MOTHER TERESA WOMEN'S UNIVERSITY

KODAIKANAL - 624 101
Tamil Nadu.

Curriculum Framework and Syllabus for

B.Sc. ZOOLOGY

(For the candidates to be admitted from the academic year 2021-2022 onwards)

(UNDER CHOICE BASED CREDIT SYSTEM- CBCS)

Mother Teresa Women's University, Kodaikanal
Department of Biotechnology
Choice Based Credit System (CBCS)
(2021-2022 onwards)
B.Sc. Zoology

1. About the Programme

B.Sc Zoology is a 3-year undergraduate programme which deals with the study of animals. The syllabus covers the basic understanding of Invertebrates, Chordates, Physiological process, Ecology, Developmental and Cell Biology etc. This undergraduate programme is generally, divided into six semesters. The programme incorporates core papers, electives and practicals. The delivery methods involve theoretical classes, lab work and hands-on practical training, outdoor tours etc. The students completing this programme generally go for higher education to build a career in academics, public and private sectors.

2. Programme Educational Objectives (PEOs)

PEO1	To provide quality education in a branch of Biological science i.e, Zoology and encourage the students for self employment in applied branches of Zoology
PEO2	To facilitate higher education and research in Zoology
PEO3	To take appropriate steps towards conservation of resources, endemic and endangered animal species
PEO4	To apply knowledge to solve the issues related to animal sciences and provide consultancy
PEO5	To develop the ability for the upliftment of society

3. Eligibility:

i. Candidate should have passed the Higher Secondary Examination conducted by the Board of Higher Secondary Examination, Govt. of Tamil Nadu or any other Examination accepted by the syndicate as equivalent there to with at least one of the following subject Biology/Zoology

ii. Candidate should have secured atleast 55% in the above subject and above in the aggregate.

4. General Guidelines for UG Programme

i. **Duration:** The programme shall extend through a period of 6 consecutive semesters and the duration of a semester shall normally be 90 days or 450 hours. Examinations shall be conducted at the end of each semester for the respective subjects.

ii. **Medium of Instruction:** English

iii. **Evaluation:** Evaluation of the candidates shall be through Internal Assessment and External Examination.

Evaluation Pattern	Theory		Practical	
	Min	Max	Min	Max
Internal	10	25	10	25
External	30	75	30	75

- **Internal (Theory): Test (15) + Assignment (5) + Seminar/Quiz(5) = 25**
- **External Theory: 75**

- **Question Paper Pattern for External examination for all course papers.**

Max. Marks: 75 **Time: 3 Hrs.**

S.No.	Part	Type	Marks
1	**A**	**10*1 Marks=10** Multiple Choice Questions(MCQs): 2 questions from each Unit	**10**
2	**B**	**5*4=20** Two questions from each Unit with Internal Choice (either / or)	**20**
3	**C**	**3*15=45** Open Choice: Any three questions out of 5 : one question from each unit	**45**
Total Marks			**75**

*** Minimum credits required to pass: 156**

- **Project Report**

A student should select a topic for the Project Work at the end of the third semester itself and submit the Project Report at the end of the fourth semester. The Project Report shall not exceed 75 typed pages in Times New Roman font with 1.5 line space.

- **Project Evaluation**

There is a Viva Voce Examination for Project Work. The Guide and an External Examiner shall evaluate and conduct the Viva Voce Examination. The Project Work carries 100 marks (Internal: 25 Marks; External (Viva): 75 Marks).

5. Conversion of Marks to Grade Points and Letter Grade

(Performance in a Course/ Paper)

Range of Marks	Grade Points	Letter Grade	Description
90 – 100	9.0 – 10.0	O	Outstanding
80-89	8.0 – 8.9	D+	Excellent
75-79	7.5 – 7.9	D	Distinction
70-74	7.0 – 7.4	A+	Very Good
60-69	6.0 – 6.9	A	Good
50-59	5.0 – 5.9	B	Average
40-49	4.0 – 4.9	C	Satisfactory
00-39	0.0	U	Re-appear
ABSENT	0.0	AAA	ABSENT

6. Attendance

Students must have earned 75% of attendance in each course for appearing for the examination. Students with 71% to 74% of attendance must apply for condonation in the Prescribed Form with prescribed fee. Students with 65% to 70% of attendance must apply for condonation in the Prescribed Form with the prescribed fee along with the Medical Certificate. Students with attendance less than 65% are not eligible to appear for the examination and they shall re-do the course with the prior permission of the Head of the Department, Principal and the Registrar of the University.

