



KAMARAJ COLLEGE

(AUTONOMOUS)

Accredited with A+ Grade by NAAC

Among Top 150 Colleges in India - NIRF Ranking 2025

இந்து நாடார் சங்கங்களால் 1966-ல் தொடங்கப்பட்ட கல்லூரி
(Affiliated to Manonmaniam Sundaranar University, Tirunelveli)

THOOTHUKUDI - 628 003.



B.Sc., ZOOLOGY

Semester – I to VI

(for the students those who joined from the academic year 2025-2026)



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SYLLABUS

(for the students those who joined from the academic year 2025-2026)

Department Profile

Name of the Programme B.Sc., Zoology

Programme code 03006

Year of Establishment 1978

Vision:

- Aim to empower students with a deep understanding of the biological sciences, critical thinking skills, and a passion for exploring the wonders of the animal kingdom.

Mission:

- To provide students with a comprehensive education in zoology, emphasizing critical thinking, scientific literacy, and hands-on experience. We aim to inspire students to become informed, engaged, and compassionate citizens, equipped to address the complex challenges facing our planet's biodiversity

College Mail Id kamarajcoll@gmail.com

College Website www.kamarajcollege.ac.in

Undergraduate degree programme

1. Introduction

Programme Outcome, Programme Specific Outcomes and Course Outcomes. Students completing this programme can present their core undergraduate discipline clearly and precisely, make abstract ideas precise by formulating them in the language of the specific discipline, describe related ideas from multiple perspectives and explain fundamental concepts. The Zoology program provides a comprehensive understanding of animal biology, preparing students for research, conservation, and wildlife management careers. Completing this programme will also enable the learners to join the teaching profession and enhance their employability for government jobs and jobs in various other public and private enterprises.

Eligibility: Students who have completed +2 courses with Mathematics, Physics, Chemistry and Biology (Or) Physics, Chemistry, Botany and Zoology

Learning Outcomes-Based Curriculum	
Programme:	B.Sc. (Zoology)
Programme Code:	03006
Duration:	3 Years (UG)
Programme Outcomes:	
P01	Disciplinary knowledge: Capable of demonstrating Comprehensive knowledge and understanding of one or more Disciplines that form a part of an undergraduate Programme of study
P02	Communication Skills: Ability to express thoughts, ideas, and arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and address opposing viewpoints.
P03	Research and Development: Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.

P04	Contribution to the Business World: To produce employable, ethical, and innovative professionals to sustain in the dynamic business world.
P05	Contribution to the Society: To contribute to the development of the society by collaborating with stake holders for mutual benefit
P06	Research-related skills: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesizing and articulating; Ability to recognize cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation
P07	Cooperation/Teamwork: Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team
P08	Scientific reasoning: Ability to analyze interpret and conclude quantitative/qualitative data; and critically evaluate ideas, evidence, and experiences from an open-minded and reasoned perspective.

Programme Specific Outcomes

Programme Specific Outcomes: On successful completion of the Bachelor of (Zoology) programme, the student should be able to	
PS01	Core Zoological Knowledge Demonstrate comprehensive understanding of animal diversity, structural organization, physiology, evolution, and developmental biology, integrating knowledge from molecular to ecosystem levels.
PS02	Practical and Technical Skills Acquire and apply laboratory and field-based skills such as animal identification, dissection, microscopy, biochemical analysis, and ecological surveys using modern scientific tools and techniques. Entrepreneur
PS03	Research and development Develop the ability to design and conduct experiments, collect and interpret data, formulate hypotheses, and draw valid scientific conclusions to solve zoological and environmental problems.

PS04	Environmental Awareness and Conservation Ethics Understand the impact of biological and human activities on ecosystems, and apply zoological knowledge to promote biodiversity conservation and sustainable development practices.
PS05	Professional, Ethical, and Communication Skills Demonstrate ethical conduct, effective communication, teamwork, and leadership qualities essential for professional success in education, research, health, and environmental sectors.

Methods of Assessment	
Recall (K1)	Simple definitions , MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate Between various ideas, Map knowledge
Evaluate (K5)	Longer essay/Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

Methods of Evaluation		Marks	
Internal Evaluation	Continuous Internal Assessment Test	15	25
	Assignment (PPT) and Seminar	5	
	Group Discussion and Viva	5	
External Evaluation	End Semester Examination		75
Total			100

Extra Credits

Curricular Activities	Co-Curricular Activities	Extra-Curricular Activities
Paper Presentation	Cultural Competitions	NCC
Paper Publication	Domain Clubs	NSS
Placement Training		Sports
Quiz		YRC
Competitions		UBA
SWAYAM /NPTEL/MOOCs		

Level	Credit			
	Participation	III Prize	II Prize	I Prize
Intra college	1	2	3	4
Intercollegiate	2	3	4	5
District	3	4	5	6
University	4	5	6	7
State	5	6	7	8
National	6	7	8	9
International	7	8	9	10

****Paper Presentation for each paper: 1credit**

Total credits Under-Graduate Courses including Lab Hours - 2025 to 2026

Semester	Hours	Credits	Additional Credits
I	30	22	2
II	30	21	2
III	30	22	2
IV	30	23	2
V	30	29	3
VI	30	24	3
Total		141	14

****Extra Credit will be given on the basis of student's performances**

Written Examination: Theory Paper (Bloom's Taxonomy based)

Question paper Model Assessment Pattern

Continuous Internal Assessment (CIA) & End Semester Examination (ESE)

- CIA : 25
- ESE:75

Theory Course:

For theory courses there shall be two tests conducted by the faculty concerned and the average of the best two can be taken as the Continuous Internal Assessment (CIA).CIA is for 30 marks max and will be converted in to 15 marks. The duration of each test shall be 1 1/4 Hrs.

Continuous Internal Assessment (Writing)	15 marks
Assignment (PPT) & Seminar	5 marks
Viva & Group Discussion	5 marks

For Theory Papers:

- Part A (10×1=10) Marks-Answer all questions (Multiple choice)
- Part B (5×5=25) Marks-Choosing either(a) or (b)
- Part C (5×8=40) Marks-Choosing either (a) or (b)

Total =75 marks

Laboratory Courses Assessment

- CIA-40marks
- ESE-60marks
- Mandatory Record submission, attendance and class participation.
- Two CIA for 40 marks max. The average of the best two can be taken as the Continuous Internal Assessment.
- The duration of each test shall be 3 hours. To avoid pulling the score down of each PO, it is suggested that the usage of L-Low (1) to be minimized. The S, M, L is based on the Course outcomes. The mapping is based on the revised Bloom's

Taxonomy Verbs used to describe your Course outcomes.

- Remember and Understanding–Lower level
- Apply and Analyse– Medium Level
- Evaluate and Create–Strong Level

Written Examination: Theory Paper (Bloom’s Taxonomy based) Question Paper Model

Assessment Pattern

Continuous Internal Assessment (CIA) & End Semester Examination (ESE)

- CIA: 25
- ESE: 75

Theory Course:

For theory courses, there shall be two tests conducted and the average of the best two can be taken as the Continuous Internal Assessment (CIA). CIA is for 30 marks max and will be converted into 15 marks. The duration of each test shall be 1 Hr.15 mints.

Continuous Internal Assessment (Writing)	15 marks
Assignment (ppt) & Seminar	5 marks
Group Discussion or Viva	5 marks
Total marks	25 marks

For Theory Papers: End Semester Examinations

1.	Part A	10X1=10 Marks (MCQ)
2.	Part B	5 X 5= 25 Marks- Choosing either (a) or (b)
3.	Part C	5X 8=40 Marks-Choosing Either (a) or (b)
	Total marks	75 marks
• The duration of each test shall be 3 hours		

Laboratory Courses Assessment

CIA - 40 marks

ESE- 60 marks

- Mandatory Record submission, attendance, and class participation.
- Two CIA for 40 marks max, the average of the best two can be taken as the Continuous internal marks.

Pedagogy:

- Technology Based Learning (PPT)
- Peer Teaching (Chalk & Talk)
- Virtual Lab
- Blended Learning (Online & Offline)
- Group Learning
- Self - Study
- Games Based Learning

Course Structure for Science Stream
First Year – Semester – I
B.Sc., Zoology
(With effect from the academic year 2025 to 2026 onwards)

Semester I	Course Code	Title of the Course	Hours /Week L/P	Credit	Duration of ESE (Hrs.)	Marks Allotted		
						CIA	ESE	Total
Part - I	25ULTL11	தமிழ் இலக்கிய வரலாறு - I	6	3	3	25	75	100
Part - II	25ULEN11	General English - I	6	3	3	25	75	100
Part - III Core - I	25UMZO11	Invertebrata	5	5	3	25	75	100
Core - I Lab	25UMZOL1	Invertebrata Lab-I	3	2	3	40	60	100
EC - I Discipline /Generic	25UEBO11	Allied Botany	4	3	3	25	75	100
	25UEBOL1	Allied Botany Lab - I	2	2	3	40	60	100
Part - IV SEC - I	25USZO11	Ornamental Fish Farming and Management	2	2	3	25	75	100
FC	25UFZO11	Introduction to Zoology	2	2	3	25	75	100
Total			30	22				
**SEC-Skill Enhancement Course			**CIA-Continuous Internal Assessment					
**EC-Elective Course			**ESE-End Semester Examination					

Course Structure for Science Stream
First Year – Semester II
B.Sc., Zoology
(With effect from the academic year 2025 – 2026 onwards)

Semester II	Course Code	Title of the Course	Hours /Week L/P	Credit	Duration of ESE (Hrs.)	Marks Allotted		
						CIA	ESE	Total
Part - I	25ULTL21	தமிழ் இலக்கிய வரலாறு - II	6	3	3	25	75	100
Part - II	25ULEN21	General English – II	6	3	3	25	75	100
Part - III Core - II	25UMZO21	Chordata	5	4	3	25	75	100
Core -II Lab	25UMZOL2	Chordata -Lab	3	2	3	40	60	100
EC - II Discipline /Generic Lab - 2	25UEBO21	Allied Botany Paper - II	4	3	3	25	75	100
	25UEBOL2	Allied Botany Lab -II	2	2	3	40	60	100
Part - IV SEC - II	25USZO21	Bio Composting for Entrepreneurship	2	2	3	25	75	100
SEC- III	25USZO22	Animal Behaviour	2	2	3	25	75	100
		Total	30	21				
** SEC-Skill Enhancement Course ** CIA- Continuous Internal Assessment ** EC –Elective Course ** ESE- End Semester Examination								

Course Structure for Science Stream
Second Year – Semester III
B.Sc., Zoology
(With effect from the academic year 2025 – 2026 onwards)

Semester III	Course Code	Title of the Course	Hours / Week	Credit	Duration of ESE (Hrs.)	Marks Allotted		
						CIA	ESE	Total
Part-I	25ULTL31	தமிழக வரலாறும் பண்பாடும்	6	3	3	25	75	100
Part- II	25ULEN31	General English - III	6	3	3	25	75	100
Part-III Core- III	25UMZO31	Cell Biology	5	5	3	25	75	100
Core -III Lab	25UMZOL3	Cell Biology Lab - III	3	2	3	40	60	100
EC- III Discipline /Generic	25UECH32	Allied Chemistry for Biological Sciences-I	4	3	3	25	75	100
	25UECHL2	Allied Practical- Volumetric Analysis	2	2	3	40	60	100
Part-IV SEC -IV (select any one)	25USZO31	1. Economic Zoology						
	25USZO32	2. Medical Laboratory Techniques	2	2	3	25	75	100
Part- IV	25UYOG31	Yoga, Culture & Heritage	2	2	1.5	25	75	100
Total			30	22				
**SEC- Skill Enhancement Course				**CIA- Continuous Internal Assessment				
**EC- Elective Course				**ESE- End Semester Examination				

Course Structure for Science Stream
Second Year – Semester – IV
B.Sc., Zoology
(With effect from the academic year 2025 – 2026 onwards)

Semester IV	Course Code	Title of the Course	Hours /Week /L/P	Credit	Duration of ESE (Hrs.)	Marks Allotted		
						CIA	ESE	Total
Part - I	25ULTL41	தமிழும் அறிவியலும்	6	3	3	25	75	100
Part - II	25ULEN41	General English –IV	6	3	3	25	75	100
Part – III Core - IV	25UMZO41	Genetics and Evolution	5	5	3	25	75	100
Core – IV Lab - 4	25UMZOL4	Genetics and Evolution - Lab	3	2	3	40	60	100
EC – IV Discipline / Generic Lab - 2	25UECH41	Allied Chemistry Paper – II	4	3	3	25	75	100
	25UECHL2	Allied Chemistry - Practical	2	2	3	40	60	100
Part-IV SEC – V (select anyone)	25USZO41	1. Wildlife Conservation and Management	2	2	3	25	75	100
	25USZO42	2. Basics of Marine Biology						
Part-V	25UEVS41	Environmental Studies	2	2	3	25	75	100
Part V	25UEA41	NCC/NSS/YRC/SPORTS	-	1	-	-	-	100
Total			30	23				
**SEC- Skill Enhancement Course				**CIA- Continuous Internal Assessment				
**EC– Elective Course				**ESE- End Semester Examination				

Course Structure for Science Stream
Third Year – Semester – V
B.Sc., Zoology
(With effect from the academic year 2025 – 2026 onwards)

Semester V	Course Code	Title of the Course	Hours /Week / L/P	Credit	Duration of ESE (Hrs.)	Marks Allotted		
						CIA	ESE	Total
Core - V	25UMZO51	Animal Physiology and Biochemistry	5	5	3	25	75	100
Core - VI	25UMZO52	Environmental Biology	4	4	3	25	75	100
Core - VII	25UMZO53	Biostatistics and Computer Application	5	5	3	25	75	100
Core - V Lab - 5	25UMZOL5	Animal Physiology and Biochemistry & Environmental Biology Lab	3	2	3	40	60	100
Core VI Lab - 6	25UMZOL6	Biostatistics and Computer Application & Elective – VI	3	2	3	40	60	100
EC5 (Generic /Discipline Specific) (Select any one)	25UEZO51 25UEZO52 25UEZO53	1. Sericulture 2. Agricultural Entomology 3. Vermitechnology	4	3	3	25	75	100
Project	25UMZOP1	Group Project	4	4	1.5	50	50	100
Part - IV Training	25UINT51	*Internship	-	2	1.5	50	50	100
Part - V	25UPDT51	Personality Development	2	2	3	25	75	100
Total			30	29				
**SEC- Skill Enhancement Course			**CIA- Continuous Internal Assessment					
**EC- Elective Course			**ESE- End Semester Examination					
*Internship – course duration - 7 to14 days (Report should be submitted & Viva Voce will be conducted for the report which is equivalent to the project Viva – voce).								

Course Structure for Science Stream

Third Year – Semester – VI

B.Sc., Zoology

(With effect from the academic year 2025 – 2026 onwards)

Semester VI	Course Code	Title of the Course	Hours /Week	Credit	Duration of ESE (Hrs.)	Marks Allotted		
						CIA	ESE	Total
Core VIII	25UMZO61	Developmental Biology	6	5	3	25	75	100
Core IX	25UMZO62	Microbiology and Immunology	6	5	3	25	75	100
Core X	25UMZO63	Animal Biotechnology and Bio Informatics	5	5	3	25	75	100
Core – VII – Lab - 7	25UMZOL7	Developmental Biology, Microbiology, and Immunology Lab- VII	3	2	3	40	60	100
EC - VII	25UEZO61	Aquaculture	5	3	3	25	75	100
Core - VIII - Lab - 8	25UMZOL8	Animal Biotechnology and Bioinformatics, & Elective -VIII Lab- VIII	3	2	3	40	60	100
SEC -VI	25USZO61	Based on your Department Choice– Applied Zoology	2	2	3	25	75	100
Total			30	24				
**SEC- Skill Enhancement Course				**CIA- Continuous Internal Assessment				
**EC- Elective Course				**ESE- End Semester Examination				

Semester - I

Invertebrata

Title of the Course		Invertebrata			
Course Type		Core - I			
Course code		25UMZ011			
Year	I	Semester	I	Credits	5
Instructional Hours Per week		Lecture	Tutorial	Lab Practice	Total
		5		-	5

Learning Objectives:	
L01	To understand the basic concepts of lower animals and observe the structure and functions.
L02	To illustrate and examine the systematic and functional morphology of various groups of invertebrates.
L03	To differentiate and classify the various groups of animal modes of life and to estimate the biodiversity
L04	To compare and distinguish the general and specific characteristics of reproduction in lower animals.
L05	To infer and integrate the parasite and economic importance of invertebrate animals.

Unit -I**15 Hours****Protozoa:**

Introduction to Classification, taxonomy and nomenclature. General characters and classification of Phylum Protozoa up to classes. Type study: Paramecium and Plasmodium - Parasitic protozoans (Entamoeba, Trypanosoma & Leishmania) - Economic importance Nutrition in protozoa-Host-parasitic interactions in Entamoeba and Plasmodium- Locomotion in protozoa.

Porifera: General characters and classification up to Classes. Type study: Sycon-Canal system in sponges. Reproduction in sponges

15 Hours**Unit - II**

Coelenterata: General characters and classification up to classes – Type study: Obelia – Corals and coral reefs – Economic importance of corals and coral reefs – Platyhelminthes: General characters and classification of up to classes. Type study: *Fasciola hepatica* (General characters, Digestive system, lifecycle and Parasitic adaptations.

15 Hours**Unit - III**

Aschelminthes: General characters and classification up to classes – Type study: *Ascaris lumbricoides* (Anatomy of Male and female, Life cycle and adaptation to parasitism), Nematode Parasites and Diseases – *Wuchereria bancrofti*, Parasitic adaptations.

Annelida: General characters and classification up to Classes. Type study: Nereis (digestive system, food and feeding habits and Reproductive system. Metamerism.

15 Hours

Unit - IV
Arthropoda: General characters and classification of Phylum Arthropoda up to Classes. Detailed study: *Penaeus indicus*. Affinities of Peripatus – Larval forms in Crustacea. Economic importance of Insects: Insect pests of Agricultural Importance- Pest of Sugarcane. Pest of coconut: The rhinoceros beetle (*Oryctes rhinoceros*). Principles of Integrated Pest Management.

Insects: Ants and Termites in Indigenous Knowledge. Use of red ant chutney (Kai Chutney) by tribal communities for medicinal and nutritional value (e.g., Odisha)

15 Hours

Unit - V
Mollusca: General characters and classification of Phylum Mollusca up to Classes. Detailed study: *Pila globose* (Anatomy, Digestive and Reproductive) Economic importance of Cephalopods.

