

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.
(Re-Accredited with ‘A++’ Grade by NAAC)
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	Credits	Total Hrs	Max Mark CA	Max Mark SE	Total
Part I	U20 TM11	Tamil	6	3	90	25	75	100
Part II	U20 EN11	English	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 GE11	Organic Chemistry	4	4	60	25	75	100
Generic Elect lab	UCH20 GL21	Organic Chemistry lab	2	-	30	-	-	-
EVS		Environmental Science	2	2	30	15	35	50
TOTAL			30	21				

Semester – II

Course	Code No	Subject	Hrs/Week	Credits	Total Hrs	Max Mark CA	Max Mark SE	Total
Part I	U20 TM21	Tamil	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
Corelab2	U ZO20 CL21	Lab in Chordata	2	1	30	40	60	100
Generic Elective	UCH20 GE21	Inorganic Chemistry (Chem)	4	4	60	25	75	100
Generic Elect lab	UCH20GL 21	Inorganic Chemistry lab (Chem)	2	-	30	-	-	-
	UCH20GL 21	Organic & Inorganic Chemistry lab (Chem)	-	2	30	40	60	100
AECC		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	U20P131	Tamil	6	3	90	25	75	100
Part II	U20EN31	English	6	3	90	25	75	100
Core 5	UZO20 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 and Biostatistics	2	1	30	40	60	100
Generic Elective	UBO20 GE31Z	Plant life forms	4	4	60	25	75	100
Generic Elective lab	UBO20G L41Z	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	UZO20 C41	Developmental Biology	4	4	60	25	75	100
Core 8	UZO20 C42	Genetics	4	4	60	25	75	100
Core lab 4	UZO20 CL41	Lab in Developmental Biology and Genetics	2	1	30	40	60	100
Generic Elective	UBO20 GE41Z	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	UZO20 NE41	Sericulture	2	2	30	15	35	50
TOTAL			30	23				

Semester V

Course	Code No	Subject	Hrs/Week	Credits	Total Hrs	Max Mark CA	Max Mark SE	Total
Core 9	U ZO20 C51	Immunology	5	5	75	25	75	100
Core 10	U ZO20 C52	Molecular biology	5	5	75	25	75	100
Core 11	U ZO20 C53	Animal Physiology	5	5	75	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
SBE I	U ZO20 SE51 A/B/C	Clinical Lab Tech. lab/ Poultry farming/IPR/ Sericulture/	2	2	30	15	35	50
		Internship	-	2	-	15	35	50
TOTAL			30	27				

Semester VI

Course	Code No	Subject	Hrs/Wk	Credits	Total Hrs	Max Mark CA	Max Mark 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	45	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
SBE III	U ZO20 SE61 A/B/C	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**

On the Job training will be undertaken by the students during the second year summer vacation after the fourth semester. Out of the maximum of 50 marks allotted for the **on the training**, report submitted by the student carries 35 marks and the other 15 marks, viva-voce examination will be conducted by the department (internal evaluation).

Training should be of minimum 10 working days at a reputed industry, research lab or medical centre.

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

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
UZO20C31	Biochemistry	Core-5	4	-	-	4

L-Lecture. T-Tutorial. P-Practicals

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

Preamble

The course integrates the concepts of Chemistry in biology field to understand the biomolecules in a better way. It emphasizes on the chemical and physical properties of biomolecules. The structure, classification and functions of carbohydrates, proteins, lipids, and nucleic acids have been unravelled.

Course Outcomes

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

	Course outcomes	Expected Proficiency %	Expected Attainment %
CO1	Illustrate the structure of atom, molecules and comprehend on the properties of water.	70	60
CO2	Explain the structure, classification, properties and importance of carbohydrates.	70	60
CO3	Decipher the structural complexity of proteins and their significance.	60	60
CO4	Interpret the biological functions of lipids and understand the chemistry of nucleic acids	70	60
CO5	Differentiate fat soluble from water soluble vitamins and unravel the mystery of enzymes.	70	70

Mapping of Course Outcomes with Programme Specific Outcomes

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

Mapping of Course Outcomes with Programme Outcomes

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

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

Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%

Course Title: Biochemistry

Unit I:

Structure of atoms and molecules; Types of bonds – Ionic, Covalent and Non covalent interactions - Van der Waals, Electrostatic, Hydrogen bonding and hydrophobic interactions; Water – molecular structure and properties (Thermal, solvent and colligative) - dissociation and ionization of water; pH and buffers (bicarbonate, phosphate and acetate); Henderson-Hasselbalch equation; pKa; Redox reactions.

Unit II:

Carbohydrates - classification – physical and chemical properties – isomerism; structure and biological importance of glucose, fructose, galactose, maltose, sucrose, lactose, starch, glycogen and chitin; Glycolysis, Glycogenesis, Glycogenolysis, Kreb's cycle and Pentose phosphate pathway.

Unit III:

Amino acids - structure, classification (based on polarity), physical properties and chemical reactions. Proteins – classification, properties and biological importance; structural organization of protein - primary, secondary - Ramachandran plot, tertiary and quaternary structure. Overview of protein metabolism; Urea cycle

Unit IV:

Lipids: Classification, properties (physical and chemical) and biological importance. Structure of triglycerides and phospholipids; Biosynthesis of fatty acids and cholesterol; Beta oxidation and lipid peroxidation. Chemical structure of DNA and RNA; Biosynthesis of nucleic acids (de novo and salvage pathways). Types of hormones and mechanisms of hormone action

Unit V:

Enzymes: Classification and mechanism of action (lock and key and induced fit theories). Michaelis Menten equation; Factors influencing enzyme activity; Regulation of enzyme activity; Coenzymes and isoenzymes. Vitamins – types, source, significance and deficiency.

Working principle and applications of: pH meter, Colorimeter and UV-Vis Spectrophotometer. Chromatography techniques - paper, thin layer and column.

Text Books

1. Jain, J.L., Sunjay Jain and Nitin Jain. 2010. Fundamentals of Biochemistry, Fifth Edition, S. Chand and Company Ltd, New Delhi.
2. Satyanarayana, U. and Chakrapani, U. 2009. Biochemistry, Books & Allied Pvt. Ltd., Kolkata.

Reference books

3. Berg J. M., Tymoczko J. L., Stryer L. 2002. Biochemistry, 5th ed., W. H. Freeman and Company, New York.

2. Murray,R.K., Granner,D.K., Mayes,P.A and Rodwell,V.W 1996. Harper's Biochemistry. 24th Edition. Prentice-Hall International.
3. Emil. L. Smith., Philip,H. and Abraham,W 1973.Principles of Biochemistry. McGraw – Hill International book Company.
4. Voet,D., Voet,G.J and Pratt,C.W. 2016.Fundamentals of Biochemistry. John Wiley and Sons, Inc.
5. Nelson, D.L., and M.M.Cox, 2010, Lehninger Principles of Biochemistry, 5th edition, Worth Publishers, New York.
6. Stryer, L., 2000. Fourth edition Biochemistry, W.H. Freeman and Company, New York.
7. Geoffrey L Zubay, William W Parson and Dennis E Vance1996. Principles of Biochemistry, William C.Brown Pub. U.K.
8. Campbell and Farrell 2008. Biochemistry Cengage Learning India (P) ltd. New Delhi.
9. Deb, A.C. 2011. Fundamentals of Biochemistry, 10th Edition, New Central Book Agency Pvt. Ltd., Kolkata.

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
UZO20C32	Biostatistics	Core 6	4	-	-	4

L-Lecture. T-Tutorial. P-Practicals

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

Preamble

The goal of Biostatistics core course is to prepare students to comprehend, improvise and employ, quantitative and qualitative techniques in statistics, and computing, to handle biological data collection and analysis. The course strives to emphasize the understanding of tools and techniques for collecting data and then summarizing, analyzing and interpreting

Course Outcomes

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

	Course outcomes	Expected Proficiency %	Expected Attainment %
CO1	Define the principle concepts in biostatistics by recognizing the definition of statistics, its objective and its relation with the other sciences.	70	60
CO2	Recognize the significance and master the methods of data collection, representation, analysis and its role in determining scope of inference.	70	60
CO3	Appreciate the power of data and manage inherent variation, bias, and uncertainty in sampling	60	60
CO4	Identify distribution patterns in experimental data generation, probability of results obtained and the required statistical action to arrive at a best possible conclusion	60	60
CO5	Apply appropriate statistical methods for analyzing one or two variables and Interpret statistical results correctly, effectively, and in context.	60	60

Mapping of Course Outcomes with Programme Specific Outcomes

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

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

Mapping of Course Outcomes with Programme Outcomes

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

CO3	S	M	L	M	-	M
CO4	S	L	L	M	-	M
CO5	S	L	L	M	-	M

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

Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%

Course Title: Biostatistics

UNIT I:

Data collection

Sampling- need, census and sample surveys, sampling and non-sampling errors, sample size determination. Collection and scrutiny of data: Primary data; designing a questionnaire and a schedule; secondary data and sources of secondary data. Sampling techniques: Quadrat, line transects, Selection of experimental animals from animal house.

UNIT II:

Data- types and presentation

Elementary concepts in Statistics: Concepts of statistical population and sample from a population; qualitative and quantitative data; nominal, ordinal, ratio, interval data; cross sectional and time series data; discrete and continuous data. Presentation of data: frequency distributions and cumulative frequency distributions; Classification and Tabulation; Parts of table. Diagrams and Graphs: Line diagrams, Bar Diagram, Pie diagrams, Histogram, Frequency polygon, Frequency poly curve, stem and leaf chart and ogives.

UNIT III: 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)

UNIT IV: Hypothesis testing

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, F test- One way ANOVA.

UNIT V: Bivariate analysis

Correlation – types, methods of correlation – graphical method, mathematical method; Karl Pearson’s Rank correlation; Regression analysis – equation, estimation of unknown value from known value; Chi-square test, test of independence. An introduction to statistical tools and software. Practical training using MS-Excel.

Text Books

- 1) Ramakrishnan.R., 2018, Biostatistics Saras Publications, Nagercoil, Tamil Nadu
- 2) Khan, I.A and Khanum, A., 2004, Fundamental of Bio- statistics, Ukaaz Publication, New Delhi.

Reference Books

- 1) Motulsky H (2017) Intuitive Biostatistics-A Nonmathematical Guide to Statistical Thinking, Oxford University Press, USA
- 2) Rosner B (2010) - Fundamentals of Biostatistics-Duxbury Press

- 3) Sokal, R.R. and Rohlf, F.J. (2009) - Introduction to Biostatistics- Second Edition
- 4) Doerge RW, Bremer M (2009) Statistics at the Bench- A Step-by-Step Handbook for Biologists, Cold Spring Harbor Laboratory Press
- 5) van Emden H (2008) Statistics for Terrified Biologists-Wiley-Blackwell
- 6) Arora, P.N and P.K.Malhan (2008). Biostatistics. Himalaya Publications, Mumbai.
- 7) Härdle,W., Mori,Y., Vieu P (2007) Statistical methods for biostatistics and related fields-Springer
- 8) Daniel, W.W (2006) Biostatistics-A foundation for analysis in health sciences, John Wiley (Asia) & sons, Singapore.
- 9) Chap T. Le (2003) Introductory Biostatistics-Wiley-Interscience
- 10) Gurumani, N. 2004. An Introduction to Biostatistics. MJP publishers, Chennai.
- 11) Zar, J.H. (1996). Biostatistical Analysis, Prentice – Hall International, USA.
- 12) Palanichamy, S. Manoharan, M. 1994. Statistical methods for Biologists, Palani Paramount Publications, Tamil Nadu.