7. Maternity Leave

The student who avails maternity leave may be considered to appear for the examination with the approval of Staff i/c, Head of the Department, Controller of Examination and the Registrar.

8. Any Other Information

In addition to the above mentioned regulations, any other common regulations pertaining to the UG Programmes are also applicable for this Programme.

B.Sc- ZOOLOGY CURRICULUM

Sl. No.	Course Code	Title of the Course	Credits	Hours		Maximum Marks		
				L	P	INT	EXT	Total
I-SEMESTER								
1.	U21LTA11	Part-I-Tamil- I	3	6	-	25	75	100
2.	U21LEN11	Part-II -English –I	3	6	-	25	75	100
3.	U21ZOT11	Core- I- Invertebrata – I	4	5	-	25	75	100
4.	U21ZOP12	Core- II– Practical - Invertebrate –I	4	-	6	25	75	100
5.	U21BOA11	**Allied- I** – Botany	4	5	-	25	75	100
6.	U21EVS11	Environmental Studies	2	2	-	25	75	100
7.	U21PEPS11	Professional English –I	4	6	-	25	75	100
		Total	**24**	**36**		**-**	**-**	**700**
II- SEMESTER								
8.	U21LTA22	Part-I-Tamil- II	3	6	-	25	75	100
9.	U2LEN22	Part-II -English –II	3	6	-	25	75	100
10.	U21ZOT21	Core- III- Invertebrata II	4	5	-	25	75	100
11.	U21ZOP22	Core – IV- Practical - Invertebrata II	4	-	5	25	75	100
12.	U21BOA22	**Allied- II** –Practical- Botany	4	-	5	25	75	100
13.	U21VAE21	Value Education	3	3	-	25	75	100
14.	U21PEPS22	Professional English- II	4	6	-	25	75	100
		Total	**25**	**30**		**-**	**-**	**700**
III- SEMESTER								
15.	U21LTA33	Part I-Tamil III	3	6	-	25	75	100
16.	U21LEN33	Part-II -English III	3	6	-	25	75	100
17.	U21ZOT31	Core- V- Basics of Cell and Molecular Biology	4	5	-	25	75	100
18.	U21CHA33	**Allied III-** Chemistry	4	5	-	25	75	100
19.	U21ZOE311/ U21ZOE312	**Elective-I**-Wildlife Biology/ Animal Behaviour	3	4	-	25	75	100
20.	U21MSS31	**Skill Based Elective-I**-Managerial Skill	2	2	-	25	75	100
21.		**Non-Major Elective-I**	2	2	-	25	75	100
22.	U21PEPS33	Professional English- III	4	6	-	25	75	100
		Total	**25**	**31**	**5**	**-**	**-**	**800**
IV- SEMESTER								
23.	U21LTA44	Part-I-Tamil IV	3	6	-	25	75	100
24.	U21LEN44	Part-II -English IV	3	6	-	25	75	100
25.	U21ZOT41	Core-VI- Chordata	4	4	-	25	75	100
26.	U21ZOP42	Core-VII-Practical - Chordata	4	-	4	25	75	100

27.	U21CHA44	**Allied- IV**- Practical- Chemistry	4	-	4	25	75	100
28.	U21ZOE411/ U21ZOE412	**Elective-II**-Animal Handling & Guidelines/Insect Vectors and Disease	3	3	-	25	75	100
29.	U21CSS421	**Skill Based Elective-II**-Computer skills for Office management	2	2	-	25	75	100
30.		**Non -Major Elective II**	2	2	-	25	75	100
31.	U21PEPS44	Professional English- IV	4	6	-	25	75	100
		Total	**29**	**37**		-	-	**900**
		V- SEMESTER						
32.	U21ZOT51	Core -VIII –Fundamental of Animal physiology	4	5	-	25	75	100
33.	U21ZOT52	Core -IX– Genetics and Biostatistics	4	5	-	25	75	100
34.	U21ZOT53	Core-X- Basics Biochemistry	4	5	-	25	75	100
35.	U21ZOT54	Core-XI- Fundamental concepts of Developmental Biology	4	5	-	25	75	100
36.	U21ZOP55	Core -XII – Practical - Animal physiology, Developmental Biology, Genetics and Biostatistics, Biochemistry	4	-	5	25	75	100
37.	U21ZOE521/ U21ZOE522	**Elective-III** – Cancer Biology/ Parasitology	3	3	-	25	75	100
38.	U21ZOS531/ U21ZOS532	**Skill Based Elective-III-** Poultry Farming/ Sericulture	2	2	-	25	75	100
		Total	**25**	**30**		-	-	**700**
		VI- SEMESTER						
39.	U21ZOT61	Core XIII –Genetic Engineering and Biotechnology	4	5	-	25	75	100
40.	U21ZOT62	Core XIV – Microbiology and Immunology	4	5	-	25	75	100
41.	U21ZOT63	Core-XV- Evolution	4	5	-	25	75	100
42.	U21ZOT64	Core XVI – Environmental Biology	4	5	-	25	75	100
43.	U21ZOP65	Core-XVII – Practical - Environmental Biology, Microbiology & Immunology Genetic Engineering& Biotechnology	4	-	5	25	75	100
44.	U21ZOE641/ U21ZOE642	**Elective –IV** – Bioinformatics / Geoinformatics	3	3	-	25	75	100
45.	U21ZOE641/ U21ZOE642	**Skill Based Elective –IV** – Aquaculture/ Ornithology	2	2	-	25	75	100
46.	U21EAS61	Extension Activities (NSS/NCC/RRC/YRC/Physical Education)	3	-	-	100		100
		Total	**28**	**30**		-	-	**800**
		Grand Total	**156**	**205**				**4600**