Echinodermata: General characters and classification of Phylum Echinodermata up to Classes. Detailed study: Asterias. Water vascular system in Echinodermata – Larval forms of Echinoderms

Extended

Professional Component (is a part of internal component only,

Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC and others to be solved (To be discussed during the Tutorial hours Not To be included in the External Examination on question paper)

Skills acquired from this course

The students are understanding the functional and systematic morphology of different groups of invertebrates They will learn about the origin of Protozoa, Coelenterata, helminths, Arthropoda, Mollusca and Echinodermata

Recommended Texts:

1. Ekambaranatha Iyyar and T.N. Ananthakrishnan, 1995 A manual of Zoology Vol.I (Part 1, 2) S. Viswanathan, Chennai
2. Ganguly, Sinha and Adhikari, 2011. Biology of Animals: Volume I, New Central Book Agency; 3rd revised edition. 1008 pp.
3. Sinha, Chatterjee and Chattopadhyay, 2014. Advanced Practical Zoology, Books & Allied Ltd; 3rd Revised edition, 1 07 0 pp.
4. Lal, S.S, 2016. Practical Zoology Invertebrate, Rastogi Publications
5. Verma, P.S. 2010. A Manual of Practical Zoology: Invertebrates, S Chand, New Delhi

References Books:

- 1 Barnes, R.S.K., Calow, P. Olive, P.J.W. Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
- 2 Barnes, R.D. (1982). Invertebrate Zoology, V Edition. Holt Saunders International Edition.
- 3 Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson

Web Resources:

- 1 <https://nbb.gov.in/>
- 2 <https://www.agshoney.com/training.html>
3. <https://icar.org.in/>

Course outcomes CO	On completion of this course, students will be able to
CO1	To understand the classification, structure, and functions of protozoans and sponges.
CO2	To describe the characteristics, classification, and life cycles of coelenterates and flatworms, and understand the ecological and economic importance of corals and parasitic adaptations in flatworms like <i>Fasciola hepatica</i> .
CO3	To identify key features of roundworms and segmented worms, and explain their anatomy, life cycles, parasitic adaptations, and the concept of metamerism in annelids like Nereis.
CO4	To understand the classification and biological features of arthropods, study economically important insects and pest management, and appreciate traditional knowledge about insects like ants and their uses in tribal medicine and nutrition.
CO5	To understand the classification and characteristics of arthropods, explain the structure and importance of species like <i>Panaeus indicus</i> and Peripatus, identify economically important insect pests, and appreciate traditional knowledge of insects like ants and termites used in indigenous medicine and nutrition.

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S- Strong (3)

M- Medium (2)

L- Low (1)

CO/PO	P01	P02	P03	P04	P05
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Invertebrata Lab-I

Title of the Course		Invertebrata Lab-I			
Course Type		Core- Major Practicals- I			
Course Code		25UMZOL1			
Year	I	Semester	I	Credits	2
Instructional Hours		Lecture	Tutorial	Lab Practice	Total
Per week		-	-	3	3
Learning Objectives					
L01	To dissect and mount various body parts and to study the various functional details of invertebrates				
L02	To understand the organs, organ system and their functions in lower animals.				
L03	To dissect and mount various body parts and to study the various functional detail of chordates				
L04	To identify the different groups of invertebrate animals by observing their external characteristics				
L05	To identify the different groups of Invertebrates to gather adequate knowledge and record.				

Unit - I: Dissection:

- Cockroach: Nervous system

Unit - II:

- Cockroach: Digestive system

Unit - III Mounting:

- Mouth Parts – Cockroach
- Mouth Parts - Honey bee
- Prawn appendages
- Earthworm – Body setae, Penial setae (Demo)

Unit - IV

Spotters: (i). Protozoa: Amoeba, Paramoecium *Entamoeba histolytica*, *Plasmodium vivax* (ii). Porifera: Sycon (iii). Coelenterata: Obelia – Colony & Medusa, (iv). Platyhelminthes: Planaria, *Fasciola hepatica*, *Taenia solium*, (v). Nematelminthes: Ascaris (Male & Female), (vi). Annelida: Nereis, Chaetopteurs, Trochophore larva (vii). Arthropoda: Scorpion, Sacculina, Limulus, Peripatus, Larvae - Nauplius, Mysis, Zoea,. (viii). Mollusca: Chiton, Pila, Sepia, Loligo, Octopus, (ix). Echinodermata: Asterias, Bipinnaria larva

Unit - V Record / Observation Note (Submission Is Mandatory)

<p>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</p>	<p>Questions related to the above topics, from various competitive examinations UPSC /TRB/NET/UGC- CSIR/GATE/TNPSC/others to be solved (To be discussed during the Tutorial hour)</p>
<p>Skills acquired from this course</p>	<p>They will learn about the Dissection of animals and understand the morphology characteristics of Protozoa, Coelenterata, helminths, Arthropoda, Mollusca and Echinodermata</p>
<p>Recommended Texts</p>	<ol style="list-style-type: none"> 1. Ekambaranatha Iyyar and T.N. Ananthakrishnan, 1995 A manual of Zoology Vol. I (Part 1, 2) S. Viswanathan, Chennai 2. Ganguly, Sinha and Adhikari, 2011. Biology of Animals: Volume I, New Central Book Agency; 3rd revised edition. 1008 pp. 3. Sinha, Chatterjee and Chattopadhyay, 2014. Advanced Practical Zoology, Books & Allied Ltd; 3rd Revised edition, 1070 pp. 4. Lal, S.S, 2016. Practical Zoology Invertebrate, Rastogi Publications. 5. Verma, P.S.2010.A Manual of Practical Zoology: Invertebrates, S Chand, New Delhi

Reference Books	<ol style="list-style-type: none"> 1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Black well Science. 2. Barnes, R.D. (1982). Invertebrate Zoology, V Edition. Holt Saunders International Edition. 3. Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson
Web sources	<ol style="list-style-type: none"> 1. www.agshoney.com/ 2. https://nisa.icar.gov.in/ 3. www.nationalgeographic.com/animals/invertebrates

Mapping with Programme Out Comes and Programme Specific Outcome

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3

S-Strong (3)

M-Medium (2)

L-Low (1)

CO/PO	P01	P02	P03	P04	P05
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3

Ornamental Fish Farming and Management

Title Of The Course		Ornamental Fish Farming and Management			
Course Type		Skill Enhancement Course - I			
Course Code		25USZO11			
Year	I	Semester	I	Credits	2
Instructional Hours		Lecture	Tutorial	Lab Practice	Total
Per week		2	-	-	2
Learning Objectives					
L01	To gain comprehensive knowledge about the biology, breeding, and care of various Ornamental fish species				
L02	To understand proper aquarium setup and maintenance, identify and manage common fish diseases,				
L03	Acquiring practical skills in breeding techniques				
L04	To develop the ability to optimize water quality parameters for optimal fish health and vibrant coloration,				
L05	The goal of successfully cultivating ornamental fish for aesthetic purposes and potential commercial applications				

Unit - I**6 Hours**

Introduction to ornamental fish keeping: Scope and importance of ornamental fish culture. Identification of commercially important ornamental fishes – Indigenous and exotic varieties.

Unit -II**6 Hours**

Biology of egg layers and live bearers: Breeding, hatchery and nursery management of egg layers (eg. Goldfish) and live bearers (eg.Guppy).

Unit - III**6 Hours**

Aquarium plants and their propagation: Food and feeding in ornamental fishes. Formulated feed and Live feed; live feed culture; identification of locally available live feed organisms

Unit - IV**6 Hours**

Aquarium design and construction: Accessories – aerators, filters and lighting. Maintenance of aquarium and water quality management. Ornamental fish diseases, their prevention, control and treatment methods.

Conditioning, packing, transport and quarantine methods. Economics, trade regulations, domestic and global export potential and marketing strategies

Unit - V**6 Hours****Aquarium Culture and Ayurvedic Influence:**

Aesthetic and therapeutic benefits: The concept of maintaining a peaceful and harmonious home (similar to modern aquarium therapy) as part of mental well-being and calmness, deeply ingrained in Indian philosophy.

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC /TRB/NET/UGC–CSIR/GATE/TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Importance for their aesthetic values as a hobby and as a source of income and identification, culture and maintenance of commercially important ornamental fishes.
Recommended Texts	<ol style="list-style-type: none"> 1. SK., Sarangi N.and Ayyappan S. (2010). Ornamental fish farming. ICAR, New Delhi. 2. Living Jewels–Ahand book on fresh water ornamental fish, (1999) MPEDA, Kochi.
Reference books:	<ol style="list-style-type: none"> 1. Dey V.K.A. (1997). Ah and book on aqua farming ornamental fishes. MPEDA, Kochi. 2. Ahilan, B., Felix N. and Santhanam R.(2008),Text book of aquariculture.Daya Publishing House, New Delhi
Web Resources	<ol style="list-style-type: none"> 1. http://ecoursesonline.iasri.res.in/course/view.php?id=297 2. https://www.ofish.org 3. https://krishijagran.com/agripedia/income-generation-by-ornamental-fish-4.culture/ 4. https://99businessideas.com/ornamental-fish-farming

Course outcomes: CO	On completion of this course, the students will be able to
CO1	To understand the scope and importance of ornamental fish culture and identify commercially important indigenous and exotic ornamental fishes.
CO2	To explain the breeding, hatchery, and nursery management of egg-laying and live-bearing ornamental fishes like goldfish and guppy.
CO3	To identify aquarium plants and understand their propagation, and differentiate between formulated and live feeds, including the culture of locally available live feed organisms.
CO4	To design and maintain aquariums, manage water quality, identify and control fish diseases, and understand packaging, transport, and trade aspects of ornamental fish keeping.
CO5	To appreciate the aesthetic and therapeutic values of aquarium culture, and understand its role in mental well-being and traditional Indian philosophy.

Mapping with Programme Out Comes and Programme Specific Outcome

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S-Strong (3)

M-Medium (2)

L-Low (1)

CO/PO	P01	P02	P03	P04	P05
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Introduction to Zoology

Title Of The Course		Introduction to Zoology			
Course Type		Foundation Course			
Course Code		25UFZ011			
Year	I	Semester	I	Credits	2
Instructional Hours		Lecture	Tutorial	Lab Practice	Total
Per week		2	-	-	2
Learning Objectives					
L01	To Know the different types of animals in the animal kingdom.				
L02	To gain knowledge of the various branches of biology.				
L03	To attain knowledge on livestock development in India and its prospects				
L04	To know the cycle of physiology and biochemistry				
L05	To develop the entrepreneurial course in Zoology				

Contents

Unit - I Animal Biodiversity and Systematics: Taxonomic hierarchy: Classification of animal kingdom- Two kingdoms and Five kingdom classification- Binomial nomenclature- Different phyla of animal kingdom – Salient features of Invertebrates and Chordates with examples.	6 Hours
Unit - II Cell Biology & Genetics: Ultrastructure of a Prokaryotic and Eukaryotic cell- importance of cell organelles. General Account on Mendelism and inheritance- DNA and RNA.	6 Hours
Unit - III Biochemistry and Physiology: Introduction to the role of essential biological compounds Proteins, Carbohydrates, Lipids, Water and Vitamins. Introduction to organ system of vital physiological functions.	6 Hours
Unit - IV Environmental Biology: Basics of atmosphere and its strata- habitats- concept and components of ecosystem. Role of Animals in Ayurvedic Medicine: Animal Products in Healing: Ayurveda, the ancient Indian system of medicine, utilizes animal products (cow urine , and milk for therapeutic purposes)	6 Hours
Unit - V Entrepreneurial Courses in Zoology: General introduction and applications: Aquaculture - Apiculture - Sericulture– Vermiculture - Poultry keeping Dairy farming.	6 Hours

<p>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</p>	<p>Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC-CSIR/GATE/TNPSC/others to be solved (To be discussed during the Tutorial hour)</p>
<p>Skills acquired from this course</p>	<p>The students are understanding the different types of animals in the animal kingdom, knowledge of the various branches of biology.</p>
<p>Recommended Texts</p>	<ol style="list-style-type: none"> 1. Shukla, G.S. & Upadhyay, V.B. (2014). Applied and Economic Zoology, Rastogi Publications. 2. Johnson and Jeyachandra, (2000), Apiculture–, Marthandam, Tamil Nadu. 3. Ganga. G, (2019), Introduction to Sericulture, Oxford and IBH Publishing1 1. 4. Jhingaran, V.G., (1997), Fish and Fisheries of India, Hindustan Publishing Corporation (India).
<p>Reference books:</p>	<ol style="list-style-type: none"> 1. Ekambaranathalyer, (2000), A Manual of Zoology, 10th edition, Viswanathan, S., Printers & Publishers Pvt Ltd 2. Kotpal, R.L. (2019), Modern text book of Zoology: Invertebrates. Rastogi Publication, New Delhi. 3. Kotpal (2015). Modern Text book of Zoology Vertebrates, Rastogi publishers, New Delhi. 4. H.C, Nigam.(2010), Biology of Chordates., Vishal Publications, New Delhi 5. Gupta. P.K., (2017), Cell and Molecular Biology, Fifth Revised Edition, Rastogi Publication, Meerut, India.
<p>Web Resources</p>	<ol style="list-style-type: none"> 1. http://globalacademicgroup.com...pdf 2. gallery">http://tbmicollege.ac.in>gallery 3. 3473">http://www.researchgate.net>3473

Course outcomes: CO	On completion of this course, the students will be able to
C01	To understand the principles of animal classification, including the taxonomic hierarchy, two- and five-kingdom systems, and binomial nomenclature, and describe the salient features of major invertebrate and chordate phyla with suitable examples.
C02	To describe the structure and functions of prokaryotic and eukaryotic cells, explain the importance of cell organelles, and understand the basic principles of Mendelian genetics, along with the structure and role of DNA and RNA.
C03	To describe the structure and functions of prokaryotic and eukaryotic cells, explain the importance of cell organelles, and understand the basic principles of Mendelian genetics, along with the structure and role of DNA and RNA.
C04	To explain the structure of the atmosphere, different habitats and ecosystems, and to understand the role of animals and animal products in Ayurvedic medicine for therapeutic use.
C05	To recognize the scope and applications of zoology-based entrepreneurship, including aquaculture, apiculture, sericulture, vermiculture, poultry keeping, and dairy farming, and appreciate their relevance in sustainable development.

Mapping with Programme Outcomes and Programme Specific Outcome

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S-Strong (3)

M-Medium (2)

L-Low (1)

CO/PO	P01	P02	P03	P04	P05
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Allied Zoology -I
(For B.Sc., botany & chemistry)

Title of the Course		Allied Zoology -I			
Course Type		Elective - I			
Course Code		25UEZ011			
Year	I	Semester	I	Credits	3
Instructional Hours Per week		Lecture	Tutorial	Lab Practice	Total
		4	-	-	4
Learning Objectives					
C01	To acquire a basic knowledge of diversity and organization of Protozoa, Coelenterata, Helminthes and Annelida				
C02	To acquire a basic knowledge of diversity and organization of Arthropoda, Mollusca and Echinodermata				
C03	To comprehend the taxonomic position and diversity among Protochordata, Pisces and Amphibia				
C04	To comprehend the taxonomic position and diversity among Reptilia, Aves and Mammalia				
C05	To acquire detailed knowledge of select invertebrate and chordate forms				

Unit	Topics	Hours
I	Diversity of Invertebrates-I Principles of taxonomy. Criteria for classification–Symmetry and Coelom–Binomial Nomenclature. Classification of Protozoa, Coelenterata, Helminthes and Annelida up to classes with two examples.	12
II	Diversity of Invertebrates-II Classification of Arthropoda, Mollusca and Echinodermata up to class level with examples	12
III	Diversity of Chordates-I Classification of Prochordata, Pisces and Amphibia up to orders giving two examples	12
IV	Diversity of Chordates-II Classification of Reptilia, Aves and Mammalia up to orders giving two examples.	12
V	Animal organization Structure and organization of (i) Earthworm (ii) Rabbit (iii) Prawn	12

Textbooks

1. Ekambaranatha Iyer, 2000. A Manual of Zoology, 10th edition, Viswanathan, S., Printers & Publishers Pvt Ltd
2. Jordan, E.L. and Verma P.S, 1995. Invertebrate Zoology, 12th edn. S. Chand & Co. 3
Kotpal, R.L, 1992. Protozoa, Porifera, Coelenterata, Annelida, Arthropoda, Mollusca, Echinodermata.

Reference Books

1. Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition.
2. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
3. Barrington, E.J.W. (1979). Invertebrate Structure and Functions, II Edition, E.L.B.S. and Nelson

Web Resources

1. <https://www.nationalgeographic.com/animals/invertebrates/>
2. <https://www.britannica.com/science/parasitic-disease>
3. <https://www.nio.res.in/>

Learning Outcomes

Course outcomes: CO	On completion of this course, the students will be able to
CO1	To understand and apply the fundamental principles of biological classification (Protozoa, Coelenterata, Helminthes, and Annelida) up to class level with appropriate examples.
CO2	To classify the phyla Arthropoda, Mollusca, and Echinodermata up to class level with appropriate examples, and explain their distinguishing characteristics and biological significance."
CO3	To classify and differentiate Prochordata, Pisces, and Amphibia up to their respective orders, with the ability to identify and describe characteristic features and representative examples.
CO4	To classify and differentiate the classes Reptilia, Aves, and Mammalia up to their respective orders with appropriate examples.
CO5	To understand and compare the structural and organizational features of representative organisms from different phyla—earthworm (Annelida), prawn (Arthropoda), and rabbit (Chordata)—to illustrate evolutionary adaptations and functional morphology.

Mapping with Programme Out Comes and Programme Specific Outcome

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S-Strong (3)

M-Medium (2)

L-Low (1)

CO/PO	P01	P02	P03	P04	P05
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Lab on Allied Zoology -I

Title of the Course		Lab on Allied Zoology -I			
Course Type		Elective - I			
Course Code		25UEBOL1			
Year	I	Semester	I	Credits	2
Instructional Hours Per week		Lecture	Tutorial	Lab Practice	Total
		-	-	2	2

Unit	Contents
I	Dissection: 1. Cockroach – digestive system 2. Cockroach – nervous system 3. Fish – digestive system (sardine or any other fish)
II	Mounting: 1. Mouth Parts – Cockroach 2. Mouth Parts – Mosquito/ Honey bee 3. Scales– Placoid, Cycloid and Ctenoid 4. Prawn appendages
III	Spotters: Paramecium, Plasmodium, Scypha, Leucosolenia, Corals. <i>Taenia solium</i> –entire, Ascaris male and female. Earthworm, Prawn ,Scorpion, Pila, Starfish, Amphioxus, Shark, Frog, Calotes, Pigeon feather and Rabbit
IV	Field visit – Study of fauna on the campus
V	Record / Observation Note (Submission Is Mandatory)

Textbooks

1. Ekambaranatha Iyyar and T. N. Ananthkrishnan, 1995 A manual of Zoology Vol.I (Part 1, 2) S. Viswanathan, Chennai
2. Ganguly, Sinha and Adhikari, 2011. Biology of Animals: Volume I, New Central Book Agency; 3rd revised edition. 1008 pp.