Course Designer:

Dr.C.Binu Ramesh, Assistant Professor in Zoology

Course Code	Course Title	Category	L	T	P	Credit
UZO20CL31	Lab in Biochemistry and Biostatistics	Core Lab-3	-	-	2	1

L-Lecture. T-Tutorial. P-Practicals

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

Preamble

Provide hands on training to perform basic laboratory techniques in Biochemistry.

Course Outcomes

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

	Course outcomes	Expected Proficiency %	Expected Attainment %
CO1	Prepare chemicals and buffers for biological reactions.	70	70
CO2	Perform basic laboratory techniques in both chemistry and biology	70	70
CO3	Qualitatively analyse the biomolecules present in the samples	70	60
CO4	Quantitatively estimates the amount of biomolecules present in the samples	70	60
CO5	Operate the instruments for biochemical assay.	70	70

Mapping of Course Outcomes with Programme Specific Outcomes

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

Mapping of Course Outcomes with Programme Outcomes

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

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

Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%

Course Title: Biochemistry and Biostatistics

1. Preparation of solutions – Molarity, Normality and Percentage
2. Determination of pH of various buffers
3. Verification of Beer's law using Colorimeter
4. Qualitative analysis of carbohydrates, proteins and lipids
5. Quantitative analysis of carbohydrates and lipids
6. Preparation of standard graph,-proteins
7. Chromatography-Paper and thin layer
8. Column chromatography
9. Vitamin C assay

Biostatistics

- 1) Representation of data - table, graph and diagrams
- 2) Estimation of mean, median, mode for the given leaf lengths
- 3) Determination of Pearson correlation and regression equation for the given data.
- 4) Determination of Goodness of fit by Chi square analysis in coin tossing trials.
- 5) Estimation of statistical significance using student's t test.

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 Designers : Dr.C.Ravi and Dr.Binu Ramesh

Thiagarajar College (Autonomous):: Madurai – 625 009

Department of Zoology

Programme code - UZO

(Course offered by Zoology Dept. to other major student joined on or after June 2020)

Course Code	Course Title	Category	L	T	P	Credit
UZO20NE31	Apiculture	NME1	2	-	-	2

L-Lecture. T-Tutorial. P-Practicals

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

Preamble

The course provides opportunity to learners to develop one step entrepreneurial skills how to rear honey bees, Harvest and market the honey, and maintain bees in a scientific way and to know the importance for becoming successful entrepreneur.

Course Outcomes

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

	Course outcomes	Expected Proficiency %	Expected Attainment %
CO1	Familiarize with the Life cycle of bee colony and types	70	60
CO2	Handle beekeeping systems and beekeeping equipment	70	60
CO3	Manage and maintain beehives for production and pollination	70	60
CO4	Extract honey using appropriate procedure, Asses the quality	70	60
CO5	Develop entrepreneur skills by theoretical learning	60	60

Mapping of Course Outcomes with Programme Specific Outcomes

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

Mapping of Course Outcomes with Programme Outcomes

B.Sc., P.O.

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

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

B.A. P.O.

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

B.B.A. P.O.

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

B.Com. P.O.

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

Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%

Course Title: Apiculture**Unit I****History and Biology of Honey bee**

History, Importance and Scope of Apiculture- Different species of Honey bees, Colony organization and life cycle, Social behavior of honey bees

Diseases and Enemies of Honey bees

Pests of Honey – Wax moth, Ants, Wasps, Mites

Bacterial disease- American Foulbrood, Viral disease – deformed wing virus, Fungal disease – Chalkbrood, Protozoan disease- *Nosema cerana*

UNIT – II**Methods of Bee Keeping**

Selection of site for apiary, Management of apiary at different seasons. Bee keeping equipment, Methods of bee keeping- Traditional and Modern methods.

Honey processing and Bee Hive products

Honey processing- Collection and Extraction, Processing, Preservation and storage of honey. Quality control standards - Honey testing

Honey- properties, adulteration and therapeutic application.
Bee products – Royal jelly, Pollen, Propolis, Bee wax, Bee venom.

Textbooks:

1. Jayashree, K.V, C.S. Tharadevi, C.S. N. Aruugam 2014. Apiculture, Saras Publication. TN.
2. Ravindranathan, K.R., 2005, A text book of Economic Zoology, Dominant publisher and distributors (P) Ltd., New Delhi.

http://nbb.gov.in/ National Bee Board <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=16175>

Course designer : **Dr.S.Selvarani**, Associate 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
UZO20C41	Developmental Biology	Core-7	4	-	-	4

L-Lecture. T-Tutorial. P-Practicals

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

Preamble

This course is designed to explore the fundamental concepts and mechanisms that regulate animal development from fertilization of the egg to formation of the adult organism including early, late and post embryonic developments.

Course Outcomes

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

	Course outcomes	Expected Proficiency %	Expected Attainment %
CO1	Explain the sequence of events and the mechanisms directing various stages of animal development including gametogenesis, fertilization, cleavage, gastrulation, blastulation etc.	70	60
CO2	Describe the formation and development of organs of an organism from embryonic cells.	70	60
CO3	Understand how gene activation plays a role in regeneration and teratogenesis	60	60
CO4	Describe the general sex cycle of animals beginning with estrus and menstrual cycle.	70	60
CO5	Explain the assisted reproductive techniques and their application	60	60

Mapping of Course Outcomes with Programme Specific Outcomes

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

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

Mapping of Course Outcomes with Programme Outcomes

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

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

Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%

Course Title: Developmental Biology

Unit 1: Early Embryonic Development

Historical review and concept of embryology. **Gametes and Gametogenesis:** Origin of primordial germ cells in mammals. Sperm – structure, types, spermatogenesis and hormonal control of spermatogenesis. Egg – structure, types, oogenesis and hormonal control of ovulation. Fertilization – sperm aggregation and activation, physiological and chemical factors involved in fertilization. Parthenogenesis: types (natural and artificial) and significance. Cleavage – planes, patterns and factors affecting the cleavage, cleavage in Amphioxus.

Unit II: Late Embryonic Development

Blastulation: salient features, types of blastula – stereo blastula, coeloblastula, discoblastula, periblastula and blastocyst in amphioxus. **Gastrulation:** salient features, metabolic and molecular changes during gastrulation, gastrulation in amphioxus. **Fate-map:** Construction of fate-map in amphibians. Morphogenetic movements of cells: epiboly and emboly.

Unit III:

Morphogenesis: Cell aggregation and differentiation in *Dictyostelium*; axes and pattern formation in *Drosophila*, amphibia and chick. **Organogenesis:** Development of brain, heart and kidney in frog. **Placentation:** Structure, types (based on the types of foetal membrane, distribution of villi and types of tissues) and functions of placenta.

Unit IV: Post Embryonic Development

Metamorphosis: Types, morphological and biological changes, and hormonal regulation in amphibian metamorphosis. **Regeneration:** Types – morphallaxis (hydra), epimorphosis (planaria) and compensatory (mammalian liver); limb regeneration in Amphibia. Factors influencing and controlling the regeneration. **Teratogenesis:** Teratogenic agents and their effects on embryonic development.

Unit V: Experimental embryology:

Sexual cycle: estrous and menstrual cycle, and their hormonal regulation. Assisted Reproductive techniques: Artificial insemination, In-vitro fertilization and embryo transfer in farm animal (cow); Cloning experiment in mammal (Dolly). Prenatal diagnosis and sex determination methods - amniocentesis, alpha-foeto protein (AFP) estimation, chorionic villus sampling and ultrasound scanning.

Text Book:

1. Carlson, B.M. 2007. Foundations of Embryology. Sixth Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.
2. Berril, N.J.1976. Developmental biology, Tata McGraw Hill Publishing Company Limited, New Delhi.

Reference Book:

1. Balinsky, B.I. and B.C. Fabian. 2012. An Introduction to Embryology. Fifth Edition, Cengage Learning India Private Limited, New Delhi.
2. Gilbert. S.F.1994. Developmental Biology. Sinauer Associates Inc. Massachusetts, USA.

3. Adams W.1986. Genetic Analysis of Animal Development. A Wiley InterScience Publication. USA.
4. Arora M.P.2009. Embryology, Himalaya Publishing House, New Delhi.
5. Chattopadhyay, S. 2017. An Introduction to Developmental Biology. Books and Allied (P) Ltd, Kolkata.
6. Subramoniam, T. 2013. Molecular Developmental Biology, Second Edition, Narosa publishing house, New Delhi.
7. Tomar, B.S. 2018. Developmental Biology. Pragati Prakashan Educational Publisher, Meerut.
8. Browder, L.W. 1984. Developmental Biology. Second Edition. Saunders College Publishing, New York.

Course Designer: **Dr.T.Rajagopal** 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
UZO20C42	Genetics	Core-8	4	-	-	4

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

Preamble

The course imparts a profound insight on the inheritance biology. Understanding the biology of inheritance is an important requirement for pursuing higher studies in the field of genetics. All applied life sciences converge at genetics, for making new products and services. Thus this course prepare the students in fitting into the requirements of academics and research.

Course Outcomes

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

#	Course Outcome	Expected Proficiency %	Expected Attainment %
CO1	Comprehend the idea of genetic material and inheritance	70	70
CO2	Differentiate the patterns of inheritance and its biological manifestations	70	70
CO3	Illustrate the effect of various levels of changes in the genetic material.	70	60
CO4	Elaborate the genetics based changes in the human system and his health.	60	60
CO5	Analyze the principles of gene flow in populations and its statistical evaluation.	60	60

K1: Knowledge K2: Understand K3: Apply

Mapping of Course Outcomes with Programme Specific Outcomes

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

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

Mapping of Course Outcomes with Programme Outcomes

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

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

Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%

Course Title: Evolution**Unit I****Transmission Genetics**

Mendelian inheritance, Mendel's Experiments-Law of Dominance and Segregation-Monohybrid ratio, Punnet square-Test cross and Back cross-Eye Colour inheritance in man. Mendel's second law- Independent Assortment-Dihybrid cross. Non-Mendelian inheritance Incomplete Dominance in Snapdragon Flower colour (Two alleles) - ABO blood inheritance (Three alleles) -Inheritance of Coat colour in Rabbits (Multiple alleles).

Unit II**Chromosomes and Genes**

DNA, genes, chromosomes and genomes. Alleles-genotype-phenotype-Dominant, Recessive, Heterozygous-homozygous-Hemizygous. Genetic material -prokaryotes, Eukaryotes and viruses, Extra-nuclear DNA: mitochondrial and chloroplast DNA, C-Value Paradox. Human Karyotype and ideogram- Autosomes and Allosomes-Barr body, Importance of telomeres.

