge on the Laboratory techniques related to Life Sciences .Interpretation of data using statistical tools, basic computer literacy.

Course Outcomes

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

	Course outcomes	Level
CO1	Collect and analyse the scientific literature from web resources. Critically evaluate information and ideas from multiple perspectives Integrate knowledge at the forefront of a particular field	K1,K2
CO2	Design an original research that takes a new technological, methodological, or theoretical approach	K2,K5
CO3	Demonstrate theoretical basis and practical skills in the use of tools, technologies and methods common to life sciences	K3,K4
CO4	Apply the scientific method and evaluate and interpret the results obtained using statistical tools.	K3,K5
CO5	Articulate analyses and propose a summative project or paper that propose solutions in response to social issues . Communicate and disseminate research findings effectively in the academic community and to stakeholders in society	K5,K6

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

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**S**	**-**	**S**	**S**
CO2	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO3	**S**	**S**	**S**	**S**	**M**	**S**	**M**
CO4	**S**	**S**	**S**	**M**	**-**	**S**	**S**
CO5	**S**	**S**	**S**	**S**	**L**	**S**	**S**

Strong –S (+++), Medium –M (++), Low-L (+)

Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S		S	L	-
CO2	S	S	S	L	-
CO3	M	S	L	L	M
CO4	M	S	S	L	M
CO5	S	S	S	M	-

Strong –S (+++), Medium –M (++), Low-L (+)