Reference Books

1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
2. Barnes, R.D. (1982). Invertebrate Zoology, V Edition. Holt Saunders International Edition.
3. Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson
4. Lal, S.S. 2005. A text Book of Practical Zoology: Invertebrate, Rastogi, Meeru

Web Resources

1. <https://nbb.gov.in/>
2. <https://www.agshoney.com/training.htm>
3. <https://icar.org.in/>

Semester - II Chordata

Title of the Course		Chordata					
Course Type		Core - II					
Year	I	Semester	II	Credits	4	Course Code	25UMZ021
Instructional Hours Per week		Lecture	Tutorial	Lab Practice		Total	
		5	--	--		5	
Learning Objectives							
LLLO1		To understand the structures and distinct features of Phylum Chordata.					
L02		To understand and able to distinguish the characteristic features of each subphylum and class.					
L03		To understand the economic importance of vertebrates.					
L04		To know about the adaptations of vertebrates.					
L05		To understand the evolutionary position of different groups of vertebrates.					

Unit	Contents	Hrs.
I	General Characters and Classification of Phylum Chordata: Origin of Chordates, Differences between non-Chordates and Chordates, General Characters of Chordates and prochordates Affinities and Systematic position of Hemichordata (Balanoglossus), Urochordata (Ascidian), Cephalochordata (Amphioxus).	15
II	Characteristics of subphylum Vertebrata Classification of Vertebrata up to Class level, Agnatha- Petromyzon- Ammocoetus larva. Pisces - General characters and classification of Pisces, Type study: <i>Scoliodon sorrakowah</i> , Origin of fishes, Affinities of Dipnoi - Types of scales and fins-Accessory respiratory organs-Parental care in fishes - Migration-Economic Importance.	15
III	Amphibia: General characters and classification - Origin of Amphibia - Type study: <i>Rana hexadactyla</i> - Adaptive features of Anura, Urodela, and Apoda - Neoteny in Urodela - Parental care in Amphibia	15
IV	Reptilia: General characters and classification - Origin of reptiles, Type study: <i>Calotes versicolor</i> , Snakes of India-Identification of Poisonous and non-poisonous snakes - Poison apparatus and biting mechanism of poisonous snakes and first aid. Snakes in Indian Knowledge Systems: From Ayurveda to Ecology and Culture	15

V	<p>Aves and Mammalia: Aves: General characters and classification, Origin of birds -Type study: <i>Columba livia</i> -, Flight adaptations, Migration. Mammalia: General characters and classification-Type study: Rabbit- Adaptive radiation in mammals - Egg laying mammals, Marsupials, Flying mammals, Aquatic mammals, Dentition in mammals.</p>	15
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Recommended Texts:

1. Ayyar, E.K. and T.N. Ananthakrishnan, (1992), Manual of Zoology Vol. II (Chordata), S. Viswanathan (Printers and Publishers) Pvt Ltd., Madras.
2. Jordan, E. K. and P.S. Verma, (1995), Chordate Zoology and Elements of Animal Physiology, 10th edition, S. Chand & Co Ltd., Ram Nagar, New Delhi,
3. Nigam, H.C. (1983), Zoology of Chordates, Vishal Publications, Jalandhar - 144008,
4. Ganguly, Sinha, Bharati Goswami, and Adhikari (2004), Biology of Animals Vol.II- New Central Book Agency (p) Ltd.
5. Kotpal. R.L.A. (2009). Modern Textbook of Zoology: Vertebrates. Rastogi Publications.
- 6.

REFERENCES BOOKS:

1. Darlington P.J. (2017), Zoogeography: The Geographical Distribution of Animals, R.E. Krieger Pub. Co.
2. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.
3. Hickman, C.P. Jr., F.M. Hickman and L.S. Roberts, (1984), Integrated Principles of Zoology, 7th Edition, Times Mirror/Mosby College Publication. St. Louis.
4. Newman, H.H. (1981), The Phylum Chordata, Satish Book Enterprise, Agra- 282003
5. Parker and Haswell, (1964), Text Book of Zoology, Vol II (Chordata), A.Z.T, B.S. Publishers and Distributors, New Delhi - 110 051

WEB RESOURCES:

1. <https://bit.ly/3Av1Ejg>
2. <http://tolweb.org/Chordata/2499>
3. <https://bit.ly/3kqTfYz>
4. <https://biologyeducare.com/aves/>
5. <https://www.vedantu.com/biology/mammalia>

Course outcomes CO	On completion of this course, students will be able to
CO1	To understand the origin and evolutionary significance of chordates and differentiate between chordates and non-chordates based on morphological and anatomical features.
CO2	To describe the distinguishing characteristics of vertebrates. Classify vertebrates up to class level with examples.
CO3	To analyze the behavioral and ecological adaptations of fishes, such as migration and parental care, and evaluate their economic importance to human welfare.
CO4	To explain the structural features, classification, evolutionary origin, and adaptive radiation of reptiles
CO5	To describe the anatomy and adaptations of <i>Columba livia</i> and the Rabbit. Discuss the origin and evolutionary trends in birds and mammals.

Mapping With Programme Outcomes and Programme Specific Outcomes

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S-Strong (3)

M-Medium (2)

L-Low (1)

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Chordata - Lab

Title of the Course	Chordata - Lab						
Course Type	Core - Lab - II						
Year	I	Semester	II	Credit	2	Course Code	25UMZOL2
Instructional Hours per week	Lecture	Tutorial		Lab Practice		Total	
	-	-		3		3	
Experiments							
Unit - I Dissections: Fish: Digestive system (Sardine) Frog: External features, Digestive system (Demo), Arterial System (Demo/Virtual).							
Unit - II Mounting: Fish: Placoid and Ctenoid scales, Frog: Brain (Demonstration).							
Unit - III Osteology: Frog/mammal: Skull and lower jaw, Vertebral column, Pectoral girdle, Pelvic girdle, Fore limb, Hind limb, Chelonia: Anapsid skull. Pigeon: skull, lower jaw, and synsacrum.							
Unit - IV Specimen and Slides: <ol style="list-style-type: none"> 1. Hemichordata: Balanoglossus, Tornaria larva 2. Protochordata: Amphioxus 3. Cyclostomata: Petromyzon, Ammocoetus larva 4. Pisces: Shark, Anabus, Cybium, Hippocampus, Echieneis, Labeo, Catla, Clarius, Anguilla, Protopterus, 5. Amphibia: Ichthyophis, Amblystoma, Hyla, Rachophorus, Bufo, Rana , Axolotl larva 6. Reptilia: Draco, Chamaeleon, Viper russelli, Naja, Bungarus, Enhydrina, Typhlops, Trionyx, Crocodilus 7. Aves: Archaeopteryx, Passer, Psittacula, Bubo, Alcedo, Columba, Corvus, Pavo, Collection and study of different types of feathers: Quill, Contour, Filoplume, Down 8. Mammalia: Ornithorhynchus, Pteropus Loris, Hedgehog 							
Unit - V Record / Observation Note (Submission is Mandatory)							

Text Books

1. N. Arumugam, A. Thangamani, S. Prasanna kumar, L.M.Narayanan,

Reference Books:

1. Newman, H.H., (1981), The Phylum Chordata, Satish Book Enterprise, Agra – 282 003
2. Parker and Haswell, (1964), Text Book of Zoology, Vol III (Chordata), A.Z.T, B.S. Publishers and Distributors, New Delhi - 110 051

Web sources:

1. <https://bit.ly/3Av1Ejg><https://biologyeducare.com/aves/>

Bio Composting for Entrepreneurship

Title of the Course	Bio Composting for Entrepreneurship						
Course Type	Skill Enhancement Course - II						
Year	I	Semester	II	Credits	2	Course Code	25USZ021
Instructional Hours per week	Lecture		Tutorial		Lab Practice	Total	
	2		-		-	2	
Learning Objectives: This course aims to provide an overall view of the							
L01	To make connections between soil, plants, and food.						
L02	To control pests and diseases without harming the environment.						
L03	To describe organic waste, composting, and finished compost.						
L04	To Ensure that water stays clean and safe.						
L05	To gain an initial understanding of the environmental benefits.						

Unit	Contents	Hrs.
I	Bio composting–Definition, types, and ecological importance.	6
II	Types of Biocomposting technology–Field pits/ground heaps/ tank/large-scale/batch and continuous methods.	6
III	Preparation of the Biocompost pit and bed using different amendments	6
IV	Applications of Biocompost in soil fertility maintenance, promotion of plant growth, value-added products, waste reduction, <i>etc</i> , Sustainable Soil Fertility through Indian Knowledge Systems.	6
V	Economics of establishment of a small biocompost unit – project report proposal for Self Help Group (Income and employment generation).	6

Course outcomes CO	On completion of this course, the students will be able to
C01	To understand the concept of biocomposting, its various types, and its ecological significance in sustainable waste management and soil health.
C02	To describe different biocomposting technologies and compare traditional and modern methods based on scale, efficiency, and suitability.
C03	To demonstrate knowledge of preparing biocompost pits and beds using suitable organic materials and amendments for effective decomposition.
C04	To evaluate the applications of biocompost in enhancing soil fertility, promoting crop productivity, producing value-added products, and reducing organic waste.
C05	To assess the economic feasibility of small-scale biocompost units and prepare a viable project proposal for self-help groups aimed at income and employment generation.

Mapping with programme outcomes and programme Specific Outcomes

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S-Strong (3) M-Medium (2) L-Low (1)

Recommended Texts:

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

Reference books:

1. In book: Recent Trends in Composting Technology (pp.268) Publisher: IK International Publishing House, New Delhi
2. Text Book on Compost Production and Utilization Paper back-Import, 28 July 2013 by Yugantha Jayasinghe Guttala (Author)

Web Resources:

1. <https://morungexpress.com/bio-composting-important-component-organic-farming>
2. <https://wikifarmer.com/en/bio-composting-by-using-agricultural-by-products/>
3. www.biogreenhouse.org

Animal Behaviour

Title of the Course		Animal Behaviour					
Course Type		Skill Enhancement Course - III					
Year	I	Semester	II	Credits	2	Course Code	25USZO22
Instructional Hours Per week		Lecture	Tutorial	Lab Practice	Total		
		2	-	-	2		
Learning Objectives: This course aims to provide training to							
L01	To learn the origin and development of animal behavior and to understand the influence of genetics and environment on animal behavior.						
L02	To understand the biological properties of animal behavior, with an evolutionary and ecological emphasis.						
L03	To compare innate and learned behavior and differentiate between various mating systems.						
L04	To impart knowledge about visual and auditory communication, courtship, mate choice, and mating systems; social behavior and social systems; and animal personality						
L05	To discuss how movement and migration behaviors are a result of natural selection						
Unit	Contents						Hrs.
I	Genetics and Behaviour: Genetic material, Genes and chromosomes, Genetic variation, Heritability of behaviour, Frequency distribution of phenotypes, Darwinian fitness, Evolution of adaptive strategies.						6
II	Evolution and Social Behaviour: Sexual selection, Altruism, and social organisation, Animal perception, Neural control of behaviour, and Visual adaptations to unfavorable environments.						6
III	Animal and the Environment: Coordination and Orientation, Homeostasis and Behaviour, Physiology and Behaviour in changing environments, Animal Learning, Conditioning and Learning, Cognitive aspects of learning. Animal Intelligence and Instinct in Ancient Indian Thought						6

IV	<p>Understanding Complex Behaviour: Instinct and learning, Displacement activities, Decision-making behaviour in Animals, Complex behaviour of hobby bees, Mechanism of decision-making. The mentality of Animals: Languages and mental representation, nonverbal communication in humans, mental images, Intelligence, tool use, and culture.</p>	6
V	<p>Chronobiology: Organization of circadian system in multicellular animals; Concept of central and peripheral clock system; Photoreception and photo-transduction; The physiological clock and measurement of day length; The relevance of biological clocks for human welfare - Clock function (dysfunction).</p>	6

Recommended Books

1. Harjindra Singh, (1990), A Text Book of Animal Behaviour, Anamol Publication.
2. Hoshang S.Gundevia and Hare Goving Singh, (1996), Animal Behaviour, S. Chand & Co., 324. Shukla, J.P. (2010), Fundamentals of Animal Behaviour, Atlantic.
3. Vinod Kumar (2002), Biological Rhythms. Narosa Publishing House, Delhi.

Reference books

1. Michael D. Breed and Janice Moore (2012), Animal Behaviour, Academic Press, USA.
2. Aubrey Manning and Martin Stamp Dawkins, (2012), An Introduction to Animal Behaviour, 6th Edition, Cambridge University Press, UK.
3. Jay, C. Dunlap, Jennifer, J. Loros, Patricia J. De Coursey (ed). (2004), Chronobiology Biological Time Keeping, Sinauer Associates Inc., Publishers, Sunderland, MA.

Web resources:

1. www.ncbs.res.in/content/animal-behaviour
2. <https://bit.ly/3i6wUxR>
3. www.behaviour.univie.ac.at/
4. www.ru.nl/bsi

Course outcomes CO	On completion of this course, the students will be able to
C01	To explain the genetic basis of behaviour and analyze how genetic variation, inheritance, and Darwinian fitness contribute to the evolution of adaptive behavioural strategies.
C02	To understand the evolutionary mechanisms underlying social behaviour, sexual selection, and altruism, and interpret the neural and sensory adaptations influencing animal perception and behaviour.
C03	To assess how animals coordinate physiological and behavioural responses to environmental changes, and evaluate different forms of learning, conditioning, and cognition.
C04	To analyze complex animal behaviours, including decision-making, communication, learning, and problem-solving, and compare cognitive and cultural aspects across animal species and humans.
C05	To explain the organization and function of biological clocks in animals, their physiological and ecological significance, and the relevance of circadian rhythm and clock dysfunction in human welfare.

Mapping With Programme Outcomes and Specific Outcomes

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S-Strong (3) M-Medium (2) L-Low (1)

CO/PSO	PS01	PS02	PS03	PS04	PS05
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Allied Zoology-II

Title of the Course		Allied Zoology-II					
Course Type		Elective					
Year	I	Semester	II	Credits	3	Course Code	25UEZO21
Instructional Hours Per week		Lecture	Tutorial		Lab Practice		Total
		4	-		-		4

Learning Objectives	
L01	To enable students to learn basic concepts relating to aspects of respiratory, circulatory, excretory nervous and sensory physiology.
L02	To enable students to comprehend the processes involved during development.
L03	To enable students to learn basic concepts of immunity and the working of immune organs and familiarize them with the recommended vaccination schedule.
L04	To enable students to comprehend the basic concepts of human genetics and patterns of inheritance.
L05	To enable students to learn about aspects of animal behaviour such as foraging, courtship, nest construction, parental care and learning.

Unit	Contents	Hours
I	Respiration - Respiratory pigments and transport of gases. Mechanism of blood clotting. Types of excretory products: Ornithine cycle. Structure of neuron - Conduction of nerve impulse, Mechanism of vision and hearing.	12
II	Fertilization, Cleavage, Gastrulation, and Organogenesis of Frog; Placentation in Mammals	12
III	Immunity Innate and Acquired - Active and Passive; Antigens and Antibodies; Immunological organs - responses in humans; Vaccination schedule	12
IV	Human Genetics: Human Chromosomes - Sex Determination in Humans; Patterns of Inheritance: Autosomal Dominant, Autosomal Recessive, X-linked, Y-linked, Multiple Allelic and Polygenic; Genetic Counselling.	12
V	Animal Behaviour: Foraging, Courtship Behaviour, Shelter and Nest Construction, Parental Care, Learning Behaviour., Animal Intelligence and Instinct in Ancient Indian Thought	12

Text Books:

1. Verma P.S. & Agarwal – (1997), Developmental Biology, Chordata embryology, S. Chand & Co.
2. Michael D. Breed and Janice Moore, (2012), Animal Behaviour, Academic Press, USA,

Reference Books:

1. Owen, J. A., Punt, J. & Stranford, S. A. (2018), Kuby Immunology, New York: W.H. Freeman & Company
2. Klug, W. S., Cummings, M. R., & Spencer, C (2016). Concepts of Genetics. (12th ed.). New Jersey: Pearson Education
3. Mathur, R. (2014), Animal Behaviour. Meerut: Rastogi.

Course Outcomes:

CO. No.	Upon the completion of this course, the students will be able to
CO1	To explain the physiological processes of respiration, excretion, circulation, and neural coordination in animals, and describe the mechanisms of sensory perception.
CO2	To describe the processes of fertilization, cleavage, gastrulation, and organogenesis in amphibians, and compare placentation mechanisms in mammals.
CO3	To distinguish between types of immunity and immune responses, explain the structure and function of immunological organs, and understand the principles of vaccination and immunological protection.
CO4	Analyze the mechanisms of sex determination, inheritance patterns of genetic traits and disorders, and interpret the applications of genetic counselling in human health. Analyse the different patterns of inheritance.
CO5	To examine different types of animal behaviours related to feeding, reproduction, parental care, and learning, and interpret their adaptive significance in natural environments.

Mapping With Programme Outcomes and Programme Specific Outcomes

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S-Strong (3) M-Medium (2) L-Low (1)

CO/PSO	PS01	PS02	PS03	PS04	PS05
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Lab on Allied Zoology-II

Title of the Course		Lab on Allied Zoology - II					
Course Type		Elective - Lab - 2					
Year	I	Semester	II	Credits	2	Course Code	25UEZOL2
Instructional Hours		Lecture	Tutorial		Lab Practice		Total
Per week		-	-		2		2
Learning Objectives							
L01		To understand the vital physiological functions of our body					
L02		To understand the different immune system and its components of our body and gain knowledge about immunization schedule					
L03		To identify and compare the embryological developmental stages in frog					
L04		To compare the basic concept of genetic inheritance					
L05		To analyse the different pattern of behaviour and its physiology					

Unit	Contents
I	Examination and analysis of Ammonia, Urea and Uric acid Estimation of haemoglobin using haemometer
II	Observation of models, charts, and diagrams: Human heart, Haemoglobin, Neuron, eye, Snellen chart for vision test, and Ear, Human karyotype, Haemophilia, Colour Blindness, Hypertrichosis, Down's syndrome, Turner's syndrome, Kline felters's syndrome;
III	Spotters- Slides and Specimen Frog egg, Cleavage, blastula, gastrula-yolk plug stage; any two placentae
IV	Examination of blood group Demonstration- Immunization schedule by WHO
V	Record /Observation Note (Submission is Mandatory)

Text Books

1. Verma p.s. & Agarwal (2004), developmental biology, chordata embryology, s. Chand & co.
2. Widmaier, e.p., raff, h. And strang, k.t. (2008), Vander's human physiology, xi edition., mcgraw-hill, 770 pp
3. Abhijit dutta, (2009), experimental biology: a laboratory science, narosa, new delhi.
4. Roitt, m, peter j. Delves, Seamus J. Martin, and Dennis R. Burton (2017), Essential Immunology, 13th edition, Wiley-Blackwell Publishing, USA.

Reference Books

1. Owen, J. A., Punt, J. & Stranford, S. A. (2018), Kuby Immunology, New York: W.H. Freeman & Company
2. Klug, W. S., Cummings, M. R. & Spencer, C (2016), Concepts of Genetics. (12th ed.). New Jersey: Pearson Education
3. Mathur, R. (2014), Animal Behaviour. Meerut: Rastogi.