Unit III**Linkage and Crossing Over and Sex-linked Inheritance**

Gene locus, Coupling and repulsion-Genetic linkage and types- Crossing over-Types and Mechanism-Frequency of Recombination: Chromosome mapping-two point (gene distance) and three point test cross (gene order). Sex determination in man and Drosophila- X-linked dominant and recessive inheritance, Colour blindness and Haemophilia- Y-linked inheritance-Hairy pinna, Sex limited and sex influenced traits -Baldness

Unit IV**Chromosomal aberrations and Cancer Genetics**

Numerical and structural chromosome abnormalities: Euploidy & Polyploidy – polyploidy in plants, Aneuploidy- Monosomy (Turner syndrome), Trisomy (Down's syndrome, Klinefelters syndrome), Mutations-point mutation, missense mutation, nonsense mutation, splice mutations, micro deletions and insertions (indels), large genomic re-arrangements-functional consequences of gene mutations. Cancer genetics: Malignant and benign- Proto oncogenes and Oncogenes-Tumour suppressor genes-DNA repair genes. Aging and its genetics: Telomerase

Unit V**Applied Genetics**

Gene therapy: Types and targets. Severe Immune System Deficiency -case study. Prenatal and Neonatal screening, Genetic counselling: Eugenics, Euthenics, Euphenics, Databases: OMIM, GENE CLINICS. Databases for population genetics- HAPMAP project , The London Dymorphology Database-POSSUM,

Text Books:

1. Verma,P.S and V.K. Agarwal.2016. Genetics, 9th Edition, S.Chand Publications.New Delhi.
2. Peter J. Russell. 2010. Genetics: A Molecular Approach, 3rd Edt,Pearson Publications, USA

References:

1. Peter E. Rosenbaum. 2010. Volpe's Understanding Evolution, McGraw-Hill, New York.
2. Dobzhansky, T., Francisco J. Ayala, G.L. Stebbins, James W.Valentine. 1977 Evolution, W.H. Freeman & Company, San Francisco.
3. D. Peter Snustad, Michael J. Simmons, 2015. Principles of Genetics, 7th Edition, John Wiley & Sons, Inc.,
4. Ledyard Stebbins, G. 1966. The process of Organic Evolution, Prentice – Hall, New Jersey.
5. Edward O. Dodson. 1960. Evolution: Process and Product, Reinhold Publishing Corporation, Newyork .
6. Gardner Eldon, J., D. Peter Snustad. 2006. Principles of Genetics, 8th Edition. John Wiley & Sons,

7. Carroll, SB., Doebley J, Griffiths AJF and Wessler SR., 2018 “An Introduction to Genetic Analysis .” W.H.Freeman and Co Ltd.

Course Designers:

1. Dr. P.Suresh
2. Dr. Poornima Kkani

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	Lab in Developmental Biology and Genetics	Core lab-4	-	-	2	1

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

Preamble

This course is designed to explore the fundamental concepts and mechanisms that regulate animal development from fertilization of the egg to formation of the adult organism including early, late and post embryonic developments.

Course Outcomes

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

	Course Outcomes	Expected Proficiency %	Expected Attainment %
CO1	Demonstrate the sequence of events and the mechanisms directing various stages of animal developments (slide / model)	70	70
CO2	Utilize laboratory techniques to mounts the developmental stages of chick embryos	70	70
CO3	Illustrate simple Mendelian traits through experiments	70	70
CO4	Trace the patterns of inheritance	60	60
CO5	Demonstrate natural selection using beads	70	60

K1: Knowledge K2: Understand K3: Apply

Mapping of Course Outcomes with Programme Specific Outcomes

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

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

Mapping of Course Outcomes with Programme Outcomes

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

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

Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%

Course Title: Lab in Developmental Biology and Genetics

Developmental Biology:

1. Study of different types of eggs - Amphioxus, frog, chick and human - based on models/charts.
2. Study of blastula and gastrula – Amphioxus and frog- slide / model
3. Study of whole mounts of developmental stages of chick: primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation.
4. Study of whole mounts of developmental stages of Cleavage (blastula, gastrula, neurula and tail-bud stage) of frog through permanent slides.
5. Study of placenta (model/ specimen).
6. Observation of sperm motility in a Bull.
7. Embryonic development of the egg of zebra fish (demonstration only)
8. Demonstration of estrous (proestrus, estrus, midestrus and diestrus) cycle in rat.

Course Designer: **Dr T.Rajagopal** Assistant Professor

Genetics

1. Demonstration and verification of Mendelian Inheritance –Monohybrid and Dihybrid crosses using beads
2. Demonstration of Hardy-Weinberg equilibrium and genetic drift using beads
3. Observation and collection of Mendelian Traits in Humans-Widow's peak, attached ear lobe, simple in chin, Color blindness
4. Preparation of Pedigree charts for the Eye disease –Glaucoma
5. Study on Human Karyotype
6. Online Mendelian Inheritance in Man (OMIM) –database search for chosen diseases
7. Genetic Experiments in Drosophila to observe Eye color in F1 and F2 generation.

Course Designer: **Dr P.Suresh Associate Professor and Dr.Poornimakkani** Assistant Professor

Thiagarajar College (Autonomous):: Madurai – 625 009

Department of Zoology

Programme code - UZO

(Course offered by Zoology Dept. to other major student joined on or after June 2020)

Course Code	Course Title	Category	L	T	P	Credit
UZO20NE41	Sericulture	NME	-	2	-	2

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

Preamble

This course gives an overview of silkworm biology & introduces students to the methods of silkworm rearing.

Course Outcomes

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

	Course outcomes	Expected Proficiency %	Expected Attainment %
CO1	Classify silkworms & trace the history of sericulture	60	60
CO2	Summarize the lifecycle of <i>Bombyx mori</i>	70	70
CO3	Outline the methods of silkworm rearing	70	60
CO4	Describe the processing of harvested cocoons	60	50
CO5	Compare the symptoms & control measures of diseases affecting silkworm	60	60

K1: Knowledge K2: Understand K3: Apply

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

B.Sc.. P.O.

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

B.A. P.O.

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

B.B.A. P.O.

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

B.Com. P.O.

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

Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%

UNIT I:

History of sericulture & silk route; Types of silkworms- mulberry & non-mulberry silkworms, univoltine, bivoltine & multivoltine ; construction of rearing house, rearing equipments & disinfection; Methods of rearing mulberry silkworm.

UNIT II:

Diseases of silkworm- causes, symptoms. Pathogenesis & control measures of Flacherie, Green Muscardine, Pebrine & Nuclear Polyhedrosis virus; Pests of silkworm- nature of damage & control pf Uzi fly and red ants; Harvesting & processing of cocoons – silk reeling- Properties of raw silk- Role of central silk board.

Text Books:

1. Ganga .G & Sulochana Chetty .J, An Introduction to Sericulture, 2nd ed., Oxford & IBH publishing house, (2020).
2. Madan Mohan Rao., An Introduction to sericulture 2nd ed., BS Publications (2019)
3. Shukla, G.S. and V.B. Upadhyay, Economic Zoology, First edition, Rastogi publication, Meerut(2016).

**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	Economic Zoology	4	4
		II	UZO20GE21B	Insect Pests and Management	4	4
		II	UZO20GL21B	Lab in Economic Zoology & Insect Pests and Management	2+2	2
Chemistry	II	III	UZO20GE31C	Economic Zoology	4	4
		IV	UZO20GE41C	Clinical Chemistry	4	4
		IV	UZO20GL41C	Lab in Economic Zoology & Clinical Chemistry	2+2	2

Scheme of Examination

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/31C	Economic Zoology	Generic Elective	4	-	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First Bot. / Second Chem	First for Botany/ Third for Chemistry	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	Expected Proficiency %	Expected Attainment %
CO1	Spell the importance of applied biological sciences such as sericulture, apiculture, aquaculture	70	60
CO2	Explain rearing methods of beneficial organisms – an economic perspectives	70	60
CO3	Spell the different strategies adopted in poultry and aquaculture	70	60
CO4	Spell the dos and donots in animal rearing	70	60
CO5	Start their own agro based small scale industry business such as poultry, apiculture, sericulture etc.,	60	50

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	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	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 meat. 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	Expected proficiency %	Expected Attainment %
CO1	Classify the types of pests and important insect groups	60	60
CO2	List the household pests and interpret disease transmission and control	70	60
CO3	Identify cattle pests and analyze their infection and control	70	60
CO4	Categorize crop pests and apply management theory and practice	70	60
CO5	Emphasize biology, infestation, and damage caused by stored product insect pests	60	60

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	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%

Unit I:

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

Unit II:

Biology, disease transmission and control of *Musca domestica* (cholera), *Anopheles stephensi* (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 Depot, 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. Ananthkrishnan, 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)

Programme Code: UZO

Course Code	Course Title	Category	L	T	P	Credit
UZO20GL21B	Lab in Economic Zoology and Insect Pest & 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	Expected Proficiency	Expected Attainment
CO1	Explain the morphology, life history of lac insect, honey bees and silkworm	70	60
CO2	Distinguish the different components of bee hives.	70	70
CO3	Appraise the quality of water and honey .	70	70
CO4	Categorize the different pests of agriculture crops	60	60
CO5	Make a field study in an ecosystem	70	60

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	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	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 CO₂ 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. LC₅₀ 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, Popular 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.

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

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

Course Code	Course Title	Category	L	T	P	Credit
UZO20GE41C	Clinical Chemistry	Generic Elective	4	-	-	4

Year	Semester	Int. Marks	Ext. Marks	Total
Second Chemistry	Fourth	25	75	100

Preamble

Elaborates the principle, procedure and applications of analytical instruments. Meet the demand on skilled personal on clinical techniques.

Course Outcome

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

	Course outcomes	Expected Proficiency %	Expected Attainment %
CO1	List the principles and applications of analytical instruments	60	60
CO2	Summarize the basis & clinical significance of the urine, blood, serum analysis	70	70
CO3	Elaborate the diseases associated with the abnormalities with urine and blood	60	60
CO4	Estimate the different components of body liquid samples	70	60
CO5	Spell the influence and importance of hormones and enzymes	60	60

Mapping of Course Outcomes with Programme Outcomes

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

Mapping of Course Outcomes with Programme Specific Outcomes

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

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

Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%

Title of the Course: Clinical Chemistry

UNIT-I

Introduction to clinical lab technology: Role of lab technologists, ethics, safety measures and precautions, cleaning and care of laboratory glassware and equipment.

Principle and application - colorimeter, centrifuge (types-clinical, gradient, differential), chromatography, autoanalyzer, ELISA and PCR.

UNIT – II

Blood composition - Collection of blood samples- anticoagulants – Haemoglobin & Anaemia– ABO Blood grouping, Formation of platelets and thrombocytopenia, Rhesus blood group system, ESR as an indicator of infection- blood sugar & diabetes - blood urea & kidney function.

UNIT- III

Collection and preservation of urine sample- Physical properties of urine (total volume, specific gravity, colour, turbidity and odour) –Components of urine - Bile salts and Bile pigment, urea – Abnormal components of urine - proteins, sugar , ketone bodies – Diseases associated with abnormalities in urine.