Non Major Elective - NME

The candidates, who have joined the UG programme, can also undergo Non Major Elective offered by other Departments.

NME	Code	Title
NME I	U21ZON311/U21ZON312	Public Health and Hygiene /Ornamental fish culture
NME II	U21ZON421/ U21ZON422	Vermicomposting/Apiculture

Additional Credit Courses (Two credit courses)

1. **U21ZOO31**: Online Course – III Semester
2. **U21ZOI41**: Internship – IV Semester
3. **U21ZOV51** : Value added course – V Semester (First Aid and Safety Methods)

Programme Outcomes (POs)

On completion of B.Sc., Zoology Programme, the students will be able

PO1	to understand the broad essential information about animals especially classification, structure, development, adaptations and evolution.
PO2	to get an exposure to the advanced field like genetic engineering, biotechnology and bioinformatics and analyze the relationship between organisms and environment.
PO3	to acquire the anatomical and functional knowledge about microbes, animals and human.
PO4	to develop practical and applied knowledge of lab techniques in different spheres of zoology.
PO5	to produce intellectually sound in life science for accomplishing scientific transformation.
PO6	to involve in scientific research activities for the betterment of Society.
PO7	to analyze and apply the acquired knowledge of biological science in different fields by integrating the functional levels for progressive growth.
PO8	to mould in self employment skills in order to develop entrepreneurship for their future well being.

Programme Specific Outcomes (PSOs)

Upon completion of B.Sc., Zoology Degree Programme the graduates will be able to

PSO1	understand the Physiology, Developmental biology , Evolution of animals and their adaptive importance.
PSO2	acquire the functional knowledge about Cell, Microbial Pathology, Genetic interaction there by realizing the role of health, immunity and vaccines.
PSO3	gain knowledge about the applications in Sericulture, Aquaculture, Apiculture, Vermiculture, Poultry farming, there by imparting skills for source of income and self employment.
PSO4	expose to the Practical's in Zoology and learn to apply in day today life with statistical tools.
PSO5	develop knowledge on biological domain and make awareness in the society.

SEMESTER – I

Course Code	U21ZOT11	INVERTEBRATA – I	L	T	P	C
CORE	I		5	-	-	4
Cognitive Level	K1:Recall K2:Understand K3:Apply					
Learning Objective	➢ To know the various forms of invertebrate animals present in the world. ➢ To distinguish various animals of invertebrates ➢ To acquire knowledge on classification, structural and functional aspects of invertebrates ➢ To learn the general rules on animal classification. ➢ To gain an overall understanding of the origin of life, diverse forms of organisms to which the taxon classified.					
Unit I	**Introduction to principles of Taxonomy:**					
Protozoa, Metazoa, Radiata, Bilateria, Acoelomata, Pseudocoelomata and coelomata. General characters and classification upto class level with Few examples. Protozoa**:** Type study: Paramecium – General organization, Cyclosis, contractile vacuoles and reproduction. General Topic: Life history, Pathogenicity and control Measures of Entamoeba and Plasmodium.						
Unit II	**Porifera:**					
Type Study: Sycon – Histology, Spicules, Gemmules, Parenchymula larva. General Topic: Canal system in sponges.						
Unit III	**Colenterata**					
Type Study: Obelia – general organization and Metagenesis. General Topic: Corals and Coral Reef						
Unit IV	**Platyhelminthes**					
Type Study: Fasciola hepatica – external morphology, digestive, Excretory and reproductive systems and Life history General Topic: Parasitic adaptation – Platyhelminth Worms						
Unit V	**Aschelminthes**					
Type Study: Ascaris – Sexual dimormphism – reproductive systems and Life cycle. General Topic: Human nematode parasites – Ancylostoma, Enterobius, Wuchereria						
Textbook	1. Agarwal, V.K. Invertebrate Zoology. S. Chand & Co. New Delhi. 2013. 2. Arumugam, Invertebrate Zoology Saras publication, 2014.					