Semester - III Cell Biology

Title of the Course		Cell Biology				
Course Type		Core - III				
Course Code		25UMZO31				
Year	II	Semester	III	Credits	5	
Instructional Hours Per week		Lecture	Tutorial		Lab Practice	Total
		5	-		--	5
Learning Objectives; This course aims at providing an overallview of						
L01	Study key milestones in the history of cell biology from early microscopy to modern discoverie.					
L02	Fundamentals of Structure, Composition, and Function of cells.					
L03	Study about cell components.					
L04	Basic structure and types of Nucleus and DNA.					
L05	Know about the cell cycle and cell division.					

Unit	Contents
I	<p>History of Cell Biology and Cell Theory: Tools and Techniques of Cell Biology, Cell Fractionation, Homogenization, Centrifugation, Staining - Vital Stains. – Cytoplasmic and Nuclear Stains. Micro Technique Methods, Microscopes-Types-Light, Compound, Phasecontrast.</p>
II	<p>The Cell: Ultra structure of Plant & Animal cell - Cytoplasm - Structure and Composition, Function - Cytoplasmic Inclusions. Viruses & Bacteria -Types and Structure.</p>
III	<p>Cell components: Plasma Membrane: Ultra Structure -Different Models – Functions, Ultrastructure and functions: Endoplasmic reticulum, Ribosomes, Golgi Complex, Lysosomes, Centrioles, Microtubules, and Mitochondria.</p>
IV	<p>Nucleus: Ultrastructure, Composition and Functions, Nuclear Membrane - Nucleoplasm - Chromosomes -Heterochromatin and Euchromatin – Giant chromosomes, Nucleolus, DNA- structure and types, DNA replication and types of replications -RNAs- Protein Synthesis.</p>
V	<p>Cell Divisions and Cell Cycle: Amitosis, Mitosis and Meiosis and their Significance - Cancer Biology – Characteristics of cancer cells, types, theories on Carcinogenesis, Ageing of Cells – Apoptosis. Ayurvedic Insights into Tumor Biology and Cellular Ageing: Several Ayurvedic herbs (e.g., Ashwagandha, Turmeric, Guduchi) show anticancer, antioxidant, and apoptotic effects in research.</p>

<p>Extended professional component (is a part of internal component only, Not To be included in the External Examination question paper)</p>	<p>Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)</p>
<p>Skills acquired from this course</p>	<p>Students understand the fundamental processes of life, as it explores the structure, function, and behaviour of cells. This course provides insights into cellular mechanisms, enabling students to grasp topics such as metabolism, genetics, and cell communication. It forms a crucial foundation for various fields, including genetics, medicine, and biotechnology.</p>
<p>Recommended Texts:</p>	
<p>1</p>	<p>Albert B., Hopkin K., Johnson A.D., Morgan D., Raff M., Roberts K. and Walter P. (2018), Essential Cell Biology ,5th Edn., (paperback) W.W. Norton & Company p.864. (Latest editions, and the style as given below must be strictly adhered to)</p>
<p>2</p>	<p>Burke, Jack. D., 1970. Cell Biology, Scientific Book Agency, Calcutta.</p>
<p>3</p>	<p>ChallonerJ. (2015), TheCell: A visual tour of the building block of life, The University of Chicago Press and Ivy Press Ltd., p.193.</p>
<p>4</p>	<p>Cohn, N. S.,(1979), Elements of Cytology, Freeman Book Co., New Delhi – 110007,495 pp</p>
<p>5</p>	<p>Cooper G.M. (2019) Th eCell–A Molecular Approach, 8th Edn. Sinauer Associates Inc., Oxford University Press p.813.</p>

References Books:	
1	Dowben, R., (1971), Cell Biology, Harper International Edition. Harper and Row Publisher, New York, 565 pp.
2	Karp G., I wasa J.and Masall W. (2015), Karp's Cell and Molecular Biology Concepts and Experiments. 8th Edn. John Wiley and Sons. p.832.
3	Loewy, A.G. and P. Sicevitz, (1969), Cell Structure and Function, Amerind Publishing Co., NewDeihi - 110 020, 516 pp.
4	Powar, C.B., (1989), Essential of Cytology, Himalaya Publishing House, Bombay - 400004, 368pp
5	Urry L.A. Cain M.L., Wasserman S.A., Minorsky P.V., Jackson R.B. and Reece J.B. (2014), Campbell Biology in Focus, Pearson Education. p.1080.
Web Resources:	
<ol style="list-style-type: none"> 1. http://www.microscopemaster.com/organelles/ 2. https://bit.ly/3tXwDSB 3. https://bit.ly/3tWNpRX 4. https://bit.ly/3AuYR9M 5. https://rsscience.com/cell-organelles-and-their-functions 	
Course outcomes CO	On completion of this course, students will be able to:
CO1	To understand and apply tools and techniques used in cell biology, including methods of cell fractionation and staining, as well as microscopy techniques.
CO2	To understand the ultrastructure and functions of plant and animal cells, with emphasis on cytoplasmic components, inclusions, and the structural diversity of viruses and bacteria."
CO3	<i>To Explain the ultrastructure and functions of the plasma membrane, describe various membrane models, and analyze the structure and roles of major cell organelles including the endoplasmic reticulum, ribosomes, Golgi complex, lysosomes, centrioles, microtubules, and mitochondria.</i>
CO4	<i>To describe the ultrastructure, composition, and functions of the nucleus and its components; explain the structure and types of DNA, mechanisms of DNA replication, types of RNA, and the processes of protein synthesis and its regulation.</i>
CO5	To explain the processes of amitosis, mitosis, and meiosis along with their biological significance and Evaluate the processes of apoptosis and explore Ayurvedic insights into tumor biology and cellular ageing with reference to medicinal herbs such as Ashwagandha, Turmeric, and Guduchi..

Mapping with programme outcomes and programme specific Outcomes

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S-Strong (3)

M-Medium (2)

L-Low (1)

CO/PSO	PS01	PS02	PS03	PS04	PS05
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Cell Biology Lab - III

Title of the Course	Cell Biology Lab - III				
Course Type	Core - III - Lab -3				
Course Code	25UMZOL3				
Year	II	Semester	III	Credits	2
Instructional Hours Per week	Lecture	Tutorial		Lab Practice	Total
	-	-		3	3
Contents					
Unit - I					
Micrometry -use of microscopes–microscopes-light microscope, cameralucida, stage and ocular micrometer					
Unit - II					
Preparation and Identification of Mitotic divisions with Onion Root Tip Cells. Preparation and Identification of different stages of Meiosis in Grasshopper testis- Demonstration only. Staining and observation of polytene chromosome in salivary glands of Chironomous larva.					
Unit - III					
Mounting of buccal epithelium and using vital stains. Preparation of human blood smears Preparation of frog blood smear.					
Unit - IV					
Spotters - Plantcell, Animalcell, T4 bacteriophage ,E.coli, Ribosomes, Mitochondria ,Golgi Apparatus, Endoplasmic Reticulum, Giant Chromosome, Nucleus, DNA, t-RNA,					
Unit - V					
Record/Observation Note (Submission Is Mandatory)					

<p>Extended professional component (is a part of internal component only, Not To be included in the External Examination question paper)</p>	<p>Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)</p>
<p>Skills acquired from this course</p>	<p>Students understand the fundamental processes of life, as it explores the structure, function, and behaviour of cells. This course provides insights into cellular mechanisms, enabling students to grasp topics such as metabolism, genetics, and cell communication. It forms a crucial foundation for various fields, including genetics, medicine, and biotechnology.</p>
<p>Reference Books:</p>	<ol style="list-style-type: none"> 1. Sinha, Chatterjee and Chattopadhyay, 2014 .Advanced Practical Zoology, Books & Allied Ltd; 3rd Revised edition, 1 07 0 pp. 2. Kambaranatha Iyyar and T.N. Ananthakrishnan,1995Amanual of Zoology Vol.I (Part 1, 2) S. Viswanathan, Chenna
<p>Web resources:</p>	<ol style="list-style-type: none"> 1. https://nbb.gov.in/ 2. www.agshoney.com/trainingl

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S-Strong (3) M-Medium (2) L-Low (1)

CO/PSO	PS01	PS02	PS03	PS04	PS05
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Economic Zoology

Title of the Course	Economic Zoology					
Course Type	Skill Enhancement Course - IV					
Course Code	25USZO31					
Year	II	Semester	III	Credits	2	
Instruction a Hours Per week	Lecture		Tutorial		Lab Practice	Total
	2		-		-	2
Learning Objectives: This course aims to providing training to						
L01	Development repreneurial skills in students					
L02	Provide hands on experience to prepare and develop products					
L03	Study the Economic importance of zoology					
L04	Develop startups					
L05	Know about the animal farming					

Unit	Contents
I	<p>Economic Entomology Apiculture: Species of honey bees – Social organisation of honey bee– selection of bees and location for apiary – Newton’s bee hive – products of beekeeping – enemies and diseases of honey bees. Sericulture: Species of silkworm– life history of mulberry silkworm– Rearing of silkworm – pests and diseases of silkworm.</p>
II	<p>Vermiculture Introduction: Types of earthworms – ecological classifications of earthworms – Physical, chemical and biological changes caused by earthworms in the soil – Natural enemies of earthworms. Vermicomposting: vermicomposting methods – factors 39 affecting vermicomposting – Vermiculture unit. Harvesting of vermicompost – vermicast–advantages of vermicompost–vermi wash and its applications</p>
III	<p>Aquaculture Fresh water aquaculture: Carp culture–types of ponds–preparation– maintenance–harvesting and management. Integrated and composite culture. Prawn culture. Marine Aquaculture: Edible – pearl oyster culture.</p>
IV	<p>Poultry Farming Poultry industry in India – Poultry for sustainable food production and livelihood - Commercial poultry farming – Nutritive value of egg and meat Broiler management (Definition; Housing and equipment; Brooding, feeding and health cover of broilers)</p>
V	<p>Dairy Farming: Dairy farming – advantages of dairying – classification of cattle breeds – Indigenous and exotic breeds – Selection of dairy cattle. Breeding – artificial insemination – Dairy cattle management – housing – water supply – Common contagious diseases. Milk - Composition of milk – milk spoilage – pasteurization – Role of milk and milk products in human nutrition. Milk Preservation and Processing in Indian Tradition</p>

Skills acquired from this course	Economic Zoology is the branch of Zoology focusing on animal study and it's Economic Importance. It Provide information about the economic value of animals and how to use the knowledge to benefit humans.
Text Books	<ol style="list-style-type: none"> 1. Sastry, N.S.R., C. K. Thomas and R.A.Singh, (2015), Livestock Production Management, 4th Ed. Kalyani Publishers, New Delhi. 2. ICAR, (2013), Hand book of Animal Husbandry, 4th Ed., ICAR Publication, Pusa, New Delhi. 3. Awasthi, V.B., (2012), Introduction to General and Applied Entomology, third edition, scientific publishers, India. 4. Vasanthraj David, B and Ramamurthy, VV., (2012), Elements of Economic Entomology, Seventh edition, Namrutha publications, Chennai. 5. Shukla & Upadhyay, (2014), Economic Zoology, 5th edn. Rastogi Publication, Meerut New Delhi.
Reference books	<ol style="list-style-type: none"> 1. Glenn Munroe, (2017), Manual of on-Farm Vermicomposting and Vermiculture, Holdanca Farms Ltd, Wallace, Nova Scotia. 2. Hanifa, M.A., (2011), Aquatic resources and aquaculture, Dominant, New Delhi. 3. Gupta, P.K., (2008), Vermicomposting for sustainable agriculture, 2nd Edition, Agrobios, India. 3. Talashikar, S.C., (2008), Earthworms in Agriculture, Agrobios, India. 4. Abishek Shukla, D., (2009), A Hand Book of Economic Entomology, Vedamse Books, New Delhi.
Web resources:	<ol style="list-style-type: none"> 1. https://bit.ly/3tXHjk8 2. https://bit.ly/3tUTHBu 3. https://bit.ly/3hVv96q 4. https://bit.ly/39nztH1 5. https://bit.ly/3CzasVO

Course outcomes CO	On completion of this course, the students will be able to
C01	To identify different species of honey bees and silkworms, and explain their life history.
C02	To classify different types of earthworms and understand their ecological roles. vermicomposting and vermiculture unit.
C03	To understand and apply the principles of freshwater and marine culture techniques.
C04	To understand the significance of poultry in sustainable develop practical knowledge for commercial poultry farming,
C05	To demonstrate knowledge of dairy cattle breeds and the traditional and modern methods of milk processing to ensure quality dairy production and its role in human nutrition."

Mapping With Programme Outcomes and Specific Outcomes

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S-Strong (3) M-Medium (2) L-Low (1)

CO/PSO	PS01	PS02	PS03	PS04	PS05
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Medical Laboratory Techniques

Title of the Course	Medical Laboratory Techniques				
Course Type	Skill Enhancement Course - IV				
Course Code	25USZ032				
Year	II	Semester	III	Credits	2
Instruction a Hours Per week	Lecture	Tutorial		Lab Practice	Total
	2	-		-	2
Learning Objectives: This course aims to providing training to					
L01	To understand the different protocols and procedures to collect clinical samples.				
L02	To explain the characteristics of clinical samples.				
L03	To demonstrate skill in handling clinical equipment.				
L04	To evaluate the safety precautions while handling clinical samples.				
L05	To summarise the control measures to avoid contamination of clinical samples.				

Unit I:

Laboratory Safety and Human Health and Hygiene: Laboratory safety –toxic chemicals and biohazards waste- biosafety level- good laboratory practice – hygiene and health issue – physiology effect of alcohol, tobacco, smoking & junk food & its treatment - biomedical waste management.

Unit II:

Haematology: Composition of blood and their function- a collection of blood & lab procedure- haemopoiesis- types of anaemia- mechanism of blood coagulation- bleeding time- clotting time- determination of haemoglobin-erythrocyte sedimentations rate-packed cell volume- Total count of RBC & WBC- Differential count WBC- blood grouping and typing- haemostasis- bleeding disorder of man - Haemolytic disease of newborn, Platelet count, reticulocytes count, Absolute Eosinophil count.

Unit III:

Medical Microbiology and Instrumentation Techniques: Definition and scope of microbiology- structure and function of cells - parasites - Entamoeba- Plasmodium- Leishmania and Trypanosome- Computer tomography (CT scan) Resonance imaging – flowcytometry – treadmill test – PET. – Magnetic

Unit IV:

Medical Physiology: Cardiovascular system- Blood pressure - Pulse – regulation of heart rate, cardiac shock. Heart sounds, Electrocardiogram (ECG) – significance – ultra sonography- Electroencephalography (EEG).

Unit V:

Diagnostic Pathology: Handling and labelling of histology specimens - Tissue processing - processing of histological tissues for paraffin embedding, block preparation. Microtomes – types of microtome- sectioning, staining –staining methods- vital staining - mounting- problems encountered during section cutting and remedies - Frozen section techniques- freezing microtome.

Text Books

1. Godker, P. B. and Darshan, P, Godker, (2011), Textbook of Medical Laboratory Technology, Mumbai.
2. Guyton and Hall, (2000), Text Book of Medical Physiology, 10th edition, Elseiner, New Delhi.
3. Mukerjee, K.L, (1999), Medical Laboratory Technology- Vol,I, II, III. Tata MC GrawHill, New Delhi.
4. Sood, R., (2009), Medical Laboratory Technology, Methods and interpretation, Jaypee Brothers Medical Publishers (P) Ltd.

Reference books

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

Web Resources

1. <https://bit.ly/3tUs8In>
2. <https://bit.ly/2XKu7mT>
3. <https://bit.ly/3hNS1EP>
4. <https://bit.ly/2ZgrLga>
5. <https://bit.ly/3hTBO1b>

Course outcomes CO	On completion of this course, the students will be able to
C01	Understand protocols and procedures to collect clinical samples for blood analysis and to study human physiology.
C02	Explain the characteristics of clinical samples.
C03	Demonstrate skill in handling clinical equipment.
C04	Evaluate the haematological and histological parameters of biological samples.
C05	Elaborate the role of medical laboratory techniques in the healthcare industry.

Mapping With Programme Outcomes and Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S-Strong (3) M-Medium (2) L-Low (1)

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Semester - IV
Genetics and Evolution

Title of the Course		Genetics and Evolution					
Course Type		Core - IV					
Year	II	Semester	IV	Credits	5	Course Code	25UMZO41
Instructional Hours Per week		Lecture	Tutorial		Lab Practice		Total
		5	-		-		5
Learning Objectives; This course aims at providing an overall view of							
L01	To understand in heritance patterns and the principles of heredity, modification and extensions of Mendel's basic principles and role of genetics in biology						
L02	To know the causes and effects of genetic variation and to gain Knowledge in linkage & recombination (crossing over) and chromosomal mutations.						
L03	To Understand 'DNA' as the basic genetic material and regulation of gene expression.						
L04	Interpret that the evolution process depends on genetic variation and know the major events in evolution.						
L05	To perceive the micro evolutionary concepts and principle of macro evolution.						

Unit	Contents	Hrs
I	Mendel And His Experiments: Monohybrid and dihybrid cross -Laws of inheritance- Mendelian traits in Man- Non-Allelic gene interaction: Complete, incomplete and codominance- Allelic Gene interaction: Complementary genes, Lethal genes and Epistasis. Multiple Alleles: ABO Blood Group – Rh Blood group. Polygenic inheritance: Skin colour of Man. Sex determination in man and genic balance theory. Cytoplasmic inheritance: Kappa particles in paramecium- Genetic material effect in shell coiling of Limnaea.	15
II	Linkage: Morgan's experiment, complete & incomplete linkage-Crossing over - types, mechanisms- chromosome mapping- interference and coincidence. Karyotype. Sex Linked Inheritance: X- linked (Haemophilia and Colour Blindness) & Y- linked (Hypertrichosis) inheritance. Non-disjunction-Chromosomal Aberrations- Structural & Numerical and translocation of chromosomes. Mutations: Types, mutagens, and molecular basis of mutation.	15

III	DNA as the genetic material: Experimental proof- DNA replication and repair mechanism- Fine structure of gene - Regulation of gene expression- operon concept (Lac operon)- Inborn errors of metabolism- Genetic counselling- Eugenics & Euthenics.	15
IV	Origin of life: Synthesis of organic molecules, Urey-Miller experiment Theories of Evolution- Lamarckism, Neo Lamarckism, Darwinism, Neo- Darwinism, Modern synthetic-Morphological, physiological, biochemical, embryological and palaeontological evidence- Geological time scale-Fossil & Fossilisation- Types, Living and Extinct fossils. The Concept of Time and Evolution in Indian Knowledge Systems	15
V	Speciation and isolating mechanism: Isolating mechanisms- Modes of speciation, Genetic drift-Adaptive radiation-Hardy Weinberg equilibrium-Convergent, Divergent and Parallel evolution- Coevolution- Colouration and Mimicry - Evolution of Horse and Humans (Biological & Cultural).	15

Extended professional component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Evolutionary genetics is a study of how genetics leads to evolutionary changes. It involves studying the evolution of the structure of the genome. This is the sum of population genetics and evolution. Genome evolution is the process by which the size and structure of the genome change over time. It will enable the students to understand and the concept of gene.