Renal function test: Test based on glomerular filtration, Test to measure renal plasma flow, Test based on tubular function

UNIT –IV

Liver function Test: Functions of liver, common liver function test- Alanine transaminase (ALT) and Aspartate transaminase (AST), Alkaline phosphatase (ALP), Albumin and total protein, Bilirubin, Gamma-glutamyltransferase (GGT), L-lactate dehydrogenase (LD), Prothrombin time (PT), Acute Viral Hepatitis Panel

UNIT – V

Thyroid function test: Test based on primary function of thyroid, Test measuring thyroid hormones in the blood , Tests based on metabolic effects of thyroid hormones

Cerebrospinal Fluid: Appearance of CSF- Pressure of CSF- Biochemical changes – Large colloidal Gold reaction

Radioisotopes in Medicine

Text books:

1. Mukherjee, K.L. 2001. Medical Lab Technology Vol I, II and III. Tata Mc Graw Hill Publishing Company Ltd. New Delhi.
2. Sood, R, 1999, Medical Laboratory Technology – Methods and Interpretations – Fifth edition, Jaypee, New Delhi.

Course Designer : **Dr.S.Selvarani** Associate Professor

Dr.Poornimakkani,Assistant Professor

Course Code	Course Title	Category	L	T	P	Credit
UZO20 GL2	Lab in Economic Zoology and Clinical Chemistry	Generic Elect Lab- 1	-	2	-	1
Year	Semester	Int. Marks	Ext.Marks		Total	
Second	Third and Fourth	25	75		100	
Preamble						

Elaborate about beneficial insects. Appraise the steps involved in the development of apiculture and sericulture unit. Brief different methods involved in water quality analyses. Acquainted with basic clinical lab techniques.

Course Outcomes

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

	Course outcomes	Expected Proficiency %	Expected Attainment %
CO1	Explain the morphology, life history of lac insect, honey bees and silkworm	60	60
CO2	Distinguish the different components of bee hives.	70	70
CO3	Appraise the quality of water and honey .	70	70
CO4	Examine and analyse the body fluids	60	60
CO5	Analyse and estimate the blood components	70	70

K1: Knowledge K2: Understand K3: Apply

Mapping of Course Outcomes with Programme Outcomes

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

Mapping of Course Outcomes with Programme Specific Outcomes

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

Blooms taxonomy: Assessment Pattern

CO5	M	-	M	M	S
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	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%

<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%

Title of the Course : Lab in Economic Zoology and Clinical Chemistry

Economic Zoology

1. Dissection of silkgland
2. Spiracle Mounting
3. Silkworm Egg, Larva, Pupa and adult
4. Identification of Types of honey bees
5. Bee Hive
6. Qualitative analysis of honey
7. Lac Insect, Lac encrustation
8. Types of Broilers and layers
9. Estimation of pH and turbidity.
10. Estimation of total alkalinity.
11. Estimation of dissolved oxygen.
12. Estimation of total hardness.
13. Estimation of phosphates.
14. Estimation of Iron
15. Estimation of primary productivity (light and dark bottle method).

Clinical chemistry

1. Paper and Thin Layer Chromatography
2. Determination of Blood group
3. Estimation of total number of White blood cells (WBC)
4. Estimation of total number of Red blood cells (RBC)
5. Estimation of total number of Platelets
6. Determination of Bleeding time
7. Determination of Clotting time
8. Hemoglobin estimation
9. Preparation of Haemin crystals from human blood
10. Urine analysis –Sugar, Albumin, ketone bodies, Bile salts
11. Separation of serum protein

Reference Books

1. Ravindranathan, K.R., 2005, A text book of Economic Zoology, Dominant publisher and distributors Pvt Ltd., New Delhi.
2. Shukla, G.S and V.B. Upadhyay, 1985, Economic Zoology, First edition, Rastogi publication, \
3. Sood, R, 1999, Medical Laboratory Technology – Methods and Interpretations – Fifth edition, Jaypee, New Delhi.

B.Sc., Zoology:

Assessment values of course learning outcomes and their mapping with program outcomes (POs)

Code	Course Name	PO1	PO2	PO3	PO4	PO5	PO6
UZO20 C11	Invertebrata	9	0	5	11	7	
U ZO20C12	Cell Biology						
U ZO20CL11	Lab in Invertebrata						
UZO20C21	Chordata						
U ZO20C22	Evolution						
U ZO20CL21	Lab in Chordata						
U ZO20C31	Biochemistry						
U ZO20C32	Biostatistics						
U ZO20CL31	Lab in Biochemistry						
U ZO20C41	Developmental Biology						
U ZO20C42	Genetics						
U ZO20CL41	Lab in Developmental Biology and Genetics						
U ZO20C51	Immunology						
U ZO20C52	Molecular biology						
U ZO20C53	Animal Physiology						
U ZO20CL51	Lab in Immunology						
U ZO20CL52	Lab in Molecular biology						
U ZO20CL53	Lab in Animal Physiology						
U ZO20 C61	Environmental Biology						
U ZO20C62	Microbiology						
U ZO20C63	Biotechnology						
U ZO20CL61	Lab in Environ Biology						
U ZO20CL62	Lab in Microbiology						
U ZO20 CL63	Lab in Biotechnology						
U ZO20CE51A	Biophysics						
U ZO20CE51B	Wild life biology						
U ZO20 CE61A	Aquaculture						
U ZO20 CE61B	Entomology						
U ZO20SE51A	Clinical Lab Tech. lab						
U ZO20SE51B	Poultry farming						
U ZO20 SE51C	IPR						
U ZO20 SE51D	Sericulture						
U ZO20 SE61A	Bioinformatics lab						
U ZO20 SE61B	Stem Cell Biology						
U ZO20 SE61C	Forensic Science						
U ZO20 SE61D	Nanotechnology						
UZO20NE31	Apiculture						
U ZO20 NE41	Sericulture						
	Value Education						
	Environmental Science						

B.Sc., Zoology:

Assessment values of course learning outcomes and their mapping with program specific outcomes (PSOs)

Code	Course Name	PO1	PO2	PO3	PO4	PO5	PO6
UZO20 C11	Invertebrata	9	0	5	11	7	
U ZO20C12	Cell Biology						
U ZO20CL11	Lab in Invertebrata						
UZO20C21	Chordata						
U ZO20C22	Evolution						
U ZO20CL21	Lab in Chordata						
U ZO20C31	Biochemistry						
U ZO20C32	Biostatistics						
U ZO20CL31	Lab in Biochemistry						
U ZO20C41	Developmental Biology						
U ZO20C42	Genetics						
U ZO20CL41	Lab in Developmental Biology and Genetics						
U ZO20C51	Immunology						
U ZO20C52	Molecular biology						
U ZO20C53	Animal Physiology						
U ZO20CL51	Lab in Immunology						
U ZO20CL52	Lab in Molecular biology						
U ZO20CL53	Lab in Animal Physiology						
U ZO20 C61	Environmental Biology						
U ZO20C62	Microbiology						
U ZO20C63	Biotechnology						
U ZO20CL61	Lab in Environ Biology						
U ZO20CL62	Lab in Microbiology						
U ZO20 CL63	Lab in Biotechnology						
U ZO20CE51A	Biophysics						
U ZO20CE51B	Wild life biology						
U ZO20 CE61A	Aquaculture						
U ZO20 CE61B	Entomology						
U ZO20SE51A	Clinical Lab Tech. lab						
U ZO20SE51B	Poultry farming						
U ZO20 SE51C	IPR						
U ZO20 SE51D	Sericulture						
U ZO20 SE61A	Bioinformatics lab						
U ZO20 SE61B	Stem Cell Biology						
U ZO20 SE61C	Forensic Science						
U ZO20 SE61D	Nanotechnology						
UZO20NE31	Apiculture						
U ZO20 NE41	Sericulture						
	Value Education						
	Environmental Science						

M.Sc., Zoology

Programme Code – PZO

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

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 Engineering 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.

Programmespecificoutcomes- M.Sc., Zoology

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

PO1	Proficient in core concepts, recent trends in different disciplines of life sciences like microbiology, biochemistry, cell and molecular biology, genetics and genetic engineering, evolution, entomology, IPR, bioethics, bioinformatics etc.,
PO2	Explain how organisms function at gene, genome, cell, tissue, organ and organ-system level of organization.
PO3	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.
PO4	Apply theoretical knowledge gained for prominent career and for further academic study.
PO5	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
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	PZO20C11	Biological Chemistry & Biophysics	5	4	75	25	75	100
Core2	PZO20C12	Microbiology	5	4	75	25	75	100
Core3	PZO20C13	Genetics & Evolution	5	4	75	25	75	100
Core Elective1	PZO20CE11	Animal Biology	6	5	90	25	75	100
Lab1	PZO20CL11	Lab in Biological Chemistry and Biophysics	3	2	45	40	60	100
Lab2	PZO20CL12	Lab in Microbiology	3	2	45	40	60	100
Lab3	PZO20CL13	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	PZO20C21	Entomology	5	4	75	25	75	100
Core5	PZO20C22	Cell & Molecular Biology	5	4	75	25	75	100
Core6	PZO20C23	Bioinstrumentation	5	4	75	25	75	100
Core Elective2	PZO20CE21	Biostatistics	6	5	90	25	75	100
Lab4	PZO20CL21	Lab in Entomology	3	2	45	40	60	100
Lab5	PZO20CL22	Lab in Cell & Molecular Biology	3	2	45	40	60	100
Lab6	PZO20CL23	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	PBO20 CE31Z	Plant Tissue Culture	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	PZO20C41	Immunology	5	4	90	25	75	100
Core11	PZO20C42	Ecology and Biodiversity	5	4	90	25	75	100
Core 12	PZO20C43	Bioinformatics	5	4	90	25	75	100
Core Elective 4	PZO20PJ41	Project	6	3	90	50	50	100
Lab10	PZO20CL41	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

	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

Course Code	Course Title	Category	L	T	P	Credit
PZO20 C31	Genetic Engineering and Biotechnology	Core-7	4	1	-	4

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

Preamble

Explain the basic principles of genetic engineering. Elaborate the fundamental steps in gene cloning and manipulation. Elaborates on construction and application of genetic engineering and helps to expertize in various gene transfer concepts.

Prerequisites

Knowledge on the principle and application of basic molecular and biotechnological methods

Course Outcomes

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

	Course outcomes	Expected Proficiency	Expected Proficiency
CO1	Outline the various techniques used in genetic engineering	70	60
CO2	Explain how scientific methodologies are used to conduct experiments and develop products	70	60
CO3	Distinguish various gene transfer methods.	70	70
CO4	Screen and select the recombinants and make use of them in various fields.	60	60
CO5	Attain knowledge to take responsibilities associated with different jobs in biotechnology	60	50

Mapping of Course Outcomes with Programme Outcomes

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

Mapping of Course Outcomes with Programme Specific Outcomes

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

S- Strong M -Medium L-Low

Title of the Course: Genetic Engineering and Biotechnology

Unit I:

Tools for Genetic engineering – restriction endonucleases – modifying enzymes – ligases, alkaline phosphatase, S1 Nuclease, PNKase. Properties of cloning vectors, Vectors used in cloning: recombinant Plasmids -PBR322, PUC, plant plasmid vector-Ti plasmids, Phage vectors -lamda ; hybrid vectors- Cosmids – Phagemids, Expression vectors –pET and shuttle vectors- YACs , BACs, animal viral vectors -adeno

Unit II:

Gene cloning in prokaryotes, Principle steps involved in recombinant DNA technology, Preparation of Genomic and cDNA libraries. Transfer of recombinant vectors to the bacterial and viral hosts-Transformation and transfection. Selection of recombinants-Direct selection, insertional inactivation method, blue white method, colony hybridization. Radioactive labeled and non-radioactive labeled nucleic acid detection. Gene cloning in eukaryotes-plant cells, yeasts and animal cells. Gene transfer in dicots by indirect transformation using Agrobacterium Ti plasmid.