References	1. P.S. Dhami and J.K. Dhami. Invertebrate Zoology –R.Cahnd & Co. New Delhi. (2010) 2. Jordan, E.K. and P.S.Verma. Invertebrate Zoology, 12th Edition.S.Chand & Co.Ltd. Ram Nagar, New Delhi 2011. 3. Kotpal, R.I., Protozoa, Porifera, Coelenterata, Annelida, Arthropoda, Mollusca, Echinodermata, Rastogi Publications, Meerut,2005.
E-references	1. https://biologydictionary.net/invertebrate 2. http://rcastilho.pt/DA/ewExternalFiles/Invertebrates_Cap_33_Cambell.pdf 3. file:///C:/Users/ACER/Downloads/invertebrates_3-4_unit_guide%20(1).pdf
Course Outcome	Upon completion of this course, the students will be able to

CO	**Course Outcomes**	**Knowledge Level**
CO1	understand the principles of Taxonomy and apply the knowledge for classification of animals	**K3**
CO2	acquired the functional knowledge about Porifera and canal system in sponges	**K2**
CO3	understand the Colenterata , Corals and Coral Reef	**K2**
CO4	learn about the platyhelminthes and parasitic adaptation – platyhelminth worms	**K1**
CO5	get knowledge on life cycle of Ascaris and Human nematode parasites	**K3**

Mapping of COs with POs & PSOs:

CO	**PO**					**PSO**						
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
CO1	S	S	M	M	M	S	S	M	N	N	M	M
CO2	S	S	M	M	M	S	M	M	M	S	S	M
CO3	S	S	M	M	M	S	S	M	M	M	M	M
CO4	S	S	M	M	M	S	M	M	M	M	S	S
CO5	S	M	M	S	S	S	M	M	S	M	M	M

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

<table>
<tr><td>Course Code</td><td>U21ZOP12</td><td rowspan="2">INVERTEBRATA (Practical)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>CORE</td><td>II</td><td>-</td><td>-</td><td>6</td><td>4</td></tr>
<tr><td>Cognitive Level</td><td colspan="6">K2:Understand K3:Apply K5:Analyse</td></tr>
<tr><td>Learning Objective</td><td colspan="6">➢ To learn the taxonomy and general characters of animal kingdom
➢ To develop knowledge about morphology and anatomy of higher invertebrates
➢ To get familiar with scientific method of identifying the organisms
➢ To dissect and explain the internal anatomy of selected animals
➢ To analyze the importance of mouth parts of various insects</td></tr>
<tr><td></td><td colspan="6">I. Mounting & identification
• Paramecium
• Examination of pond water collected from different places for diversity in protista
• Study of whole mount of Euglena, Amoeba and Paramecium, Classify giving reasons up to order, salient features and its biological significance
• Entamoeba , Volvox, Plasmodium life cycle, Trypanosome, Leishmania, Noctulica
• Sycon , Hyalonema, Euplectella, Spongilla, Cliona
• Obelia, Physalia, Millepora, Aurelia, Metridium,
• Ctenoplana – Pleurobranchia, Velamen
• Fasciola hepatica, Taenia solium and their life cycles, Planarian, Schistosoma
• Ascaris lumbricoides male , female and its life stages , Enterobius, Wuchereria, Dracunculus, Trichinella
Relate structure and functions
• Sponge – Spicules
• Sponge – Gemmule
• Taenia – Scolex
Draw labelled sketch -
Sycon (T.S), T.S.of Planaria, T.S. of Fasciola hepatica, T.S of Taenia solium, T.S of Ascaris (Male & Female)
To submit a Project Report on any related topics on life cycles/coral/ coral reefs.</td></tr>
<tr><td>Textbook</td><td colspan="6">1. Lal, S.S , A Text Book of Practical Zoology: Rastogi, Meerut.2014.
2. Verma, PS. A Manual of Practical Zoology-Invertebrares, S Chand Publications, New Delhi, (2010).</td></tr>
</table>