Recommended Texts:	
1	Guptha G.K., (2013), Genetics Classical to Modern, Rastogi publishers, Meerut.
2	Verma P. S. and V. K. Agarwal.,(2018),Genetics, S. Chand & Company Pvt Ltd
3	Veer Bala Rastogi., (2019),Text Book of Genetics, Generic
4	Verma P.S and Agarwal V.K.,(2006), Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand & Company Ltd.

References Books:	
1	Cooper, Geoffrey M., 2018 .The cell: A Molecular Approach, Eighth Edition, Oxford University Press.
2	Dads on E.O. (1960). Evolution: Process and Product. Reinhold Pub.
3	Dobzhansky T., 1982.Genetics and The Origin of Species, Columbia University
4	Fletcher Hand Hickey I., 2015. Genetics, IV Edition. GS, Taylor and Francis Group, New York and London.
5	Gardner, Anne.2009. Human Genetics, Scion Publishing Ltd.
Web Resources:	
1. https://go.nature.com/2XE8V1q 2. https://bit.ly/3zoTt6B3 3. https://bit.ly/2XAm7oa 4. https://bit.ly/2XEbhxi 5. https://bit.ly/3AB4bso	

Course outcomes CO	On completion of this course, students will be able to:
CO1	To understand the principles of Mendelian genetics and gene interactions by studying:
CO2	To explain and analyze the fundamental principles of Mendelian genetics, understand Mendel’s laws of inheritance, and apply these concepts to human traits.
CO3	To analyse the causes of variations in genetic material and predict the effect on a population using different techniques.
CO4	To understand and explain the synthesis of organic molecules, analyze and compare various theories of evolution.
CO5	To apply the principles of Hardy-Weinberg equilibrium to population genetics. Differentiate among convergent, divergent, and parallel evolution, and describe examples of coevolution.

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S-Strong (3) M-Medium (2) L-Low (1)

CO/PSO	PS01	PS02	PS03	PS04	PS05
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Genetics and Evolution - Lab

Title of the Course	Genetics and Evolution - Lab						
Course Type	Core - IV - Lab - 4						
Year	II	Semester	IV	Credits	2	Course Code	25UMZOL4
Instructional Hours Per week	Lecture		Tutorial		Lab Practice		Total
	-		-		3		3
Learning Objectives: This course aims at providing knowledge on							
L01	To encourage the students to learn the usage of genetics experiments						
L02	To know the causes and effects of mutations.						
L03	To encourage students to understand the significance of living fossils and know the contributions off a mouse evolutionists.						
L04	To identify the variation in the animal kingdom and its role in evolution						
L05	To record the spotters and analyse the genetics and evolutionary theories.						

Experiments
<p>Unit -I : Genetics: Breeding Experiment: Chi-Square test to be illustrated with beads 1. a) Monohybrid Cross b) Dihybrid Cross. 2. Observation of Simple Mendelian traits in man-to be recorded. 3. Observation and study of Polygenic inheritance of quantitative traits to be interpreted in graphs: 4. height of students b) weight of students</p> <p>Unit- II 5. Identification of human blood groups to be analysed for the students 6. Culture of Drosophila and observation of mutants</p> <p>Unit -III Evolution: Gene Frequency: Hardy-Weinberg law-Probability Experiment. 1. Adaptive radiation: Feet / Beak of Birds 2. Visit to an evolutionary significance place</p> <p>Unit-IV Spotters: Normal karyotype in male and female, Down's syndrome, Klinefelter's syndrome, Turner's syndrome, Colour Blindness, Haemophilia, Hypertrichosis Colouration and Mimicry: Lycod on and Krait; Stick insect, Leaf insect, and Animals of evolutionary significance: Peripatus, Archeopteryx, Limulus.</p> <p>Unit-V Record/Observation Note (Submission Is Mandatory)</p>

Extended professional component (is a part of internal component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Text Books	<ol style="list-style-type: none"> 1. Surya Nandan Meena, Milind Naik, (2019), Advances in Biological Science Research: A Practical Approach, Academic Press, New York, USA. 2. Michael Perlin, William Beckerson, Adarsh Gopinath, (2017), Cell, Genetics, and Molecular Biology: A Lab Manual (First Edition), Cognella Inc., USA. 3. Mammata Behera, Rinny Swain, Aditya Pratap Singh, (2024), A Practical manual of fundamentals of Genetics, Bigfoot Publications.
Reference Books:	<ol style="list-style-type: none"> 1. Robert F. Schleif, Pieter C. Wensink, (2012), Practical Methods in Molecular Biology, Springer-Verlag, NY, USA. 2. Sarah Stauffer, Aaron Gardner, Wilko Duprez, Dewi Ayu Kencana Ungu, Philip Wismer, (2018), Labster Virtual Lab Experiments: Basic Genetics, Springer Publishers, NY, USA. 3. Dr. Kishore R. Pawar, Dr. Ashok E. Desai, 2019. A textbook of Organic Evolution,
Web resources:	<ol style="list-style-type: none"> 1. https://nbb.gov.in 2. http://icar.org.

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S-Strong (3)

M-Medium (2)

L-Low (1)

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Wildlife Conservation and Management

Title of the Course		Wildlife Conservation and Management					
Course Type		Skill Enhancement Course - V					
Year	II	Semester	IV	Credits	2	Course Code	25USZO41
Instructional Hours Per week		Lecture	Tutorial	Lab Practice		Total	
		2	--	--		2	
Learning Objectives: This course aims to provide an overall view of							
L01	To understand and discuss the importance of wildlife, its values, modern concepts in wildlife management, and relevant conservation policies.						
L02	To assess and in still strong foundations on wildlife policies and be familiar with a variety of laws and regulations						
L03	To analyse and design appropriate approaches to turn conflict in to tolerance and coexistence, with an emphasis on the human dimensions of human-wildlife interactions.						
L04	To evaluate and integrate all the related areas like Fundamentals in Ecology, Forestry, and Natural Resource Conservation approaches and develop the role PVA models for the protection of Endangered species						
L05	To explain the advanced scientific basis for wildlife management and discuss National and International Efforts for successful wildlife conservation						

Unit	Contents	Hrs.
I	Biodiversity Extinction and Conservation Approaches: Perspectives and Expressions. Identification and prioritization of Ecologically sensitive areas (ESA). Coarse filter and fin filter approaches. Regional and National approaches for biodiversity conservation.	6
II	Theory and Analysis of Conservation of Populations: Stochastic perturbations – Environmental, Demographic, spatial and genetic stochasticity. Population viability analysis-conceptual foundation, uses of PVA models.	6
III	National and International Efforts for Conservation: International agreements for conserving marine life, Convention on Wetlands of International Importance (Ramsar Convention), Conservation of Natural Resources. Overview of conservation of Forest & Grassland resources.	6
IV	Wild life in India: Wild life wealth of India & threatened wildlife, Reasons for wildlife depletion in India, Wildlife conservation approaches and limitations. Wildlife Habitat: Characteristic, Fauna and Adaptation with special reference to Tropical Forest. Protected Area concept: National Parks, Sanctuaries and Biosphere Reserves, Ancient Traditional Lifestyles and Wildlife	6
V	Management of Wildlife: Distribution, status. Habitat utilization pattern, threats to the survival of Slender Loris, Musk deer, Great Indian Bustard, Olive Ridley turtle. Wildlife Trade & legislation, Assessment, documentation, Prevention of trade, Wildlife laws and ethics. Visit a Sanctuary or Biosphere reserve and write a report.	6

Field visit to study the forest Ecosystem and its conservation sanctuary, national park, etc.

Extended professional component (is a part of internal component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
References Books:	
1	Robinson WL and Eric G Bolen, (1984), Wildlife Ecology and Management, Macmillan Publishing Company, New York, p 478.
2	Aaron, N.M. (1973), Wildlife ecology, W.H. Freeman Co. San Francisco, U.S.A.
3	Dasmann R F, (1964), Wildlife Biology, John Wiley & Sons, New York, p231.
Text Books	
1.	Justice Kuldip Singh (1998), Hand book of Environment, Forest and Wildlife Protection Laws in India, Natraj Publishers, Dehradun.
2	Hosetti, B.B. (1997), Concepts in Wildlife Management, Daya Publishing House, Delhi.
Web Resources:	
	<ol style="list-style-type: none"> 1. https://bit.ly/39oPj44 2. https://bit.ly/3lHdEYl 3. https://bit.ly/3CwBCfY 4. https://bit.ly/3EDYr3a 5. https://bit.ly/3tVtG4U

Course outcomes CO	On completion of this course, students will be able to:
C01	To understand the causes and consequences of biodiversity loss and extinction, and evaluate various conservation strategies and approaches to protect and sustain biodiversity at local, national, and global levels.
C02	To analyze population dynamics and apply theoretical models to assess factors influencing population viability, growth, and decline in conservation contexts.
C03	To understand and analyze the various national and international policies, treaties, and organizations dedicated to biodiversity conservation, and evaluate their impact on preserving natural habitats and endangered species.
C04	To evaluate the current conservation strategies and policies in India, and propose sustainable solutions for wildlife management and habitat preservation.
C05	To apply principles and techniques of wildlife management to develop sustainable conservation strategies that balance ecological, social, and economic factors.

Mapping with programme Outcomes and Programme Specific outcomes

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S-Strong (3) M-Medium (2) L-Low (1)

CO/PSO	PS01	PS02	PS03	PS04	PS05
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Basics of Marine Biology

Title of the Course		Basics of Marine Biology					
Course Type		Skill Enhancement Course - V					
Year	II	Semester	IV	Credits	2	Course Code	25USZ042
Instructional Hours Per week		Lecture	Tutorial	Lab Practice		Total	
		2		--		2	
Learning Objectives; This course aims at providing an overall view of							
L01	To understand and learn the physical, chemical and biological aspects of marine environment and to gain knowledge about the management of oceans.						
L02	To introduce students to the marine environment and its indigenous organisms.						
L03	To study the principles, concepts and facts through which the student can better understand and appreciate the nature of the sea and its inhabitants.						
L04	To acquaint the student with the characteristics used to identify and classify marine plants and animals and to develop an awareness of the career possibilities available to students in this area.						

Unit I:

Marine Ecology: Marine environment- ecological factors- light, temperature, salinity, pressure; Classification of marine environment; Pelagic environment – Planktonic and Nektonic adaptations; Distribution and ecological role of other coastal environments - coral reefs, estuaries, mangroves, sea grass beds, kelp forests polar seas and hydrothermal vents.

Unit II:

Physical Oceanography : Physical Properties of Seawater- density, viscosity, surface tension, conductivity and their relationship; temperature distribution in the sea - heat budget, UV radiation; Dynamics of the ocean-general surface circulation, Waves, Currents and Tides, Tsunami.

Unit III:

Chemical Oceanography : Chemical composition of seawater- ionic, major and minor constituents, constancy- ionic compositions and factors affecting constancy- major and minor elements, trace elements- their importance, distribution. Chemistry of seawater constituents- concept of chlorinity and salinity - methods of measurements, nutrients - biogeochemical cycles.

Unit IV:

Biological Oceanography: Sea as a biological environment- Plankton- classification based on size, mode of life and habitat. Phytoplankton and Zooplankton - methods of collection, estimation of standing crop-wet and dry weight estimation-plankton volume settling and displacement methods.

Unit V:

Marine Pollution and Ocean Management: Ocean pollution- kinds and quantities of pollutants, toxic effects and control measures – oil spills, plastics, nuclear waste disposal in marine environment, Eutrophication. Role of National and international agencies and organizations in ocean management-FAO, UNEP, DOD, WOCE, WHOI, IOI Malta, IMO INMARSAT- IUCN, SCAR, SCOR, Marpol, Traffic. Visit to a marine diversity centre and writ a report.

Recommended Text:

1. Thurman, Harold, (2001), Introduction to Oceanography, Prentice Hall Inc. New Jersey. 506 pp.
2. Bertness, M.D, S. D. Gaines and M.K. Hay (2000), Marine Community Ecology Sinauer Associates.
3. Grant Gross, M., (1993), Oceanography: A view of the earth (sixth edition). Prentice Hall Inc. New Jersey.
4. Fincham A. A, (1984), Basic Marine Biology. Cambridge University Press, England. 157 pp.
5. John Resech Jr. (1979), Marine Biology. Reston Publishing Company, Virginia. 257 pp.

Reference Books:

1. Barbara E. Curry, (2016), Advances in Marine Biology, Volume 74, Ist Edition. Academic Press ISBN: 9780128036075
2. Peter Castro, Michael E. Huber, (2015), Marine Biology; Series Botany, Zoology, Ecology and Evolution. McGraw-Hill Education.
3. Philip V. Mladenov, (2013), Marine Biology: A very short introduction, Ist Edition. Oxford University Press.
4. Venkataraman K, Raghunathan C, Raghuraman R, Sreeraj C. R, (2012), Marine diversity in India. Zoological Survey of India, Kolkata.178 pp.
5. Amy Hill. (2002), Marine Biology: An Introduction to Ocean Ecosystems (Marine Biology Ser) Walch publishing.

Web Resources:

1. <https://www.livescience.com>
2. <https://www.icriforum.org>
3. <https://www.cbd.int>

Course Outcomes (COs)

Course outcomes CO	On completion of this course, students will be able to:
CO1	To define marine ecosystem, recognize and describe the interrelationship between biology and ocean technology
CO2	To articulate and classify the dynamics and the physical attributes of the ocean, interpret the factors which affect the global climate.
CO3	To Identify and analyze the physical and biological factors of marine environments, and focus life in the open sea.
CO4	To evaluate the impact of variations in abiotic factors in marine productivity and justify the role of human activities in the degradation of marine ecosystems.
CO5	To categorize marine pollutants and develop controlling measures in collaboration with the institutions for ocean management.

Semester - V
Animal Physiology and Biochemistry

Title of the Course		Animal Physiology and Biochemistry					
Course Type		CORE - V					
Year	III	Semester	V	Credits	4	Course Code	25UMZ051
Instructional Hours		Lecture	Tutorial	Lab Practice	Total		
Per week		5	--	--	5		
Learning Objectives: This course aim is to provide an understanding of							
L01	To familiarize students with the principles and basic facts of Animal Physiology.						
L02	To-give students an insight into the molecular and cellular basis of Animal.						
L03	Physiological functions.						
L04	To make the students aware of how the structure – function relationships and its synchronization with the molecular signals.						
L05	To help students gain knowledge in the basic structure of carbohydrates, fats and proteins and to understand the role of bio molecules in metabolism and learn the metabolic pathway.						

UNIT	CONTENTS
I	<p>Nutrition & Respiration Nutrition: Gastrointestinal tract of man. Digestion - the role of enzymes and absorption of carbohydrates, proteins and lipids. Vitamins-their deficiency. Respiration: Structure of lungs In man. Respiratory pigments: structure of haemoglobin, Transportation and Exchange of oxygen and carbon dioxide-Bohrs effect-bronchitis, asthma - Physiological effects of smoking.</p>
II	<p>Circulation & Excretion Blood-composition and functions, Mechanism of clotting. Types of Hearts – Heart beat and its regulation - pacemaker – Cardiac cycle – ECG - Pulse and blood pressure. Structure of kidney Nephron structure & mechanism of urine formation, Excretory products.</p>
III	<p>Neuromuscular Co-ordination Neuron – Structure, types of neurons - Nerve impulse – Synaptic transmission– Neurotransmitters. Reflexaction, Nerve disorders– epilepsy, Alzheimer’s disease, Parkinson’s disease. Muscles – Structure and Types of Muscles –Physiological properties of Muscle contraction- Biochemical events of muscle contraction.</p>
IV	<p>Endocrine glands: Structure, secretions and functions of endocrine glands of vertebrates, – Pituitary, Thyroid, Parathyroid Adrenal, Thymus, Islets of Langerhans, Ovary and testis. Chemoreceptors-Photoreceptors–mammalian eye–visual pigments – physiology of vision.</p>
V	<p>Biochemistry: Structure and Classification of Carbohydrates, Protein, Amino acids, Lipids. Enzymes: classification - mechanism of action. Metabolism: Glycogenesis– Glycogenolysis-Gluconeogenesis and Glycolysis, Kreb's cycle, Cori cycle; Deamination & Transamination; β - oxidation of fats.</p>

<p>Extended professional component (is a part of internal component only, not-to be included in the External Examination question paper)</p>	<p>Activities having a direct bearing on Skill development containing Employability / Entrepreneurship As the syllabus is for V-semester students, they will be able to understand the basic concepts in Animal Physiology. Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)</p>
<p>Skills acquired from this course</p>	<p>They will understand the life – supporting properties, functions and processes of animals or the parts.</p>
<p>Recommended Texts:</p>	
<p>1</p>	<p>Ambika Shanmugam, (2001), Fundamentals of Biochemistry for Medical Students, Karthik Offset Printers, Chennai.</p>
<p>2</p>	<p>Parameswaran, Ananta Krishnan and Ananta Subramanian, (1975), Outlines of Animal Physiology, S. Viswanathan (Printers & Publishers) Pvt .Ltd., 329pp.</p>
<p>3</p>	<p>Nelson, D.L. & Cox, M.M. (2017) Lehninger principles of Biochemistry (7th edition), W.H. Freeman and Co., New York.</p>
<p>4</p>	<p>Agarwal RA., Anil K Srivastava. Kaushal Kumar., (1978), Animal Physiology and Biochemistry, S. Chand & Co. Ltd., New Delhi Publishing.</p>
<p>References Books:</p>	
<p>1</p>	<p>Guyton, A.C. and Hall, J.B., (2011), Text Book of Medical Physiology, 9th Edition, W.B. Sanders Company, Prism Books (Pvt.) Ltd., Bangalore.</p>
<p>2</p>	<p>Ganong, W.F. (2019), Review of Medical Physiology, McGraw Hill, New Delhi, 340 pp.</p>
<p>3</p>	<p>Hill, W.R., Wyse, G.A and Anderson, M. (2016), Animal Physiology (4th edn). Sinauer Associates Oxford University Press; USA, 828 pp.</p>
<p>4</p>	<p>Prosser C.L., (1985), Comparative Animal Physiology, Satish Book Enterprise, Agra- 282 003, 966 pp.</p>
<p>Web Resources:</p>	
<ol style="list-style-type: none"> 1. https://microbenotes.com/category/biochemistry 2. https://animalphys4e.sinauer.com 3. https://nptel.ac.in/courses/102/104/102104042/ 4. https://biochem.oregonstate.edu 	

Course learning outcome:

CO.No.	On completion of this course, students will be able to:
C01	Be able to explain how the various organ systems are coordinated and controlled.
C02	Be able to list the functions of various organs in relation to physiological processes.
C03	Be able to develop the idea of multi-level controlling and feedback mechanism in relation to various physiological functions.
C04	Be able to understand the basic physiological process related to adaptation, metabolism and major requirements.
C05	Be able to gain knowledge in the basic structure of carbohydrates, fats and proteins and to understand the role of biomolecules in metabolism and learn the metabolic pathway.