Unit-III:

Animal cell culture: Requirements for animal cell, tissue and organ culture. Characteristics of animal cell growth in culture, substrates for cell growth. Primary and secondary cell culture, adherent and suspension cultures; finite and continuous cell lines. Natural and synthetic media for cell culture. Methods for scale up of cell culture process, Organ culture on plasma dots; agar; in liquid medium. Whole embryo culture. Cryopreservation of animal cells. Applications of animal cell culture-Valuable products from cell culture (Erythropoetin), Synthesis of monoclonal antibodies by hybridoma technology, Tissue engineering of artificial skin and cartilage, cell viability assay (MTT assay) for drug testing, vaccine production using animal cells.

Unit-IV:

Expression and purification of cloned gene products. Transgene, transgenesis, Strategies of gene transfer in animals; Physical gene transfer methods-treatment through microinjection, ultrasonication, particles bombardment, PEG mediated and electroporation- targeted gene transfer, knock out mice, Animal cloning (nuclear transfer method -Dolly). transfer of animal cells/embryo, Transgenic animals (Sheep and fish) and Plants (Bt cotton, droughtresistant plants and its applications. Animal bioreactors and molecular Pharming. Bioethics in genetic engineering, Intellectual property rights and protection

Unit –V:

Techniques in Biotechnology: Types and methods of fermentation, PCR-(Nested, Reverse

transcriptase PCR) DNA finger printing (RAPD and RFLP), DNA sequencing methods- (Maxam Gilbert, Sanger's, Automated and NGS), Advanced techniques: DNA microarray, RNA interference, Gene editing-Crispr cas-9.

Text Books

1. Gupta P.K. 2010, Elements of Biotechnology, 2nd edition, Rastogi publications, New Delhi
2. Dubey R.C. 2009. A text book of Biotechnology. S.Chand & Company, New Delhi

Reference Books

1. Brown, T.A. 2006. Gene Cloning & DNA Analysis: An introduction. V edn. Blackwell publishing USA.
2. Glick, R and Pasternak, J 1994. Molecular Biotechnology. Panima Publishing Corporation, New Delhi
3. Balasubramanian, D., C.F.A. Bryce, K.Dharmalingam, Y.Green, Kunthala Jeyaraman. 2004. Concepts in Biotechnology. Universities (P) ltd. Hyderabad.
4. Chawla, H.S. 2000 Introduction to Biotechnology, Oxford & IBH Publishing Co. Pvt.Ltd. New Delhi.
5. Crueger, W. and A. Crueger, 2000. Biotechnology: A Test Book of Industrial Microbiology, 2nd edn. Panima Publishing Corporation, New Delhi.
6. Mitra, S. 1996 Genetic Engineering Principles and Practice Macmillan India Ltd. India
7. Trehen, K. 2002. Biotechnology, New Age International (P) Ltd. New Delhi
8. Trevan, M.D., S. Boffey, K.H. Goulding and P. Stanbury, 1990, Gene Biotechnology – Himalaya Publishing House, New Delhi.
9. <https://www.neb.com/tools-and-resources/feature-articles/crispr-cas9-and-targeted-genome-editing-a-new-era-in-molecular-biology?device=pdf>

Course designers: Dr. Poornima Kkani

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
PZO20 CL31	Lab in Genetic Engineering and Biotechnology	CoreLab-7	-	-	3	2

Year	Semester	Int. Marks	Ext.Marks	Total
Secondt	Third	40	60	100

Preamble

Demonstrate the basic techniques in genetic engineering and biotechnology.

Prerequisites

Basic knowledge on cell and molecular biology techniques.

Course Outcomes

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

	Course outcomes	Expected Proficiency %	Expected Proficiency %
CO1	Perform basic techniques in genetic engineering and biotechnology.	70	70
CO2	Explain the Central Dogma of Biology and its importance in genetic engineering	70	70
CO3	Isolate genetic material from tissues and microbes.	70	70
CO4	Make use of instruments applicable in biotechnology.	70	60
CO5	Take responsibilities associated with different jobs in biotechnology	60	60

Mapping of Course Outcomes with Programme Outcomes

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

Mapping of Course Outcomes with Programme Specific Outcomes

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

S- Strong M -Medium L-Low

Title of the Course: Lab in Genetic Engineering and Biotechnology

1. Isolation of Plasmid and Genomic DNA from microbes
2. Isolation of Genomic DNA from animal tissues
3. Restriction digestion of Plasmid DNA
4. Competent cell preparation
5. DNA ligation, Recombinants selection- blue white screening
6. Demonstration of PCR amplification
7. Demonstration of Western Blotting
8. Protoplast Isolation
9. Biogas production-demonstration
10. Ethanol production-Khune's fermentation

References

1. Ausubel, F.M. 1997. Short Protocols in Molecular Biology, Second Edition, John Wiley & Sons. Harvard Medical School.
2. Brown, T.A. 1998. Molecular Biology Lab Fax II Gene analysis, Second Edition, Academic Press, UK.
3. Glover, D.M. and Hames, B.D. 1995. DNA cloning – A practical approach, Vol. 1 - 4, IRC Press.
4. Janarthanan, S. and Vincent, S. 2007. Practical Biotechnology: Methods and protocols, University Press.
5. Sambrook, J., Fritsch, E.F. and Maniatis, T. 2001. Molecular Cloning – A lab manual. Vol. III – Second Edition CSH Press, Cold Spring Harbor.
6. Swami, P.M. 2009. Lab Manual of Biotechnology. Rastogi Publications, Meerut.
7. Hardin C, Edwards, J A. Riell, D. Presutti, W. Miller and D. Robertson. 2008. Cloning Gene Expression and Protein Purification. Oxford University Press. U.K.

Course designers: Dr. Poornima Kkani

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
PZO20C32	Animal Physiology	Core-8	4	1	-	4

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

Preamble

The course provide an insight into the mechanisms behind various physiological processes of anorganism

Prerequisites

Knowledge on the organization of different organ systems

Course Outcomes

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

	Course outcomes	Expected Proficiency %	Expected Proficiency %
CO1	Explain the structural organization of different systems within body	70	70
CO2	Categorize the functions of different organ systems in animals.	70	70
CO3	Spell the role of body fluids	60	50
CO4	Explain how an organism/individual respond to external stimuli	60	60
CO5	Distinguish animal behavioral pattern	60	60

Mapping of Course Outcomes with Programme Outcomes

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

Mapping of Course Outcomes with Programme Specific Outcomes

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

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)	20%(30)
Understand -K2	15%(9)	15% (9)	20%(30)
Apply-K3	30%(18)	30% (18)	20%(30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20%(30)
Create-K6	60	60	150

Title of the Course: Animal Physiology

Unit – I Nutrition and Digestion

Feeding and Digestion – Nutritional types, Feeding mechanism- feeding on small particles, on food masses and on liquids. Digestion – intracellular and extracellular, Mechanism of digestion, absorption-absorption of carbohydrates, fats, proteins; mechanisms of absorption; defecation.

Unit – II Respiraton and Circulation

Respiration - External and Internal (Tissue) respiration - Respiratory pigments - disibution, composition, properties and functions - Pulmonary ventilation, Respiratory volumes and capacities,respiratory quotient; Adaptations to high altitude and diving. Transport of gases - Anaerobiosis

Circulation - Types - Composition, Properties and functions of blood - Types of Heart. Human - Cardiac cycle - Cardiac rhythm - origin of heart beat - regulation of heart beat - ECG - Blood pressure.Blood clotting mechanism.

Unit- III Excretion

Excretion – Excretory Organs in animals - Kinds of excretory products - ornithine cycle - mechanisms of urine formation in mammals - hormonal regulation of excretion.

Homeostasis - regulatory mechanisms - osmoconformers , osmoregulators - organs concerned with osmo-ionic regulation (skin, gills and kidneys) - osmo - ionic regulation in aquatic and terrestrial vertebrates.

Thermoregulation - acclimation and acclimatization - heat death - cold death - poikilotherms - heterotherms - homeotherms - temperature regulation in poikilotherms and homeotherms - physiology of hibernation - aestivation Biorhythms - definition, types and examples and adaptive significance

Unit – IV Neuro and Sensory Physiology

CNS and PNS. Structure and types of neurons and glial cells. Propagation of nerve impulse. Synapse, synaptic transmission. Synthesis of neurotransmitter – acetyl choline. Reflex and reflex arc- properties and types of reflexes. Muscle Physiology – types of muscles - Ultra structure of skeletal muscle – properties – mechanism of muscle contraction – Tetanus – Muscle fatigue

Receptors- classification – chemoreceptors – touch receptors – phonoreceptors- mammalian ear- organ of corti- working mechanism- phonoreception in Birds . photoreceptors- vertebrate mammalian eye-structure of retina- visual pigments – physiology of vision-binocular vision – adaptation to darkness- compound eyes and Mosaic vision.

Unit-IV Endocrine system

Endocrine Glands – structure, secretions and functions of endocrine glands in vertebrates – Pituitary, hypothalamus, Thyroid, Parathyroid, Adrenal, Thymus, Islets of Langerhans, Gastrointestinal hormones – Hormones of Insects and Crustaceans

Unit-V Behavioural Physiology

Animal Behaviour: Definitions of Ethology, history of animal behaviour and significance Behaviour patterns: Innate –Reflexes, taxes, instincts and motivation. Learned behavioural patterns – habituation, imprinting, trial and error, and conditioning – classical and operant, Insight.

Behavioral interactions: Instinctive behaviour pattern, social behaviour, Altruistic behaviour, Territorial behaviour – Aggression, Submission, Communication- Courtship behaviour, nesting behavior, chemical communication, sound and light communication, cyclic behaviour – Hibernation, Migration.

Text Books

1. Bijlani, R.L. 2001. Fundamentals of Physiology. I edn. JayPee brothers, NewDelhi
2. Subrahmanyam, S., Madhavankutty, K. and Singh, H.D. 1996 (Eds). Text Book of Human Physiology. S. Chand & Company Ltd. NewDelhi.