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S- Strong (3) M- Medium (2) L- Low (1)

CO/PO	P01	P02	P03	P04	P05
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Environmental Biology

Title of the Course		Environmental Biology					
Course Type		CORE - VI					
Year	III	Semester	V	Credits	4	Course Code	25UMZ052
Instructional Hours Per week		Lecture	Tutorial		Lab Practice	Total	
		4	-		--	4	
Learning Objectives; This course aims to provide an understanding of							
L01	To create an awareness to the students about the theories, concepts and basics of Environmental Biology.						
L02	To create an awareness to the students about the theories, concepts and basics of Environmental Biology.						
L03	To make an awareness of the fresh water habitat and marine habitat.						
L04	To provide adequate explanation to students about the pollutions and population ecology.						
L05	To give an idea about natural resources and conservation.						

UNIT	CONTENTS
I	<p>Ecosystem Concept of an ecosystem-Structure and function of an ecosystem- Producers, consumers and decomposers- Energy flow in the ecosystem- Ecological succession-Food chains, food webs and ecological pyramids Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem Grassland ecosystem - Desert ecosystem-Aquatic ecosystems (ponds, estuaries).</p>
II	<p>Population Ecology Definition and characteristics: Density, Natality, Mortality, Migration, Emigration and Immigration, Population fluctuation- Age pyramid, growth and growth curve - factors affecting population growth- Carrying capacity. Population regulation and human population control.</p>
III	<p>Environmental Stresses And Management: Global climatic pattern, global warming, ozone depletion, Acid rain, Pesticides and other chemical in agriculture, industry and hygiene and their disposal. Bio indicator and biomarkers of environmental health. Biodegradation and bioremediation of heavy metals</p>
IV	<p>Environmental Pollution Definition- cause, effects and control measures of: -Air pollution – Water pollution-Soil pollution-Marine pollution-Noise pollution -Thermal pollution-Nuclear hazards.</p>
V	<p>Biodiversity Conservation: Biodiversity crisis – habitat degradation, poaching of wild life. - Socio economic and political causes of loss of biodiversity. - In situ and ex situ conservation of biodiversity -Hot spots of Biodiversity. Green peace movement - Chipko Movement - Role of government agencies: Central and State Pollution Control Boards-Ministry of Environment and Forests- National Biodiversity Authority. Awareness, Programme, NGOs, Natural Disaster Management,</p>

Extended professional component (is a part of internal component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	The students are understanding about the relationship between living organisms and the impact of human activities in the environment and also its helps students understand how to apply scientific methods and ethical principles to solve environmental Problems and develops an appreciation for the environment and a desire to protect it.
Recommended Texts:	
1	Matthew R. Fisher, 2018. Environmental Biology. Open Oregon Educational Resources. James Madison University
2	Asthana, D.K. and Meera, A. 2009. A text book of environmental studies, S.Chand, New Delhi.
3	Sanyal, K. Kundu, M. and Rana, S. 2009. Ecology and environment, Books and allied, Kolkata.
4	Grant, W.E. and Swannack, T.M., 2008, Ecological Modelling, Blackwell.
References Books:	
1	Odum E.P. 1983. Basic Ecology, Saunders, New York
2	Wilkinson, D.M., 2007, Fundamental Processes in Ecology: An Earth system Approach Oxford University Press, UK
3	Saha, T.K. 2010. Ecology and Environmental biology, Books and Allied, Kolkata.
Web Resources:	
1.	https://bit.ly/2VYWOM5
2.	https://bit.ly/2VZQFiT
3.	https://bit.ly/3kqdXYA
4.	https://bit.ly/39rvvgt

Course learning outcome:

CO. No.	On completion of this course, students will be able to:
C01	Understand the fundamental structure and functions of the ecosystem.
C02	Assess the inter-relationship between organisms and between biotic and abiotic factors in an ecosystem.
C03	Analyze the factors that cause pollution, climate change, loss of biodiversity and depletion of resources.
C04	Evaluate the impact of human population growth and socio- economic development on the structure and function of the ecosystem.
C05	Design plans to scientifically solve environmental problems using biological tools, technologies and government policies.

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S- Strong (3) M- Medium (2) L- Low (1)

CO/PO	P01	P02	P03	P04	P05
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Biostatistics and Computer Application

Title of the Course		Biostatistics and Computer Application					
Course Type		CORE - VII					
Year	III	Semester	V	Credits	3	Course Code	25UMZO53
Instructional Hours Per week		Lecture	Tutorial	Lab Practice	Total		
		5	-	--	5		
Learning Objectives; This course aims at providing knowledge on							
L01	To get the basic knowledge about collection and presentation of data						
L02	To calculate standard deviation, correlation coefficient, chi-square an analysis and to understand hypothesis testing.						
L03	Use the technique to analyze the results of the experiments.						
L04	To gain basic knowledge about computers						
L05	To acquire the knowledge about the office automation.						

UNIT	CONTENTS
I	Introduction and Basics: Definition and Scope: Population and Samples – Types of variables. Collection and sources of data: Primary and secondary data. Sampling methods & Sampling procedures. Classification and Presentation of data: Frequency distribution. Tabulation & Diagrammatic representation of data: tables - parts- types; diagrams – line diagram – bar diagram – pie diagram- histogram – graphs. Measures of Central tendency –Calculation of Mean, Mode and Median (Grouped and Ungrouped Data)
II	Measures Of Dispersion: Range, Standard Deviation and Standard Error, Variance, Coefficient of Variation. Hypothesis Testing-Null hypothesis- Level of significance - Chi-square test – Calculation and application, Students-t Test - Calculation and application.
III	Correlation: Introduction, Types, Perfect positive and negative, Linear and Non-Linear methods; Scatter diagram, Karl Pearson’s correlation coefficient, Interpretation of the Correlation coefficient. Regression Analysis – Regression line, Regression equations.
IV	Introduction to Computer – Application of Computer – Generation of computer - Components of Computer: Input devices and Output devices – CPU – Memory: Primary and Secondary Memory - Operating system – Windows – Linux – Unix – Android. Multimedia, AI, Cyber Security.
V	Introduction to Office Automation: Word Processing: Open, Save and close a Word document; Edit text – formatting, bullets, Spell Checker - headers and footers, numbering, printing. Spreadsheets: MS Excel – entering and editing text and data – adjusting row and column height – Save and close a Word document; Edit text – formatting, bullets, Spell Checker-headers and footers, numbering, printing. Spread sheets: MS Excel – entering and editing text and data – adjusting row and column height

Extended professional component (is a part of internal component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
<p>Text Books (Latest Editions)</p> <ol style="list-style-type: none"> 1. Daniel, W.W. (2012) <i>Biostatistics: A Foundation for Analysis in Health Sciences</i> (10th edition) John Wiley. 2. Zar, J.H. (2013) <i>Biostatistical Analysis</i> (5th edition) Pearson. 3. Gurumani, N. 2005. <i>Biostatistics</i>, 2nd edition, MJP Publishers India. 4. Adabala N., and Rajaram, V. (2014), <i>Fundamentals of Computers</i>, PHI Learning 	
<p>Reference Books (Latest editions, and the style as given below must be strictly adhered to)</p> <ol style="list-style-type: none"> 1. Antonisamy, B., Solomon Christopher and P. Prasanna Samuel, (2011). <i>Biostatistics: Principles and practices</i>. Mac Graw Hill Education Pvt. Ltd. New Delhi. 2. Daniel, W. W., (2000), <i>Biostatistics: A foundation for analysis in the health sciences</i>, 7th Ed. John Wiley & Sons Ltd. New York. 3. Michael C., Whitlock and Dolph Schluter, (2009). <i>The analysis of biological data</i>, 2nd Ed. Mac Millan Publishers, New York, USA. 4. Ronser B., (2006), <i>Fundamentals of Biostatistics</i>, Thomson Brooks / Cole, 6th Ed. Duxbury press, Singapore. 5. Reema Thareja, (2019), <i>Fundamentals of Computers</i>, Oxford University Press. 	
<p>Web Resources</p> <ol style="list-style-type: none"> 1. https://bit.ly/2VYWOM5 2. https://bit.ly/2VZQFiT 3. https://bit.ly/3kqdXYA 4. https://bit.ly/39rvvgt 	

Course Outcomes:

CO. No.	Upon the completion of this course, the students will be able to
C01	Attaching sight on statistical methods for the analysis of biological data.
C02	Undertake statistical operations in biology.
C03	Able to compare the data.
C04	Analyze and use the computers
C05	Gain basic understanding of computer hard ware and software and use productive software's effectively.

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S- Strong (3) M- Medium (2) L- Low (1)

CO/PO	P01	P02	P03	P04	P05
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Animal Physiology, Biochemistry and environmental Biology Lab

Title of the Course		Animal Physiology, Biochemistry and Environmental Biology Lab					
Course Type		CORE - LAB - 5					
Year	III	Semester	V	Credits	3	Course Code	25UMZOL5
Instructional Hours Per week		Lecture	Tutorial		Lab Practice		Total
		-	-		3		3
Learning Objectives; This course aims to provide an understanding of							
L01	Analyse the Oxygen consumption and Opercular movement of a fish						
L02	Operate some instruments to estimate physiological parameters.						
L03	Analyse the selected physiological functions						
L04	Apply laboratory skills in higher studies and attain employability						
L05	Develop drawing and writing skills through record and design experiments						

UNIT	CONTENTS
I	<p>Physiology:</p> <ol style="list-style-type: none"> 1. Rate of Oxygen consumption of fish 2. Effect of temperature on the Opercular movement of a fish – Calculation of Q₁₀. 3. Action of Salivary amylase in relation to enzyme concentration and temperature. 4. Demonstration of blood pressure using a Sphygmomanometer. 5. Qualitative test for Ammonia, Urea and Uric acid. 6. Protein estimation by Bradford method (Demo) 7. Qualitative tests for identification of carbohydrates, proteins and lipids.
II	<p>Ecology:</p> <ol style="list-style-type: none"> 1. Estimation of dissolved Oxygen–any 2 water samples. 2. Dissolved carbon- di – oxide – any 2 water samples 3. Estimation of total and phenolphthalein alkalinity–any 2 samples. 4. Identification and mounting of any two marine/ fresh water planktons

III	<p>Spotters / Charts: Physiology: Intestinal villi, Haemoglobin, Myoglobin, neuron, Sphygmomanometer, Haemocytometer, ECG, Nephron, Cardiac muscle, striated muscle and Non-striated muscle, Thyroid gland, Adrenal, Glucose, Amino acid. Ecology: Mutualism: Hermit crab and Sea anemone, Commensalism: Echeneis and Shark, Parasitism: Sacculina on Crab, Predation: Snake and rat, Ecosystem–Pond, Food chain – Forest ecosystem, grassland ecosystem, age pyramid. Secchi disc.</p>
IV	<p>1. Visit to a local polluted site – Urban / Rural / Industrial / Agricultural. 2. Study of a simple ecosystems - pond /river /hill slopes, etc. Visit to Sanctuaries and National Parks – Report (Mandatory)</p>
V	<p>Record / Observation Note (SUBMISSION IS MANDATORY)</p>

Biostatistics and Computer Application and Sericulture Lab

Title of the Course		Biostatistics and Computer Application and Sericulture Lab					
Course Type		CORE LAB - 6					
Year	III	Semester	V	Credits	3	Course Code	25UMZOL6
Instructional Hours		Lecture	Tutorial		Lab Practice		Total
Per week		-	-		3		3
Learning Objectives; This course aims to provide an understanding of							
L01	To encourage the students to learn the usage of genetics experiments.						
L02	To know the causes and effects of mutations.						
L03	To encourage students to understand the significance of living fossils and know the						
L04	Contributions of famous evolutionists.						
L05	CO4 To identify the variation in the animal kingdom and its role in evolution.						

UNIT	CONTENTS
I	<p>BIOSTATISTICS AND COMPUTER APPLICATION:</p> <ol style="list-style-type: none"> 1. Find out the Mean, Median, Mode, Standard deviation, Standard error and Coefficient of variance using serrations of Neem leaves. 2. Calculation of correlation from Length and width of leaves. 3. Spotters: Bar diagram, Histogram, Pie diagram and Frequency curve and polygon, Computer Mouse, CPU, Keyboard, Monitor.
II	<p>SERICULTURE:</p> <ol style="list-style-type: none"> 1. Dissection of silk glands of a silkworm. 2. Dissection of the digestive system of a silkworm. 3. Dissection of the nervous system of a silkworm 4. Selection of mulberry leaves according to different stages. 5. Life history–egg, larva, pupa and adult. 6. Sexual dimorphism in larva, pupa and adult. 7. Mulberry varieties such as MR2, S30, S36, V2. 8. Chandrika 9. Rearing tray and rearing stand. 10. Raw silk. 11. Report on a field visit to a sericulture farm. (Mandatory

Sericulture

Title of the Course		Sericulture					
Course Type		ELECTIVE -VI					
Year	III	Semester	V	Credits	3	Course Code	25UEZO51
Instructional Hours Per week		Lecture	Tutorial	Lab Practice	Total		
		4	--	--	4		
Learning Objectives; This course aims at providing knowledge on							
L01	Study the scope and importance of Sericulture for betterment of human welfare.						
L02	Introduce the concepts of sericulture and mulberry cultivation.						
L03	Get deep knowledge on diseases of silk worm and pests of mulberry plants.						
L04	Understand the methods of harvesting, and cocoon marketing.						
L05	Adopt sericulture as a vocation as it is rural agro based based cottage industry.						

UNIT	CONTENTS
I	IMPORTANCE OF SERICULTURE: Sericulture industry in India, sericulture as cottage industry, role of Central Silk Board, Moriculture, Mulberry varieties – High yielding varieties – Varieties for rainfed conditions. Morphology of mulberry plant, methods of propagation, irrigation, manuring – Biofertilizers – Green manuring – Triacontanol for increased mulberry productivity – Seriboost, pruning, harvesting and storing of mulberry leaves, package of practices for mulberry cultivation.
II	DISEASES OF MULBERRY Fungal diseases: fungal root, shoot and leaf diseases; Bacterial diseases: leaf blight disease, rot disease; Viral diseases: mulberry leaf mosaic disease, Dwarf disease, Nematode diseases: root knot disease; Deficiency diseases: nitrogen deficiency, phosphorus deficiency, potassium deficiency, magnesium deficiency and calcium deficiency Diseases

III	<p>BIOLOGY OF SILKWORM Classification of Mulberry silk worm-habit and habitats; Voltinism- races of silkworms; Life cycle- Structure of egg- larva- pupa and adult- Sexual dimorphism. Digestive system- circulatory system- excretory system- respiratory system, nervous system and reproductive system.</p>
IV	<p>REARING OF SILK WORM COCOON MARKETING Rearing house (CSB model)-Rearing appliances. Rearing operation: Disinfection-Brushing –Maintenance of optimum conditions, feeding– Bed cleaning–Spacing. Methods of Rearing; Young age worms – Chawki rearing - Rearing of late age larva-Types: Shelf rearing. Floor rearing, Shoot rearing- Application of Sampoorna. Mounting: Mountages-Methods–Precautions. Cocoon marketing: Characteristics of cocoon- – defective cocoons – harvesting methods. – Shell ratio and rate fixation.</p>
V	<p>DISEASES OF SILK WORMS & REELING Protozoan disease: Pebrine; Viral diseases: Flacherie, Gattine, Grasserie; Bacterial diseases: Flacherie, Septicemia, Sotto, Court; Fungal diseases: Muscardine ; Silk reeling: Cocoon stifling–types- storage of stifled cocoons -sorting – cocoon boiling and de flossing– brushing ,Process of reeling: Different methods- silk waste and by products of silk reeling- Raw silk and marketing.</p>

Extended professional component (is a part of internal component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts:	
1	An Introduction to Sericulture: By M. Madan Mohan Rao, this book is available in paperback.
2	A Text book of Sericulture: By Dr. HemRaj, this book is about silkworm biology and rearing.
3	Breeding and Rearing of the SilkWorm: By LSC rozier, this book is about Breeding and rearing of the silk worm.
References Books:	
1	Ganga, G. and I. Sulochana Chetty, An introduction to Sericulture. Oxford & IBH Publishing Company Private Limited, S -155, Panchshila Park, New Delhi.
2	Kamile Afifa.S and Masoodi M. Amin, Principles of Temperate Sericulture, Kalyani Publishers, B- 1/1292, Rajinder Nagar, Ludhians.
3	Kesary, M and M.Johnson, Sericulture, Department of Zoology, N.M... ChristianCollege, Marthandam
4	Dandin, S.B, Jayant Jayaswal and K.Giridhas, H and Book of Sericultural Technologies, Central Silk Board, Madivala, Bangalore-68.
Web Resources:	
1.	https://agritech.tnau.ac.in/sericulture/seri_index.html
2.	https://dacollege.org/uploads/stdmat/zoology-unit2.pdf
3.	https://hts.assam.gov.in/portlet-innerpage/rearing-of-mulberry-silkworm-0
4.	https://silks.csb.gov.in/pune/wp-content/themes/Common_District/dpm-frame2.html

Course learning outcome:

CO.NO	On completion of this course, students will be able to:
C01	Understand the scope of sericulture and mulberry cultivation practices.
C02	Gain knowledge on diseases of silkworms and pests of mulberry
C03	Understand the classification, life cycle and physiology of silkworms.
C04	Apply the rearing methods, harvesting of cocoon and cocoon marketing.
C05	Decide to start sericulture unit / reeling unit in the local area and become notable entrepreneur.

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S- Strong (3)**M- Medium (2)****L- Low (1)**

CO/PO	P01	P02	P03	P04	P05
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Agricultural Entomology

Title of the Course		Agricultural Entomology					
Course Type		ELECTIVE -VI					
Year	III	Semester	V	Credits	3	Course Code	25UEZO52
Instructional Hours Per week		Lecture	Tutorial	Lab Practice		Total	
		4	--	--		4	
Learning Objectives; This course aims at providing knowledge on							
L01	Explain the basic concepts of entomology and observe the pest status of agriculture.						
L02	Illustrate and examine the systemic and functional morphology of various group of agricultural insect pests.						
L03	Differentiate and classify the various groups of insect animals and estimate biodiversity.						
L04	Understand the methods of harvesting, and cocoon marketing.						
L05	Infer and integrate the economic importance of insect species.						

UNIT	CONTENTS
I	Outline classification of insects - Causes for insect assuming pest status - Methods of collection, mounting and preservation of insect pests
II	Insect vectors of plant diseases, Insect pests of stored grains their preventive and curative methods, Most common insect pests of the following plants and their control measures: Paddy, Sugarcane, Groundnut, Coconut and Cotton. Locust and its control. Insect pollinators and scavenger.
III	Apiculture: Introduction, types of honey bees, hive, apiary, selection of bees for apiary, Newton's bee hive, enemies and diseases of honey bees. Sericulture: Introduction, types of silk worms, silk worm races, life history of mulberry silk worm, features of sericulture industry, pests and diseases of silk worm. Lac Culture.
IV	IPM, physical, mechanical, chemical and biological control methods, Pesticide application equipment.

V	Introduction and steps towards IPM, Pheromones, antifeedents, repellents and biopesticide.
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Extended professional component (is a part of internal component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Text Books (Latest Editions)

1. David, B and Ananthakrishnan, T.N. (2006), General and Applied Entomology, Second edition, Tata McGraw hill publishing company Ltd., New Delhi, India.
2. 2 Vasanthraj David, B. and Ramamurthy, V.V. (2012), Elements of Economic Entomology, Seventh edition, Namrutha publications, Chennai.
3. Pruthi, H.S. (1969), Textbook on Agricultural Entomology, I.C.A.R. Publication, New Delhi.
4. Awasthi, V.B. (2012), Introduction to General and Applied Entomology, third edition, scientific publishers.

Reference Books (Latest editions, and the style as given below must be strictly adhered to)

1. Abishek Shukla, D. (2009), A Hand Book of Economic Entomology, Vedamse Books, New Delhi.
2. Ministry of Agriculture, Government of India, (1995), Manual on Integrated Pest Management in Rice and Cotton.
3. John William S. (1995), Management of Natural Wealth, Loyola College Publications, Chennai.

Web Resources

1. <http://www.fao.org>
2. <http://flybase.bio.indiana.edu/>
3. <http://www.ipm.ucdavis.edu>
4. <http://www.ent.iastate.edu/list/>
5. www.entsoc.org

Course learning outcome:

CO.NO	On completion of this course, students will be able to:
C01	Examine and identify the systemic and functional morphology of various group of agricultural insect pests.
C02	Differentiate and classify the various groups of insects and estimate the biodiversity.
C03	Explain the pest status in agriculture and control measures.
C04	To compare the methods and outcomes of integrated pest management.
C05	List the economic importance of agricultural insect species.

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S- Strong (3) M- Medium (2) L- Low (1)

CO/PO	P01	P02	P03	P04	P05
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Vermitechnology

Title of the Course		Vermitechnology					
Course Type		ELECTIVE -VI					
Year	III	Semester	V	Credits	3	Course Code	25UEZO53
Instructional Hours Per week		Lecture	Tutorial	Lab Practice	Total		
		4	--	--	4		
Learning Objectives; This course aims at providing knowledge on							
L01	Gain the knowledge about the types of earthworms.						
L02	To understand the culture techniques of earthworms						
L03	Understand the production of vermicompost.						
L04	Understand the environment conservation process and its importance and protection of Earth worms through vermiculture.						
L05	To gain the knowledge about the marketing of vermicompost.						

UNIT	CONTENTS
I	Earthworm taxonomy: Morphological and anatomical – Classification of earthworms – Food habits – Digestive system – Excretion – Reproduction and Life cycle – Earthworm as farmers’ friend.
II	Types of earthworms: Exotic and native species – South Indian and North Indian species used in Vermicomposting – Collection and Preservation of earthworms for vermicomposting – Culture techniques of earthworms.
III	Vermicompost production: Requirements – Different methods of Vermicomposting – Heap method – Pot method and Tray method – changes during Vermicomposting.
IV	Role of Earthworms in soil fertility: Use of Vermicompost for crop production – Use of earthworms in land improvement and land reclamation – Economics of Vermicompost and vermiwash production. Earthworms as animal feed – Medicinal value of earthworm meal – Role of Earthworms in Solid Waste, Sewage and faecal waste management and Vermifilters. Earthworms as bioreactors.

v	Interaction of earthworms: Interaction of earthworms with other organisms – Influence of chemical inputs on earthworm activities – Large scale manufacture of Vermicompost, packaging of vermicompost and its marketing – Financial supporting – Government and NGOs for vermiculture work.
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Extended professional component (is a part of internal component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Text Books

1. Bhatt J. V. & S. R. Khambata (1959), Role of Earthworms in Agriculture, Indian Council of Agricultural Research, New Delhi.
2. Edwards, C.A. and J.R. Lofty (1977), Biology of Earthworms, Chapman and Hall Ltd., London.
3. Clive A Edwards, (2004), Earthworm Ecology, CRC Press.
4. Rhonda L Edwards and Clive A., (2010), Vermiculture Technology, CRC Press Inc
5. Lee, K.E. (1985), Earthworms: Their ecology and Relationship with Soils and Land Use, Academic Press, Sydney.

REFERENCE BOOKS:

1. Kevin, A and K. E .Lee (1989), Earthworm for Gardeners and Fisherman, (CSIRO, Australia, Division of Soils)
2. Satchel, J.E. (1983), Earthworm Ecology, Chapman Hall, London.
3. Wallwork, J.A. (1983), Earthworm Biology, Edward Arnold (Publishers) Ltd. London.
4. Christy, M. V. (2008), Vermitechnology, 1st edition, MJP Publishers.
5. Lekshmy, M. S., Santhi R. (2012), Vermitechnology, Sara Publications, New Delhi, India,

Web Resources

1. <https://www.earthwormsoc.org.uk/earthworm-biology>
2. <https://unacademy.com/content/upsc/study-material/biology/types-of-earthworms-used-in-vermiculture/>
3. <https://www.techscience.com/phyton/v90n3/41918/html>

Course learning outcome:

CO. NO	On completion of this course, students will be able to:
C01	Improve the knowledge for identification of earthworms.
C02	Find out Vermicomposting is an eco-friendly, economically and socially acceptable technology
C03	Apply Vermitechnology to convert the rural and urban garbage into nutrient rich ecofriendly organic manure.
C04	Justify and prove that the earthworms are having the capacity to observe heavy metals into their tissues.
C05	Improve Vermitechnology to manufacture the vermicompost in small scale industry.

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S- Strong (3) M- Medium (2) L- Low (1)

CO/PO	P01	P02	P03	P04	P05
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Group Project

Title of the Course		Group Project			
Course Type		Project			
Course Code		25UMZOP1			
Year	III	Semester	V	Credits	4
Instructional Hours Per week		Lecture	Tutorial	Lab Practices	Total
		4	-	--	4

Guidelines:

1. It shall be a Group activity with Maximum of 8 students in each group.
2. A Group project report should be submitted at the end of 5th semester, during the practical examination.
3. The Group Project Report shall have a minimum of 25 to 100 pages.
4. Evaluation scheme for the Project-(50:50 for Internal: External)
5. The external examiner will evaluate the external 50 marks.

Personality Development

Title of the Course		Personality Development			
Course Type		Indian Knowledge System (IKS)			
Course Code		25UPDT51			
Year	III	Semester	V	Credits	2
Instructional Hours Per week		Lecture	Tutorial	Lab Practices	Total
		1	1	--	2

UNIT - I

Personality - Definition – Determinants – Personality Traits –Theories of Personality – Importance of Personality Development. Self-Awareness – Meaning – Benefits of Self – Awareness – Developing Self – Awareness. SWOT – Meaning – Importance- Application – Components. Goal Setting Meaning- Importance – Effective goal setting – Principles of goal setting – Goal setting at the Right level.

UNIT - II

Self-Monitoring – Meaning – High self – monitor versus low self-monitor – Advantages and Disadvantages self-monitor- Self –monitoring and job performance. Perception- Definition-Factor influencing perception- Perception process –Errors in perception – Avoiding perceptual errors. Attitude – Meaning- Formation of attitude – Types of attitude - Measurement of Attitudes – Barriers to attitude change – Methods to attitude change. Assertiveness - Meaning – Assertiveness in Communication – Assertiveness Techniques – Benefits of being Assertive – Improving Assertiveness.

UNIT - III

Team Building – Meaning – Types of teams – Importance of Team building- Creating Effective Team. Leadership – Definition – Leadership style- Theories of leadership – Qualities of an Effect leader. Negotiation Skills – Meaning – Principles of Negotiation – Types of Negotiation – The Negotiation Process – Common mistakes in Negotiation process. Conflict Management – Definition- Types of Conflict- Levels of Conflict – Conflict Resolution – Conflict management.

UNIT -IV

Communication – Definition – Importance of communication – Process of communication - Communication Symbols – Communication network – Barriers in communication – Overcoming Communication Barriers. Transactional Analysis – Meaning – Ego States – Types of Transactions – Johari Window- Life Positions. Emotional Intelligence- Meaning – Components of Emotional Intelligence- Significance of managing Emotional intelligence – How to develop Emotional Quotient. Stress Management – Meaning – Sources of Stress – Symptoms of Stress – Consequences of Stress – Managing Stress

UNIT - V

Social Graces – Meaning – Social Grace at Work – Acquiring Social Graces. Table Manners – Meaning – Table Etiquettes in Multicultural Environment- Do's and Don'ts of Table Etiquettes. Dress Code – Meaning- Dress Code for selected Occasions – Dress Code for an Interview. Group Discussion – Meaning – Personality traits required for Group Discussion-Process of Group Discussion- Group Discussion Topics. Interview – Definition- Types of skills – Employer Expectations –Planning for the Interview – Interview Questions- Critical Interview Questions.

References:

1. Dr.S. Narayana Rajan, Dr. B. Rajasekaran, G. Venkadasalaphthi, V. Vijuresh Nayaham and Herald M.Dhas, **Personality Development**, Publication Division, Manonmaniam Sundaranar University, Tirunelveli
2. Stephan P.Robbins, **Organisational Behaviour**, Tenth Edition, Prentice Hall of India Private Limited, New Delhi,2008
3. Jit S. Chandan, **Oragnisational Behaviour**, Third Edition, Vikas Publishing House Private Limited, 2008
4. Dr.K.K. Ramachandran and Dr.K.K. Karthick, **From Campus to Corporate**, Macmillan Publishers India Limited, New Delhi, 2010.

Semester - VI Developmental Biology

Title of the Course		Developmental Biology					
Course Type		CORE VIII					
Year	III	Semester	VI	Credits	4	Course Code	25UMZO61
Instructional Hours Per week		Lecture	Tutorial		Lab Practice		Total
		6	-		--		6
Learning Objectives							
L01	To create an awareness to the students about the theories, concepts and basics of Developmental Biology						
L02	To provide students about the idea of sex cells, fertilization, cleavage, differentiation and development of organs.						
L03	To make an awareness of the induction, organizers and development of extra embryonic structures.						
L04	To provide adequate explanation to students about the late embryonic developments and post embryonic development and ageing						
L05	To give an idea about teratogenesis, invitro fertilization, stem cells and amniocentesis to the students						

UNIT	CONTENTS
I	Gametogenesis & Fertilization Basic concepts of developmental biology. Structure & types of Spermatozoa, Mammalian egg- Egg membranes. Types of egg- Spermatogenesis – Oogenesis. Fertilization – mechanism, theories and significance– Parthenogenesis.
II	Blastulation & Gastrulation Cleavage - Planes and Patterns, Factors controlling cleavage. Fate map and its construction. Blastulation (frog) – types of blastula, Morphogenetic movements. Gastrulation of chick
III	Organogenesis Development of Brain, Development of Heart in a frog. Development of kidneys. Fetal membranes in Chick. Placentation in Mammals.
IV	Applied Embryology Organizer concept – Structure – mechanism of induction and competence. Nuclear transplantation. Regeneration: types - events and factors. Embryonic stem cells & significance. Methods to culture embryo.

V	<p>Human embryology Menstrual cycle and menopause-Pregnancy- development. Erythroblastosis foetalis. Twins – types. Infertility – causes. Test tube baby. Assisted Reproductive Technology – Embryo transfer – Amniocentesis.</p>
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Extended professional component (is a part of internal component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

TEXTBOOKS

1. Balnisky B.I. (2012), An Introduction to Embryology, W.B. Saunders and Co.
2. Berril NJ, Kars G (1986). Developmental Biology, McGraw Hills.
3. Gilbert SF (2010), Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
4. Dubey RC & Maheshwari DK, (2015), A Textbook of Microbiology, S. Chand Publishers, New Delhi.
5. Pelczar MJ, Chan EC, Pelczar MF. (2001), Elements of microbiology. McGraw-Hill International Book Company.

REFERENCEBOOKS

1. Majumdar NN. (2015), Vertebrate embryology, Tata McGraw-Hill, New Delhi.
2. Verma PS & Agarwal VK (2018), Chordate Embryology, S. Chand Publishers, New Delhi
3. Willey JM, Sherwood L, Woolverton CJ. (2001), Prescott's microbiology. Singapore: McGraw-Hill.

WEB RESOURCES

1. <https://mvi-au.vlabs.ac.in>
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5293490/>
3. <https://WWW.AAAAL.ORG/>
4. <https://WWW.BSACI.ORG/>

Course learning outcome:

CO. No.	Upon the completion of this course, the students will be able to
CO 1	Acquire knowledge on fishpond construction and its management.
CO 2	Gain knowledge about finfish culture practices.
CO 3	Learn about shell fish culture and seaweed cultivation.
CO 4	Get knowledge about fish feeding behaviour, and diseases.
CO 5	Learn about methods of harvesting techniques.

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S- Strong (3) M- Medium (2) L- Low (1)

CO/PO	P01	P02	P03	P04	P05
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Microbiology and Immunology

Title of the Course		Microbiology and Immunology					
Course Type		CORE IX					
Year	III	Semester	VI	Credits	4	Course Code	25UMZO62
Instructional Hours Per week		Lecture	Tutorial		Lab Practice		Total
		6	-		--		6

UNIT	CONTENTS
I	History and Scope of Microbiology Whittaker's classification of microorganisms – Ultra structure – Salient features and classification of microbes (Bacteria, Virus, Actinomycetes and Fungi). Bacterial growth and nutritional requirements – culture techniques and types of culture media –media preparation. Staining of Bacteria.
II	Medical Microbiology Study of common bacterial and viral diseases in man: Causative organisms, mode of transmission, pathogenicity, symptoms and preventive measures- Bacterial diseases - Typhoid, Tuberculosis, Leprosy, Syphilis. Viral diseases- Influenza, Poxviruses (Chicken pox) Hepatitis- B, AIDS, Corona (Covid-19), Rabies, Dengue.
III	Food Microbiology Microbial food spoilage, food poisoning, physico- chemical methods in food preservation. Dairy microbiology- Pasteurization, fermented milk products (Curd and Cheese). Industrial microbiology- Basic design of fermentor, industrial fermentation of ethanol, penicillin and enzymes. - Biology of Nitrogen fixation and nitrogen fixers.
IV	Scope of Immunology Types of Immunity- innate and acquired- Organs involved in immunity – structure and functions- Cells involved in immune response - Immune response- Humoral and Cell- mediated immune response Mechanism- Primary and secondary immune response.
V	Immunoglobulins Structure, types, distribution, and biological functions- Antigen-antibody reactions – agglutination precipitation and immune diffusion. Hypersensitivity - Types with examples- Autoimmune Diseases - Concept and types Organ transplantation- types of graft, mechanism of allograft rejection- MHC- Classes- Vaccines- types, vaccination schedule.

Extended professional component (is a part of internal component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Text Books

1	Aneja K.R., (2022), Experiments in Microbiology, plant pathology, Tissue culture and Mushroom Cultivation, New Age International, New Delhi.
2	Atlas R.M., (1988), Microbiology – fundamentals and applications, Macmillan Publishing Company, New York.
3	Greenwood D, Richard CD, John S and Peuther F (1992), Medical Microbiology, 16th edition. ELBS, Churchill living stone.
4	Roitt, M, Peter J. Delves, Seamus J. Martin and Dennis R. Burton, (2017), Essential Immunology, 13th Edition, Wiley-Blackwell Publishing, USA.

Reference Books

1	Salle A.J., (2007), Fundamental Principles of Bacteriology, TataMcGraw – Hill Publishing Company Limited, New Delhi.
2	ABrock T.D. and Madigan M.T., (2010), Biology of Microorganisms, Prentice Hall of India Private Limited.
3	Madigan MT, Martinko JM and Parker J (2012). Brock Biology of Microorganism, 11th edition Prentice Hall International Inc. London.
4	AbulA. Andrew, Lichtman. H, Shiv.P, (2014). Cellular And Molecular Immunology, 8th Edition, Published By W.B. Saunders.

Web Resources

- 1 <https://vlab.amrita.edu/?sub=3&brch=73>
- 2 <https://learn.chm.msu.edu/vibl/>
- 3 <https://mvi-au.vlabs.ac.in>
- 4 <https://virtuallab.tlc.ontariotechu.ca/intro.php>

Course learning outcome:

CO. No.	Upon the completion of this course, the students will be able to
C01	Understand history, relevance of microbiology and classification of bacteria.
C02	Understand the cause of various bacterial and viral disease and prevention.
C03	Gain knowledge of various microbes related to food, environment and industries.
C04	Will be able to understand the immuneresponse and immunity
C05	Learn the immunological techniques in detail.

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S- Strong (3) M- Medium (2) L- Low (1)

CO/PO	P01	P02	P03	P04	P05
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Animal Biotechnology and Bio Informatics

Title of the Course		Animal Biotechnology and Bio Informatics					
Course Type		CORE - X					
Year	III	Semester	VI	Credits	3	Course Code	25UMZO63
Instructional Hours		Lecture	Tutorial		Lab Practice		Total
Per week		5	-		--		5
Learning Objectives							
L01	Understand the principles and applications of genetic engineering in animals						
L02	Apply computational tools and bio informatics techniques to analyse animal genomics						
L03	Design and execute experiments to apply biotechnology and bio informatics						
L04	Understand regulation of gene expression in animals and genetic factors						
L05	Access the societal and ethical implications of animal biotechnology						

UNIT	CONTENTS
I	Fundamentals of Biotechnology: Definition, Scope and Importance of Biotechnology. Enzymes- Restriction enzymes – Enzymes useful for genetic engineering. Vectors: Plasmids- types, characteristic features, Plasmid vector: (pBR322, Ti Plasmid), Bacteriophage vector: (Lambda phage and M13), Cosmid, YAC; Animal vector: (SV40), Transposons as vectors. DNA Library.
II	Techniques in Animal Biotechnology: Gene cloning: steps in cloning, selection of clones. Introduction of recombinant DNA into host cells: prokaryotic and Eukaryotic animal cells (Transformation, Transfection, Transduction, Microinjection, Electroporation, Liposome fusion). Screening and selection of recombinants (Direct selection, Insertional inactivation, blue-white selection, Colony hybridization). Blotting techniques: Methods of different types of blotting (Southern, Northern and Western); PCR: principle, types and application. Gel electrophoresis.