REFERENCE BOOKS

1. V.K. Agarwal, 2009, Animal Behaviour (Ethology), S. Chand & Company Ltd, New Delhi.
2. Renganathan, T.S. 2002. A text book of Human Anatomy. VI edn. S. Chand and Company Ltd., NewDelhi.
3. Hoar W.S 2004. General and Comparative Physiology. Prentice-Hall of India (P) Ltd.NewDelhi
4. Singh, H.R and Neeraj Kumar 2009. Animal Physiology andBiochemistry. Vishal Publishing Co, NewDelhi.
5. Bentley,P.J. 1998. Comparative Vertebrate Endocrinology (3rd edn).Cambridge UniversityPress
6. Chatterjee, C.C. 1997. Human Physiology. Medical allied agency,Calcutta.

Course Designer : **Dr.S.Selvarani and Dr.T.Rajagopal**

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
PZO20CL32	Lab in Animal Physiology	Core Lab-8	-	-	3	2

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

Preamble

Provide hands on training on various experiments that elaborates how physiological systems in animals operate and are regulated.

Prerequisites

Knowledge on various biomolecules, organs and organ systems

Course Outcomes

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

	Course outcomes	Expected Proficiency %	Expected Proficiency %
CO1	Explain the influence of different systems in the normal functioning of the body	70	70
CO2	Estimate the level of biomolecules in body fluids and determine the influence of various factors on physiological activity of animals.	70	70
CO3	Elaborate on the principal physiological systems in animals, how they operate and how they are regulated.	60	50
CO4	Design, conduct experiments, analyze and interpret data for investigating problems in physiological systems and allied fields	60	60
CO5	Establish entrepreneurship ventures such as consultancy, medical lab and training centres .	60	60

Mapping of Course Outcomes with Programme Outcomes

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

Mapping of Course Outcomes with Programme Specific Outcomes

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

S- Strong M -Medium L-Low

Title of the Course: Lab in Animal Physiology

1. Effect of temperature on salivary amylase activity
2. Effect of pH on salivary amylase activity
3. Effect of substrate concentration on salivary amylase activity
4. Observation of Haemin crystals in human blood
5. Determination of blood pressure using Sphygmomanometer
6. Qualitative analysis of urine for albumin, sugar, ketone bodies and bile salts
7. Qualitative analysis excretory products – Ammonia, urea, uric acid
8. Osmotic haemolysis in animal cells
9. Haemolymph circulation in insect flight appendages
 - Determination of visual activity with snelle's chart
 - Rate of oxygen consumption in fish
 - Effect of temperature on operculum movement of fish
 - Determination of ovulation – Saliva fern pattern study**
 - Chemical communication in ants**
 - Field study -**

Reference books:

1. Hoar W.S 2004. General and Comparative Physiology. Prentice-Hall of India (P) Ltd. New Delhi
2. Singh, H.R and Neeraj Kumar 2009. Animal Physiology and Biochemistry. Vishal Publishing Co, New Delhi.

Course Designer : **Dr.S.Selvarani and Dr.T.Rajagopal**

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
PZO20C 33	Developmental Biology	Core-9	4	1	-	4

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

Preamble

Provides an insight into the development of an organism starting from gametogenesis to organogenesis. The course highlights the concepts of regeneration, metamorphosis and assisted reproductive technology

Prerequisites

Basic knowledge on organs associated with reproductive system and cell biology

Course Outcomes

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

	Course outcomes	Expected Proficiency %	Expected Proficiency %
CO1	Elaborates the various stages of embryogenesis and organogenesis	70	60
CO2	Explain the basis of organ differentiation. Trace the sequence of events in fertilization	70	60
CO3	Illustrate the methods of assisted reproductive technology	60	60
CO4	Appraise on metamorphosis, regeneration and ageing as a part of postembryonic development	60	60
CO5	Emphasize the modern implications of developmental biology in terms of oogenesis, <i>in-vitro</i> fertilization, stem cell research and amniocentesis	60	60

Mapping of Course Outcomes with Programme Outcomes

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

Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	M	S	S
CO2	S	S	L	L	M
CO3	M	---	S	S	M
CO4	M	---	---	---	M
CO5	L	M	S	S	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)	20%(30)
Understand-K2	15%(9)	15% (9)	20%(30)
Apply -K3	30%(18)	30% (18)	20%(30)
Analyze -K4	20% (12)	20% (12)	20% (30)
Evaluate -K5	20% (12)	20% (12)	20%(30)
	60	60	150

Title of the Paper: Developmental Biology

Unit I

Historical thoughts and concepts, scope of embryology. Gametogenesis: primordial germ cells, origin of primordial germ cells. Spermatozoan: sperm - structure, types and spermatogenesis; egg - morphology (size, shape and egg membranes) and organization (yolk, pigments and egg cortex), types and oogenesis.

Unit II

Fertilization: Approximation of gametes - Chemotaxis, fertilizing-antifertilizing reaction, acrosome reaction, cortical reaction and physiological changes in fertilization. **Parthenogenesis:** types (natural and artificial) and significance. **Cleavage:** salient features, planes of cleavage, patterns of cleavage and factors affecting cleavage. **Gastrulation:** salient features, metabolic and molecular changes during gastrulation, gastrulation in amphioxus.

Unit III

Fate-map: construction of fate-map in amphibians – artificial and natural markings. **Organogenesis:** development of brain, heart and kidney in frog. **Placentation:** classification (based on the types of foetal membrane involved, distribution of villi and types of tissues involved) and physiology of placenta.

Unit-VI

Differentiation: types, processes and factors causing (induction, competence, determination). **Metamorphosis:** amphibian metamorphosis – ecological, morphological and physiological and chemical changes. **Regeneration:** types, events in regeneration and factors influencing regeneration. **Teratogenesis:** Malformation and disruption, gene-phene relationship, autophene, allophene and teratogenic agents (retinoic acid, pathogens, alcohol, drugs and heavy metals).

Unit V

Male Reproductive System in human: testes, seminiferous tubules, epididymis, spermatic cord, ejaculatory ducts, auxiliary male genital glands (prostate gland and bulbourethral or cowper's glands). Female Reproductive System in human: ovary, oviduct, genital duct and uterus. Sexual cycle: estrous and menstrual cycle, hormonal regulation of ovulation. Assisted Reproductive Technology: Artificial insemination (AI), *In-vitro* fertilization (IVF)-Test tube baby, Embryo transfer (ET), Contraceptive devices and vaccines.

Text books

1. Balinsky, B.I 1981. An Introduction to embryology. W.B.Saunders and Co.London
2. Verma., P.S

Reference books

1. Berril, N.J.1976. Developmental biology, Tata Mc.Graw Hill Pub.Co.Ltd.
2. Gillbert. S.F.1994. Developmental Biology. Sinauer Associates Inc.Massachusetts,
3. Adams W.1986. Genetic Analysis of Animal Development. A Wiley InterScience Publication.USA.
4. Arora M.P.2009. Embryology , Himalaya Publishing House, New Delhi
5. Rastogi.,

Course Designers: Dr. T S Ramyaa Lakshmi Dr. T Rajagopal

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
PZO20 CL33	Lab in Developmental Biology	Core Lab-9	-	-	3	2

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

Preamble

Explain the development of organ and organ system using slides , spotters and models

Prerequisites

Basic knowledge on embryogenesis and organogenesis

Course Outcomes

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

	Course outcomes	Expected Proficiency %	Expected Proficiency %
CO1	Make use of microscope and mount a specimen	70	70
CO2	Identify the different stages of development –model organism	70	70
CO3	Summarize and distinguish the structural organization of different organ and organ system	60	60
CO4	Spell the influence of hormones in development	60	60
CO5	Work in a clinical lab and perform experiments related to histology and developmental biology	60	60

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

Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	---	---	M	L	---
CO2	M	M	M	M	---

CO3	S	M	---	M	L
CO4	M	---	---	M	---
CO5	M	---	S	S	M

S- Strong M -Medium L-Low

Title of the Course : Lab in Developmental Biology

1. Observation of different stages of chick blastoderm (24, 48, 72 and 96 hrs)
2. Temporary mounting of chick blastoderm (24, 48, 72 and 96 hrs)
3. Regeneration in tadpoles.
4. Observation of bull spermatozoa.
5. Observation of frog-egg, sperm, cleavage, blastula, gastrula and neurula-Slide
6. T.S. of testis and ovary of mice-slide
7. Human eye and ear-model
8. *In vitro* culture of chick embryo
9. Microtome technique –demonstration
10. Effect of thyroxine and iodine in Amphibian metamorphosis
11. Observation of endocrine glands in chick.

Reference books

Tyler .M.S2008. Developmental biology- A guide for experimental study. Sinauer Associates ,Sunderland, Massachusetts USA.

Arora M.P.2009. Embryology , Himalaya Publishing House, New Delhi

Course Designers: Dr. T S Ramyaa Lakshmi Dr. T Rajagopal

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

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

Programme Code - PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO20CE31 B	Applied Zoology	Interdisciplinary Paper for Botany	5	1	-	5

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

Preamble

Branch of biology deals with animals and animals life, including the study of the structure, physiology, development of economically important animals

Prerequisites

Basic knowledge on different animal rearing methods.

Course Outcomes

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

	Course outcomes	Expected Proficiency %	Expected Proficiency %
CO1	Explain about economically important insects and familiar with the different types of animal cultures.	70	60
CO2	Make use of various animal culture techniques for their livelihood.	70	60
CO3	Tackle problems related to sustainable livestock development.	60	60
CO4	Develop as a skilled professional and animal scientist.	60	60
CO5	Establish animal farm or get job opportunities in animal husbandry firms, pursue research as their career prospective.	60	50

Mapping of Course Outcomes with Programme Outcomes

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

Mapping of Course Outcomes with Programme Specific Outcomes

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

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)	20%(30)
Understand -K2	15%(9)	15% (9)	20%(30)
Apply-K3	30%(18)	30% (18)	20%(30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20%(30)
Create-K6	60	60	150

Title of the Paper ;Applied Zoology

Unit I

Protozoan and Helminthic parasites: Biology, pathogenicity and control measures of *Plasmodium vivax*, *Entamoeba Histolytica*, *Wuchereria bancrofti* & *Ascaris lumbricoides*. Major infectious and communicable disease: Pathogenicity, symptoms, treatment, prevention of Syphilis & AIDS.

Unit II

Agricultural insect pest: Biology, damage caused and control measures of any one insect pest of paddy (*Scirpophaga incertulas*), cotton (*Helicoverpa armigera*) & sugarcane (*Chilo infuscatellus*). Veterinary parasites: Biology, damage caused and control measures *Tabanus striatus*, *Bovicola bovis* & *Haematobia irritans*.

Unit III

Apiculture: Species of honey bees - Newton's bee hive - rearing of honey bees - economic importance of honey. Sericulture: Types of silk - life cycle of mulberry silkworm (*Bombyx mori*) and rearing. Lac culture: Strains of lac insects - cultivation of lac insect and economic importance.

Unit IV

Fish culture: Types of fish farming - cultivable freshwater fishes of catla, mrigal & rohu - economic importance of fishes. Prawn culture: Types of prawn fishery - species of prawns - culture of fresh water prawns. Pearl culture: Types of pearl oysters and their occurrence - pearl formation - pearl culture techniques.

Vermiculture: Cultivable earthworm - culture technique - economic importance. Poultry: Housing - food and feeding of fowls - breeds of poultry (layers and broilers) - disease control (Ranikhet & Pullorum).