III	<p>Transgenic Animal Technology: Transgenesis: Concept, transgenes, transgenic animal models - knockout mice, sheep- Dolly, Applications of transgenesis - animals as bioreactors. Superbug & bioremediation, Bioweapons.</p> <p>Medical biotechnology: Hybridoma technology - Monoclonal antibodies. Gene therapy: Ex vivo and in vivo, role in cancer treatment. Molecular markers: RFLP, RAPD, DNA fingerprinting and application.</p>
IV	<p>Applications and Ethics: Animal cell culture - Basic requirements and techniques of cell culture, natural and synthetic culture media, primary culture and sub culture; Stem cells: types, culture and applications. Organ culture: Artificial Skin.</p> <p>Industrial biotechnology: Basic concepts of fermentation, production of ethanol. Human genome project: Mapping of human genome, applications. Ethics: Socio-ethical problem, ethical implications. IPR.</p>
V	<p>Bioinformatics: Definition of Bioinformatics, Databases: Nucleotide sequence database: Gen Bank, EMBL, and DDBJ. - Protein sequence database: SWISS-PROT, UniProt, - Structural database: PDB. Sequence Alignment: Pair wise sequence alignment- Multiple sequence Alignment. Data base similarity Search tools: BLAST, FASTA. Protein structure visualizing tools: Rasmol, SPD Bviewer, Scope and Applications of bioinformatics.</p>

Extended professional component (is a part of internal component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

TEXTBOOKS

1. Saxena J., Baunthiyal M., RaviI. 2015. Laboratory Manual of Microbiology, Biochemistry and Molecular Biology, Scientific Publishers, India
2. Bansal M.P., 2013. Molecular Biology and Biotechnology: basic experimental protocols, The Energy and Resources Institute (TERI), New Delhi, India.
3. Chaitanya K.V., 2013. Cell and molecular biology: A Lab Manual, Phi Learning Pvt. Ltd., New Delhi, India.
4. Namita Mendiratta and P Rastogi, (2022), Bioinformatics: Methods and Applications: genomics, proteomics and drug discovery, PHI Learning.
5. Anna Tramontano, (2006), Introduction to Bioinformatics, Chapman & Hall

REFERENCE BOOKS

1. Leonard Davis, Mark Dibner, James Battey, 2012. Basic Methods in Molecular Biology, Elsevier Science Publishing Co., NY, USA.
2. Robert F. Schleif, Pieter C. Wensink, 2012. Practical Methods in Molecular Biology, Springer
3. In Xiong, (2007), Essential Bioinformatics, Cambridge University Press.
4. Hamid D. Ismail, (2022), Bioinformatics, Taylor & Francis Ltd.
5. Jonathan Pevsner, (2022), Bioinformatics Functional Genomics, John Wiley

WEB RESOURCES

1. <http://cbii-au.vlabs.ac.in/>
2. https://media.hhmi.org/biointeractive/vlabs/transgenic_fly/index.html
3. <https://www.ibiology.org/biology-techniques/>

Course outcome:

CO. No.	Upon the completion of this course, the students will be able to
C01	To describe, examine and interpret the organization of genomic material and to research theories of genetic inheritance.
C02	To prepare samples of genetic molecules and to determine their purity, structure and characteristics.
C03	To experiment with genomic preparations and devise techniques to distinguish genetic material in different organisms to survey biodiversity.
C04	To assess the changes in genetic material and to predict and consider the consequences of those changes.
C05	To use bio informatics tool for research analysis

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S- Strong (3) M- Medium (2) L- Low (1)

CO/PO	P01	P02	P03	P04	P05
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Developmental Biology, Microbiology and Immunology - Lab

Title of the Course	Developmental Biology, Microbiology and Immunology - Lab						
Course Type	Core - VII - Lab - 7						
Year	III	Semester	VI	Credits	4	Course Code	25UMZOL7
Instructional Hours Per week	Lecture		Tutorial		Lab Practice		Total
	-		-		3		3

UNITS	CONTENTS
I	DEVELOPMENTALBIOLOGY Mounting and Observation of lives perms of a vertebrate Mounting and Observation of egg of a vertebrate Temporary mounting and Observation of chick embryo development: 24, 48, 72 & 96 hours.
II	MICROBIOLOGY Sterilization techniques – Preparation of Media Isolation of bacteria by pure culture- streak plate- pour plate method Preparation of culture serial dilution technique. Isolation of bacteria from various sources – soil / water / air Simple staining of bacteria. Gram’s staining of bacteria Microscopic examination of living bacteria – Hanging drop method. Visit to a Microbiology lab and write a report.
III	IMMUNOLOGY Identification of ABO blood grouping and Rh blood grouping among the students. Charts on Lymphoid organs in Man.
IV	SPOTTERS Blastula of frog, Gastrula of frog Chick embryo 24, 48, 72 & 96 hours, Discoidal, Cotyledonary, Zonary and Diffuse placenta Autoclave, Hot air oven Agar plate, Agar stab -Agar slant, Inoculation needle. T- Cell, B- Cell, Thymus, Bone marrow, Spleen, Lymph node (T.S / entire organ), Immunoglobulin’s - Ig G & Ig M.
V	Record / Observation Note (SUBMISSIONIS MANDATORY).

Extended professional component (is a part of internal component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill.

TEXT BOOKS

1. Balnisky B.I. (2012), an Introduction to Embryology, W.B. Saunders and Co.
2. Gilbert SF (2010), Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
3. Dubey RC & Maheshwari DK, (2015), a Textbook of Microbiology, S. Chand Publishers, New Delhi.
4. Pelczar MJ, Chan EC, Pelczar MF. (2001), Elements of microbiology. Mc Graw - Hill International Book Company.
5. Delves PJ, Martin SJ, Burton DR, and Roitt IM. (2017), Essential immunology. John Wiley & Sons.

REFERENCE BOOKS

1. Majumdar NN. (2015), Vertebrate embryology, Tata McGraw-Hill, New Delhi.
2. Verma PS & Agarwal VK (2018), Chordate Embryology, S. Chand Publishers, New Delhi
3. Willey JM, Sherwood L, Woolverton CJ. (2001), Prescott's microbiology. Singapore: McGraw-Hill.

WEB RESOURCES

1. <https://mvi-au.vlabs.ac.in/>
2. <https://www.merlot.org/merlot/viewMaterial.htm?id=79694>
3. <https://WWW.BSACI.ORG/>

Course outcome:

CO. No.	Upon the completion of this course, the students will be able to
CO 1	To recollect the fundamental procedure of Developmental Zoology, Microbiology & Immunology.
CO 2	To understand the principles and adopt the techniques for their future courses.
CO 3	To apply the theoretical knowledge of food preservation, fermentation and immunization schedule.
CO 4	To evaluate the present situation to check for any outbreak of contagious diseases.
CO 5	To conclude the prevalence of diseases in adverse conditions and able to formulate solutions to manipulate/ manage the dangerous situation.

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S- Strong (3) M- Medium (2) L- Low (1)

CO/PO	P01	P02	P03	P04	P05
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Aquaculture

Title of the Course		Aquaculture					
Course Type		EC - VII					
Year	III	Semester	VI	Credits	4	Course Code	25UEZO61
Instructional Hours Per week		Lecture	Tutorial		Lab Practice	Total	
		5	-		--	5	
Learning Objectives							
L01	To introduce and also to familiarize the basic and aspects of Aquaculture.						
L02	To enumerate the aquaculture potential and practices in India and augment food production from aquatic resources through aquaculture.						
L03	To introduce the culture practices of both fin fish and shell fishes.						
L04	To study the feeding and breeding techniques and will help them to pursue higher studies and research and job opportunities in aquaculture						
L05	Access the societal and ethical implications of aquaculture						

UNITS	CONTENTS
I	INTRODUCTION Definition, scope of aquaculture, cultural techniques, Aquaculture in India - Freshwater, Coastal and marine aquaculture – Water quality management.
II	PREPARATION OF POND Types of fish ponds. Nursery pond, rearing pond and culture pond. Fin fish culture-Culture of Indian major carp-Bundh breeding, Induced breeding, Transport of fish seeds. - Induced breeding - Types of prawn culture in India. Edible Oyster culture and Pearl Oyster culture.
III	TYPES OF CULTURE PRACTICES Extensive, Semi-intensive and Intensive culture, Monoculture, Monosex culture, Polyculture, Cage culture, and Pen culture. Integrated fish farming - Paddy cum fish culture. Animal husbandry cum fish culture, Sewage fed fish culture.
IV	FISH FEED AND DISEASES Artificial fish feed: feed formulation, feed ingredients, pellets. Live feeds and their culture: Artemia, Diatoms, Rotifers, Micro Algae. Parasites and Diseases of aquaculture organisms: Ectoparasites and Endoparasites, Bacterial, Viral and Fungal diseases - Nutritional deficiency diseases.
V	FISH PRESERVATION TECHNIQUES AND FISHERY BY PRODUCTS Fish spoilage, - drying, salting, pickling, smoking, canning, freezing, and chemical preservation. freezing, canning, drying. Fishmeal, fish flour, fish silage, fish solubles, fish body oil, fish liver oil, fish sausage, fish maw, isinglass, fish manure and guano.

Extended professional component (is a part of internal component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

TEXT BOOKS

1. Sandhu, G.S. 2010. A Textbook of fish and Fisheries of India. Wisdom Press, New Delhi.
2. N. Arumugam, Saras Publications, 114/35G, A.R.P.Camp Road, Periyavilai, Kottar Po, Nagercoil – 629002.

REFERENCE BOOKS

1. Pandian, T.J., Sustainable freshwater fisheries, 2001
2. Vijayan, K.K. et al., 2007. Indian Fisheries: A progressive outlook. CMFRI Publications, Kochi.
3. Mohan Joseph Modayil and Pillai, N.G.K. 2007. Status and perspectives of Marine fishery research in India. CMFRI Publications, Kochi.
4. Mohan Joseph Modayil and Jayaprakash, A.A. 2003. Status of exploitative
5. marine fisheries research of India. CMFRI Publications, Kochi.

WEB RESOURCES

1. <https://egyankosh.ac.in/bitstream/123456789/70776/1/Unit-1.pdf>
2. <https://www.fao.org/4/ac210e/AC210E06.htm>
3. <https://asciindia.com/img/English%20IECs/English%20Pamphlet/1.Fish%20Diseases.pdf>

Course Outcomes

CO. No.	Upon the completion of this course, the students will be able to
C01	Acquire knowledge on fish pond construction and its management.
C02	Gain knowledge about finfish culture practices.
C03	Learn about shellfish culture and seaweed cultivation.
C04	Get knowledge about fish feeding behaviour, and diseases
C05	Learn about methods of harvesting techniques.

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S- Strong (3) M- Medium (2) L- Low (1)

CO/PO	P01	P02	P03	P04	P05
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Animal Biotechnology and Bioinformatics Lab

Title of the Course	Animal Biotechnology and Bioinformatics Lab						
Course Type	CORE Lab - 8						
Year	III	Semester	VI	Credits	2	Course Code	25UMZOL8
Instructional Hours Per week	Lecture		Tutorial		Lab Practice		Total
	-		-		3		3

UNITS	CONTENTS
I	ANIMAL BIOTECHNOLOGY Isolation of genomic DNA – Demonstration, Isolation of Plasmid – Demonstration of Protein separation by PAGE (Poly acrylamide gel electrophoresis)– Demonstration of Quantitative estimation of DNA by spectrophotometry DNA separation by AGE (Agarose gel electrophoresis)- Demonstration of PCR techniques.
II	BIOINFORMATICS Sequence retrieval from databases (NCBI) Multiple sequence alignment of the sequence – (using the online tool Clustal Omega).
III	Spotters/Models/Charts/Photos PBR322, Tiplasmid, Lambda Phage, Restriction enzyme, recombinant DNA Electroporation, Microinjection, Southernblotting, RFLP, RAPD, Monoclonal antibody, Stem cells, Dolly, Laminar air flow, autoclave, Fermentor, NCBI, EMBL, BLAST.
IV	AQUACULTURE -PRACTICALS <ol style="list-style-type: none"> 1. Determination of pH in two watersamples. 2. Estimation of dissolved oxygen. 3. Estimation of alkalinity in two samples. 4. Mounting Placoid, Cycloid and Ctenoid scale. 5. Spotters, Slides, models and Charts: Catla, Rogu, Mirgal, Channa, Penaeus, Crossostrea, Raftculture, Pinctada, Argulus, Lernaea, Marine and freshwater prawn.
V	Record / Observation Note (SUBMISSIONIS MANDATORY).

Extended professional component (is a part of internal component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

TEXTBOOKS

1. Saxena J., Baunthiyal M., RaviI. 2015. Laboratory Manual of Microbiology, Biochemistry and Molecular Biology, Scientific Publishers, India
2. Chaitanya K.V., 2013. Cell and molecular biology: A Lab Manual, Phi Learning Pvt. Ltd. New Delhi, India.
3. Namita Mendiratta and PRastogi, (2022), Bioinformatics: Methods and Applications: genomics, proteomics and drug discovery, PHI Learning.
4. Anna Tramontano, (2006), Introduction to Bioinformatics, Chapman & Hall/CRC.

REFERENCEBOOKS

1. Leonard Davis, Mark Dibner, James Battey, 2012. Basic Methods in Molecular Biology, Elsevier Science Pubilshing Co., NY, USA.
2. Robert F.Schleif, Pieter C. Wensink, 2012. Practical Methods in Molecular Biology, Springer
3. In Xiong, (2007), Essential Bioinformatics, Cambridge University Press.
4. Hamid D. Ismail, (2022), Bioinformatics, Taylor & Francis Ltd.
5. Jonathan Pevsner, (2022), Bioinformatics and Functional Genomics, John Wiley

WEB RESOURCES

1. <http://cbii-au.vlabs.ac.in/>
2. https://media.hhmi.org/biointeractive/vlabs/transgenic_fly/index.html
3. <https://www.ibiology.org/biology-techniques/>
4. <https://go.nature.com/3zAZm09>

Course learning outcome:

CO. No.	Upon the completion of this course, the students will be able to
C01	To describe, examine and interpret the organization of genomic material and to research theories of genetic inheritance.
C02	To prepare samples of genetic molecules and to determine their purity, structure and characteristics.
C03	To experiment with genomic preparations and devise techniques to distinguish genetic material in different organisms to survey biodiversity.
C04	To assess the changes in water quality. Deep understanding in Indian major carps.

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S- Strong (3) M- Medium (2) L- Low (1)

CO/PO	P01	P02	P03	P04	P05
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Applied Zoology

Title of the Course	Applied Zoology						
Course Type	Skill Enhancement Course - VI						
Year	III	Semester	VI	Credits	3	Course Code	25USZO61
Instructional Hours Per week	Lecture		Tutorial		Lab Practice	Total	
	2		-			2	
Learning Objectives: This course aims at providing training to							
L01	To make aware of the graduates about the economic importance of animals for income generation and to create a self-employment venture.						
L02	To understand the concepts of Vermiculture, Mariculture, Sericulture, Poultry and Dairy farming.						
L03	To enable the students to realize the importance and culture of economically important aquatic organisms.						
L04	To provide means of sustenance and earning lively hood and monetary profit through commercial and industrial aquaculture.						
L05	To make the graduates aware of the importance of animals as resources for in come generation and to create confidence for their self-Employment						

UNITS	CONTENTS
I	INSECT PESTS AND THEIR CONTROL - Definition of Pest- Causes for insects attaining pest status Damage and loss due to pests. A brief account on pests affecting agricultural crops. Rice (Rice stem borer, Rice gall midge, Rice hopper), Sugarcane (Sugar cane leaf hopper, root borer, shoot borer), Cotton (Pink and spotted boll worm), Coconut (Rhinoceros beetle), Vegetables (Red pumpkin beetle, Cabbage butterfly, Hadda beetle (tomatoes and potatoes), Brinjal shoot borer),. Insect pests of stored grains (Rice weevil, Khapra beetle (wheat), Pulse beetle). Insect pest control methods (Physical, mechanical, chemical and biological), IPM.
II	MARICULTURE -Introduction –Definition. Biology of shrimp - cultivable species-methods of culture-pond site- artificial breeding - live feeds - hatchery management. Cultivable edible oyster species- biology- culture-; cultivable pearl Oyster- biology- pearl formation – culture of Pearl oyster.

III	VERMICULTURE - Selection of species for vermiculture – Vermicomposting- Organic resources for vermiculture - Vermicomposting methods (Pit Method and Heap Method) - Harvesting of vermicompost - Factors affecting vermicomposting. Advantages of vermicompost.
IV	POULTRY MANAGEMENT - Breeds of chicken- Indigenous breeds and exotic breeds (American, Asiatic, English and Mediterranean breeds) - Construction of poultry house- Intensive method of poultry rearing (Deep litter system and Cage system)- Feeding 15 CO4 93 equipment. Incubation of eggs (Natural and artificial). Diseases affecting poultry and their prevention methods..
V	DAIRY, SHEEP AND PIGGERY FARMING - Livestock development in India and its future prospects. Cattle breeds- (Dairy, Draught and Dual purpose breeds). Exotic breeds of cows. Buffalo breeds in India. Indigenous and exotic breeds of sheep for wool and meat production. Piggery - economically important breeds and economic importance

Extended professional component (is a part of internal component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Text Books	Jaiswal Vand Jaiswal KK (2014) Economic Zoology. PHIL earning Private, Limited, Delhi, India.
Reference books	1. Edwards CA and Bater B. (1996) Ecology of earth worms. 3 rd edition, Chapman and Hall, London 2. Ismail SA (1997) Vermicology– The biology of earthworms. Orient Longman Ltd., Chennai
Web resources	1. https://agritech.tnau.ac.in/pdf/6.pdf 2. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/mariculture 3. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/vermiculture 4. https://agritech.tnau.ac.in/animal_husbandry/ani_chik_poultry%20mgt.html 5. https://wiseias.com/livestock-farming-guide/

Course learning outcome:

Course outcomes CO	On Completion of this course, the students will be able to
C01	Assess the methods and uses of vermin composting and prepare vermicompost.
C02	Explain the aqua cultural practices for oyster and shrimp culture methods and hatchery management
C03	Apply the knowledge of moriculture and silk worm rearing
C04	Analyze the methods of poultry farming, diseases and control measures
C05	Apply the knowledge of dairy farming

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	P01	P02	P03	P04	P05	P06	P07	P08
C01	3	3	2	3	3	2	3	3
C02	2	3	3	3	2	3	3	2
C03	3	3	3	2	3	3	3	2
C04	3	3	3	3	3	3	3	3
C05	3	2	3	3	2	3	3	2

S- Strong (3)**M- Medium (2)****L- Low (1)**

CO/PO	P01	P02	P03	P04	P05
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

Blue Print – End Semester Examinations Semester – I - VI

Class: U.G

Time: 3 Hours

Max. Marks: 75

Section A (10 x 1 = 10)

Answer all questions.

Choose the correct answer. (With four options)

	Unit I	Unit II	Unit III	Unit IV	Unit V
Question Nos.	1 & 2	3 & 4	5 & 6	7 & 8	9 & 10

Section B (5 x 5 = 25)

Answer all questions choosing either (a) or (b).

Answer should not exceed 250 words

	Unit I	Unit II	Unit III	Unit IV	Unit V
Question Nos.	11 (a) & 11 (b)	12 (a) & 12 (b)	13 (a) & 13 (b)	14 (a) & 14 (b)	15 (a) & 15 (b)

Section C (5 x 8 = 40)

Answer all questions choosing either (a) or (b).

Answer should not exceed 500 words

	Unit I	Unit II	Unit III	Unit IV	Unit V
Question Nos.	16 (a) & 16 (b)	17 (a) & 17 (b)	18 (a) & 18 (b)	19 (a) & 19 (b)	20 (a) & 20 (b)