Text Books:

1. Shukla, G.S. and V.B. Upadhyay, 1985, Economic Zoology, First edition, Rastogi publication, Meerut.
2. Ravindranathan, K.R., 2005, A text book of Economic Zoology, Dominant publisher and distributors (P) Ltd., New Delhi.

Reference Books:

1. Kotpal, R.L., S.K. Agrawal and R.P. Khetarpal, 1985, Invertebrate Zoology, Sixth edition, Rastogi publication, Meerut.
2. Ahsan, J. and S.P. Sinha, 1985, A hand book on economic zoology, Third edition, S. Chand & company (P) Ltd., New Delhi.
3. Rathinasamy, G.K., 1999. Medical entomology and elementary parasitology, Viswanathan publication, Chennai.
4. Fenimore, P.G. and A. Prakash, 1992, Applied Zoology, Wiley Eastern Limited, New Delhi.
5. Singh, R.A., 1984, Poultry production, Kalyani publisher, New Delhi.
6. Banerjee, G.C., 1986, Poultry, Second edition, Oxford & IBH publisher, New Delhi.

Coursedesigners: Dr.N.Arun Nagendran

Course Code	Course Title	Category	L	T	P	Credit
PZO20C41	Immunology	Core-10	4	1	-	4

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

Preamble

Immunology, also known as immunobiology, is the study of the vertebrate immune system. The immune system is the organ system responsible for protecting the organism from infection by micro-organisms, viruses, and parasites. As such, it covers a wide range of topics, from history of Immunology, Types of Immunity & Immunotechniques, Transplantation & Tumour Immunology, Immunological disorders & Vaccinology. This course will be an overview of a variety of topics that together describe the development and function of the immune system.

Prerequisites

Basic knowledge on organ and immune system

Course Outcomes

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

	Course outcomes	Expected Proficiency %	Expected Proficiency %
CO1	Acquire in depth knowledge on the biology of the cells of immune system, including their development and specific functions	70	60
CO2	Interpret how cells interact with each other in the formation of an immune system.	60	60
CO3	Explain the molecular basis of how immune system identifies pathogens	60	60
CO4	Appraise the importance of immunodiagnosis, immunotherapy and vaccination.	60	60
CO5	Skilled at immunological techniques, experimental basis and reasoning that underlies the materials in the course.	60	50

Mapping of Course Outcomes with Programme Outcomes

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

Mapping of Course Outcomes with Programme Specific Outcomes

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

S- Strong M -Medium L-Low

Blooms taxonomy: Assessment Pattern

Blooms Taxonomy			
	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Remember -K1	15%(9)	15% (9)	20%(30)
Understand -K2	15%(9)	15% (9)	20%(30)
Apply-K3	30%(18)	30% (18)	20%(30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20%(30)
	60	60	150

Title of the course : Immunology

Unit I

Introduction and Overview – Historical perspective, Types of immunity – Innate: anatomic, physiologic, phagocytic, and inflammatory–Acquired or Adaptive: antigenic specificity–diversity- Immunologic memory–self/non self-recognition, Humoral–Cell-mediated immunity, Cells and organs of the immune system – Ontogeny and development of Immune cells – immunogenicity – Antigen – characteristics, classes of antigens-Haptens –Adjuvants. Antibody types – Isotypes & its subtypes, Allotypes, Idiotypes, and Antibody structure& functions. Generation of antibody diversity.

Unit II

Generation of B and T cell responses – Antigen binding receptors – T cell receptors, B cell receptors and MHC (HLA) molecules, B cell maturation, activation and differentiation – Major Histocompatibility complex – Antigen processing and presentation – T cell maturation, activation and differentiation – Principle of Antigen antibody interactions - Precipitation, Agglutination ,C activation, Cell lysis, Opsonization, Neutralization and cross reactivity.

Unit III

Immune effector mechanisms – Cytokines – functional properties; Complement system – Classical – Alternate -Lectin components, activation; Cell mediated immunity-Cytotoxic T cells, NK cells, ADCC, Hypersensitivity – antibody mediated(Type I) reactions, antibody mediated cytotoxic (Type II) reactions, Immune complex mediated (Type III) hypersensitivity, T cell mediated (Type IV) delayed hypersensitivity. Immunology of infectious diseases – Viral, bacterial, protozoan, fungal and helminthes.

Unit IV

Tolerance and Autoimmunity – organ specific autoimmune diseases, systemic autoimmune diseases, Immunodeficiency diseases – Phagocytic, complement deficiencies, humoral, cell mediated, combined immune deficiencies, Acquired Immunodeficiency. Immune system in health – Microbiome, Immunization –active and passive, vaccine induced immunity, Types of Vaccines – Organism vaccines – recombinant antigen & vector vaccines – DNA /RNA vaccines – synthetic peptide vaccines, edible vaccines, Sars-CoV2 vaccine development. Tumour immunology-Tumour antigens,Tumour immune surveillance and immune evasion. Tumour immuno diagnosis and Cancervaccines.

Unit V

Transplantation immunology –Types, Transplantation antigens, immunological basis of graft rejection, immunosuppressive therapy - Immunotechniques and Immunotechnology-Application of precipitation, agglutination, ELISA, RIA, Western blotting, immunofluorescence techniques. Hybridoma Technology, antibody engineering. Application of Monoclonal antibodies Immunoinformatics-Basics, immunological databases, Epitope prediction, computational vaccinology – Reverse vaccinology .

Text Books:

1. Coico, R., Sunshine, G., Benjamini, E., 2003 Immunology: A Short Course, VIth edition. Wiley-Blackwell, NewYork
2. Goldsby, R.A., Kindt, T.J., Osborne, B.A., Kuby, J. 2002. Immunology, Vth edition, W.H. Freeman and Company, NewYork.

Reference Books:

- 1) Abbas, A.K., A.H. Lichtmann and Y.S. Pober. 2000, Cellular and Molecular Immunology, fourth edition, W.B. Saunders company,London.
- 2) Coleman, R.M., M.F. Lombard., & N.E. Sicared. 1992. Fundamental Immunology, second edition, Wm.C. Brown Publishers,USA.
- 3) Cruse, J.M. & R.E. Lewis. 1998. Atlas of Immunology. CRC Academic Press. NewYork.
- 4) Delves, P.J., Martin, S.J., Burton D.R., Roitt, I.M. 2011. Roitt's Essential Immunology. XIIth edition. Wiley-Blackwell, Oxford, UK.
- 5) Goldsby, R.A., T.J. Kindt., & B.A. Osborne. 2000. Kuby Immunology. Fourth edition. W.H. Freeman and Company, NewYork.
- 6) Nandhini Shetty. 1993. Immunology – Introductory Text Book, Wiley Eastern Limited,New Delhi.
- 7) Roitt., Brostaff J. and Male D. 2001 Immunology VI edition, Mosby,London.

Course Designer : **Dr.M.Thiruvalluvan and Dr.C.Binnu Ramesh**

Thiagarajar College (Autonomous):: Madurai – 625009**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
PZO20CL41	Lab in Immunology	Core Lab-10	-	-	3	2

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

Preamble

Brief about different immunological techniques. Explain how our immune system protect us from infection and disease. Employ laboratory techniques that basically develop the preanalytical, analytical and post analytical skills for the performance of the tests.

Prerequisites

Basic skills related to animal physiology and immunology.

Course Outcomes

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

	Course outcomes	Expected Proficiency %	Expected Proficiency %
CO1	Differentiate different lymphoid organs.	70	70
CO2	Demonstrate antigen for immune response.	70	70
CO3	Demonstrate agglutination assays	70	70
CO4	Portray preanalytical, analytical and post analytical skills for the performance of the various diagnostic tests.	60	60
CO5	Start a diagnostic lab or to get a job opportunity in clinical labs	60	50

Mapping of Course Outcomes with Programme Outcomes

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

Mapping of Course Outcomes with Programme Specific Outcomes

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

S- Strong M -Medium L L o w

Title of the Course : Lab in Immunology

1. Virtual dissection and Display of Lymphoid organs of mice and chicken.
2. Enumeration of percentage occurrence of innate and adaptive immune cells.
3. Isolation of lymphocytes from sheep spleen
4. Raising of polyclonal antibodies in fish: Part -1. Preparation of different types of antigen
5. Raising of polyclonal antibodies in fish: Part -2. Immunization protocol for different antigens
6. Raising of polyclonal antibodies in fish: Part -3. Bleeding techniques in different animal models (virtual and real time in fish)
7. Natural haemolytic/antibacterial activity of unimmunized serum
8. Electrophoretic separation of serum proteins
9. Complement mediated haemolysis
10. Haemagglutination (or) Haemolysin titration assay
11. Bacterial agglutination assay
12. Isolation and enumeration of lymphocytes from human blood.
13. Determination of lymphocyte viability by Trypan blue dye exclusion test
14. Scale allograft rejection in fish
15. Estimation of serum lysozyme and total peroxidase secretion

Reference books:

1. Hudson L and Hay F.C., Practical Immunology, (1989), 3rd ed., Blackwell Publishing, London.
2. Garvey J.S., Cremer N.E and Sussdorf D.H., Methods in Immunology, (1983), 3rd ed., Benjamin / Cummins Publishing, London.
3. Stites D.P., Terr A.L and Parslow T.G., Basic and Clinical Immunology, (1994), Prentice Hall Publishing, Canada.

Thiagarajar College (Autonomous):: Madurai – 625 009

Department of Zoology

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

Programme Code PZO

CourseCode	Course Title	Category	L	T	P	Credit
PZO20C42	Ecology and Biodiversity	Core-11	4	1	-	4

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

Preamble

The course explains the basic concepts, components of ecosystems, types of biodiversity and different indices. The main focus of the course is on the ecology of ecosystem, community ecology, bio-geographical zones of India, global environmental change and biological diversity. It also explains the in-situ and ex-situ conservation of bio-resources and Environmental Legislation.

Prerequisites

Basic knowledge on environmental science, species distribution and biodiversity.

Course Outcomes

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

	Course outcomes	Expected Proficiency %	Expected Attainment %
CO1	Compare the biotic and abiotic interactions, theory and principles of ecosystem ecology and Community Ecology.	70	70
CO2	Demonstrate an understanding of key ecological interactions and processes: Population Ecology – Characterization, growth curves population regulation, life history strategies of metapopulation.	70	60
CO3	Interpret the application of tools for Pollution measures like cytogenetic bioassay, Ames test, DNA probes and immunoassay, BOD and Gas biosensors, for monitoring the environmental pollution.	60	60
CO4	Explain scales and patterns and threats in biological diversity with the sustainable management aiming at the conservation of species and habitats.	60	60
CO5	Know and apply the rules and recommendations related to environmental protection.	60	60

Mapping of Course Outcomes with Programme Outcomes

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

Mapping of Course Outcomes with Programme Specific Outcomes

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

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)	20%(30)
Understand -K2	15%(9)	15% (9)	20%(30)
Apply-K3	30%(18)	30% (18)	20%(30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20%(30)
Create-K6	60	60	150

Title of the Paper : Ecology and Biodiversity

Unit I

The Environment: Abiotic environment- biotic and abiotic interactions. **Ecosystem Ecology:** Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine). **Community Ecology:** Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.

Unit II

Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax.

Habitat and Niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement. **Population Ecology:** Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemec extinctions, age structured populations. **Species Interactions:** Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.

Unit III

Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India. **Applied Ecology:** Environmental pollution (causes, effects and mitigation measures of

air, water, land, noise and nuclear hazards); global environmental change (eutrophication, biomagnifications, greenhouse effect, acid rain and ozone depletion). **Pollution monitoring/measurement:** plant and animal test systems in bioassays, cell biology (cytogenetic bioassay and Ames test), molecular biology (DNA probes and immunoassay) and biosensors (BOD and Gas biosensors) in environmental monitoring.

Unit IV

Biological diversity: characteristics of biodiversity; levels of diversity - genetic, species and ecosystem; values of biodiversity; patterns of diversity - alpha, beta and gamma; diversity indices – Shannon, Simpson and Jaccard index. **Threats of biodiversity:** habitat loss, poaching of wildlife, man-wildlife conflicts; IUCN categories of threat, endangered and endemic species of India, red data book; Hot spots of biodiversity; India as a mega-diversity nation.

Unit V

Wild Life/Biodiversity Conservation: Necessity for conservation; organization involved in wildlife conservation – UNEP, MAB, WWF, EPA, NWAP. **Types of conservation of Biodiversity:** *in-situ* (biosphere reserves, national parks, wild life sanctuaries, sacred grooves) and *ex-situ* conservation (Zoological and Botanical gardens, cryopreservation, tissue culture); Indian case studies on conservation/management strategy (Project Tiger and Elephant). **Environmental Legislation:** Wildlife (Protection) Act, 1972 and Environmental (Protection) Act, 1986.

Text Books

1. Odum, E.P. 1996. Fundamentals of Ecology. Nataraj Publishers, Dehradun.
2. Stiling, P. 2004. Ecology – Theories and applications. Prentice Hall of India Pvt. Ltd., New Delhi.

References

1. Briggs, D., Smithson, P., Addison, K. and Atkinson, K. 1997. Fundamentals of Physical Environment. II edn. Routledge, UK.
2. Chang, K. 2002. Geological Information system. Tata McGraw Hill publishers. New Delhi.
3. Kumaraswamy, K., Alagappa Moses, A. and Vasanthi, M. 2001. Environmental Studies. Bharathidasan University Publication, Tiruchirappalli.
4. Cunningham, W.P. and Saigo, B.W. 1999. Environmental science. Vth edn. Tata McGraw Hill publishing Co., New Delhi.
5. Krishnamoorthy, K.V. 2004. An Advanced Text Book of Biodiversity-principles and practice. II reprint. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
6. Mackenzie, N., Ball, A.S. and Virdee, S.R. 1999. Instant notes in Ecology. Viva Books Pvt. Ltd. New Delhi.
7. Meffe, G.K. and Carroll, C.R. 1994. Principles of Conservation Biology. Sinauer Associates, Inc., USA.
8. Miller Jr, G.T. 1996. Living in the environment. IX edn. 8. Scanvic, J.Y. 1997. Aerspatial Remote sensing in Geology. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

Course Designer: . Dr. T Rajagopal

Course Code	Course Title	Category	L	T	P	Credit
PZO20 CL42	Lab in Ecology and Biodiversity	Core Lab-11	-	-	3	2

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

Preamble

Elaborates on scientific methods appropriate to environmental issues and improvement.
Provide field and laboratory experience

Prerequisites

Knowledge on different ecosystem and animal diversity

Course Outcomes

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

	Course outcomes	Expected Proficiency %	Expected Attainment %
CO1	Make a survey and abundance of an organism in a geographical area.	70	70
CO2	Analyse the quality of water and pollution status of different environment.	70	70
CO3	Analyse the biodiversity data statistically and present graphically.	70	60
CO4	Apply the skills acquired to meet the needs of oneself and society	60	60
CO5	Assume job in companies or organization involved in environmental monitoring. Employ the skills acquired to carry out research projects	60	60

Mapping of Course Outcomes with Programme Outcomes

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

Mapping of Course Outcomes with Programme Specific Outcomes

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

S- Strong M -Medium L-Low

Title of the Paper : Lab in Ecology & Biodiversity

1. Ecosystem designing – tracing food chain, food web and Ecological Pyramids.
2. Density and relative abundance of organism in grassland ecosystem.
3. Estimation of Dissolved Oxygen in water samples.
4. Estimation of free carbon dioxide in water samples.
5. Determination of alkalinity in water samples.
6. Measurement of primary productivity in an ecosystem.
7. Estimation Biological Oxygen demand of an aquatic ecosystem.
8. Morphometric studies of a pond.
9. Biological water quality analysis – Pollution indicators.
10. A laboratory study on the effect of eutrophication.
11. Detection of mutagenic agents in water samples using Ames test.
12. Survey of soot and dust pollution in Madurai city.
13. Survey on the diversity of agro-produces in vegetable markets.
14. Assessment of pollution status of river Vaigai.
15. Calculation of diversity indices. Survey on domestic biodiversity

Course Designers: . Dr. T Rajagopal

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
PZO20C43	Bioinformatics	Core-12	4	1	-	4

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

Preamble

Bioinformatics is an interdisciplinary course that emphasizes the integration of computer science with biology. A foundation in biology, computer science, and statistics provides the basis for developing and applying computational methods to test biological hypotheses.

Prerequisites

Basic knowledge on softwares. Nucleic acids and proteins organization

Course Outcomes

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

	Course outcomes	Expected Proficiency %	Expected Attainment %
CO1	Familiarize with network concepts, <i>in silico</i> approaches, biological databases available	70	70
CO2	Assume computer knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics	70	60
CO3	Determine“sequence to structure prediction” –concept	70	60
CO4	Extract information from large databases and to use this information in computer modelling	70	70
CO5	Assess and apply bioinformatic tools in biomedical research	60	60

Mapping of Course Outcomes with Programme Outcomes

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

Mapping of Course Outcomes with Programme Specific Outcomes

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

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)	20%(30)
Understand -K2	15%(9)	15% (9)	20%(30)
Apply-K3	30%(18)	30% (18)	20%(30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20%(30)
Create-K6	60	60	150

Title of the Course: Bioinformatics

Unit I

Internet concepts, Bioinformatics a multidisciplinary approach, Scope and applications of Bioinformatics. Biological databases- Nucleic acid databases (Genbank, DDBJ and EMBL) Protein databases - primary, composite, secondary Specialized databases-SGD, TIGR, Structural databases -PDB, CATH ModBASE.

Unit II

Sequence similarity search (FASTA and BLAST). Significance of E-value. Introduction to ORF and primer designing. Secondary structure prediction: Hidden Markov method

Unit III

Multiple sequence alignment (CLUSTAL W), conserved domain search (Motif). Phylogenetic analysis- phylogenetic tree construction (Neighbor Joining method and Maximum parsimony). **Unit IV**

Homology modeling - SPDB viewer. Ramachandran plot for evaluation of predicted structure. Data mining for drug designing and docking analysis. Structure visualization tool-RASMOL

Unit V

Genomics-scope and applications of structural and functional genomics, microarray technology Proteomics scope and applications of structural and functional-2D gel electrophoresis, Mass spectroscopy and MALDI-TOF

Text Books

1. Attwood, T.K. and Parry, D.J – Smith, D.J. 2005. Introduction to Bioinformatics.

Pearson Education (Singapore) Pvt.Ltd.

2. Twyman, R.H. 2003. Instant notes on Bioinformatics. Viva Books Pvt. Ltd.,NewDelhi

ReferenceBooks

1. Baxevanis, A.D. and Quellette, B.F.F. 2009. Bioinformatics. A practical guide to the analysis of genes and proteins. II edn. Wiley-Intern Science Publication, NewYork.
2. Mount, W. 2005. Bioinformatics sequence and genome analysis. Cold Spring harbour Laboratory Press, NewYork.
3. Pevsner, 2009. Bioinformatics and Functional Genomics. Wiley DreamtechIndia
4. Lesk, M.A. 2008. Introduction to Bioinformatics. Oxford Univ.Publishers

Course Designers :Dr. RM.Murugappan, Dr.Poornima kkani

Thiagarajar College (Autonomous):: Madurai – 625009**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
PZO20CL43	Lab in Bioinformatics	Core-12	-	-	3	2

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Fourth	4	60	100

Preamble

Provides hands on training on basic in silico analyses. Elaborates how bioinformatic tools can be utilized in biomedical research.

Prerequisites

Knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics.

Course Outcomes

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

	Course outcomes	Expected Proficiency %	Expected Attainment %
CO1	Retrieve nucleic acid and protein sequences	70	70
CO2	Predict evolutionary relationship between different species	70	70
CO3	Predict and validate the structure of a protein, drug design	70	70
CO4	Outline the intersection of life and information sciences	60	60
CO5	Work in a lifescience division of software, pharmaceutical industry	60	50

Mapping of Course Outcomes with Programme Outcomes

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

Mapping of Course Outcomes with Programme Specific Outcomes

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

S- Strong M -Medium L-Low

Title of the Course: Lab in Bioinformatics

1. Sequence retrieval and analyses
2. Database (homology) searches using different types of BLAST
3. Multiple sequence alignment using CLUSTAL W and Multalin.
4. Phylogenetic tree construction
5. Identification of Motif (eMotif)
6. Identification of restriction sites using NEB cutter.
7. Identification of protein cleavage site using pep cutter tool.
8. Protein structure prediction-Secondary and tertiary (Homology Modelling)
9. 3D visualization of structures using Rasmol and discovery studio viewer.
10. Molecular docking using Arguslab and Hex.

Reference books.

1. Pevsner, 2009. Bioinformatics and Functional Genomics. Wiley Dreamtech India Ltd., New Delhi.
2. Claverie, J and C. Notredame 2003. Bioinformatics A beginner's guide. Wiley Publishing Inc. India.
3. Mani, K and N. Vijayaraj 2004. Bioinformatics a practical approach. Aparna Publishers, Coimbatore.

Course Designers : Dr. RM. Murugappan, Dr. Poornima kkani

Programme Code PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO20PJ41	Project	CoreElective-4	-	-	6	6

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Fourth	50	50	100

Preamble

Expose to collect and read literature pertaining to their project work. Train the students to do lab exercise individually under the guidance of their project guide

Prerequisites

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

Course Outcomes

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

	Course outcomes	Expected Proficiency %	Expected Attainment %
CO1	Collect and analyse the scientific literature from web resources	70	60
CO2	Explain the theoretical basis of the tools, technologies and methods common to microbiology;	60	60
CO3	Demonstrate practical skills in the use of tools, technologies and methods common to microbiology,	70	60
CO4	Apply the scientific method and hypothesis testing in the design and execution of experiments.	60	60
CO5	Construct a summative project or paper that draws on current research, and/or techniques in life sciences.	70	70

Mapping of Course Outcomes with Programme Outcomes

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

Mapping of Course Outcomes with Programme Specific Outcomes

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

S- Strong M -