References Book	1. Kotpal, R.L., Agarwal, S,K. and Khetarpal, R.P.R., Modern Text Book of Zoology, 2. Rastogi Publications, Meerut, 2005.
E.Refernces	1. https://www.uou.ac.in/sites/default/files/slm/BSCZO-104.pdf 2. http://www.zoologyresources.com/uploadfiles/books/dc64b77d8769325515d17c945e461b45.pdf (Invertebrates and chordatas)
Course Outcome	**Upon completion of this course, the students will be**

	CO	**Course Outcomes**	**Knowledge Level**
	CO1	to know the mounting of Euglena, Amoeba and Paramecium	**K2**
	CO2	compare and distinguish the morphological features of invertebrates	**K2**
	CO3	identify the organisms	**K3**
	CO4	gain knowledge about internal structure of organisms	**K2**
	CO5	Analyze the life cycles of invertebrates	**K5**

Mapping of COs with POs & PSOs:

CO	**PROGRAMME OUTCOMES (PO)**								**PROGRAMME SPECIFIC OUTCOMES (PSO)**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	M	S	S	S	M	S
CO2	S	S	S	S	M	S	S	S	S	M	S	S	S
CO3	S	S	S	S	S	M	S	S	S	S	S	M	S
CO4	M	S	S	S	S	S	M	S	M	S	S	M	S
CO5	S	S	S	S	S	S	S	M	S	S	S	S	M
CO5	S	S	S	S	S	S	S	M	S	M	S	S	M

Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark No Correlation (N) - 0 mark

Course Code	U21BOA11	BOTANY	L	T	P	C
Allied	I		5	-	-	4
Cognitive Level	K1:Recall K2:Understand K3:Apply					
Learning Objective	➢ To understand the taxonomy aspects of plants ➢ To learn the structure, reproduction & classification of lower plants ➢ To identify the plants as either monocotyledons or dicotyledons ➢ To gain knowledge for water absorption mechanism and photosynthesis					
Unit I	**Characteristics of Algae and Fungi:**					
Classification of Algae, Structure and Reproduction of Algae- Oscillatoria, *Sargassum*. Economic importance of Algae. General characters of fungi, life cycle of Puccinia, Economic importance of Fungi .						
Unit II	**Cryptogams and phanerogams:**					
Structure and life cycle of Bryophyte - *Funaria* Structure and life cycle of Pteridophyte -*Lycopodium* Structure and life cycle of Gymnosperm- *Gnetum*						
Unit III	**Plant anatomy:**					
Types of tissues and Meristems. Primary structure, of Dicot and monocot stem, root . Structure of mature Anther and ovule, Fertilization and Dicot embryo.						
Unit IV						
General Outline of Benthem &Hooker's classification, Merits & Demerits. Floral Characters and Economic importance of Rubiaceae, Caesalpinaceae, Asclepidaceae and Poaceae.						
Unit V	**Plant physiology:**					
Absorption of water and minerals, Transpiration- movement and loss of water in plants; Stomatal physiology, Photosynthesis; Photosynthetic pigments, light and Dark reaction(C3 cycle only). Photorespiration.						
Text Books	1. Pandey, P.B. College Botany - 1: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. Chand Publishing, New Delhi. 2014. 2. Bilgrami, K.S. A Textbook of Algae. CBS Publisher & Distributors, New Delhi, ISBN: 978-8123900490. 2010.					
Reference Books	1. Sharma, P. D. Microbiology, Rastogi& Co., Meerut. 2011. 2. Alexopoulos, C.J., C.M. Mims and M. BlackMell. Introductory Mycology. IV Edition. Miley India (P) Ltd., Daryaganj, New Delhi. 2007. 3. Vashishta, Sinha A.K, Adarsh Kumar.Bryophytes, S.Chand & Company ltd., New Delhi. 2011.					

E-References	1. http://herba.msu.ru/shipunov/school/biol_154/textbook/intro_botany.pdf 2. http://www.survivorlibrary.com/library/strasburgers_text-book_of_botany_1921.pdf 3. https://biolympiads.com/wp-content/uploads/2018/09/1-Botany Basics.pdf
Course out come	Upon completion of this course, the students will be able to

CO	**Course Outcomes**	**Knowledge Level**
CO1	acquire knowledge of classification of algae and fungi and its economic importance.	**K1**
CO2	know the lifecycle of bryophtes, pteridophytes and gymnossperm.	**K2**
CO3	compare and differentiate the dicot and monocot plants	**K3**
CO4	identify the Rubiaceae, Caesalpinaceae, Asclepidaceae and Poaceae family by using floral characters	**K3**
CO5	understand the transpiration, water absorption and photosynthesis	**K2**

Mapping of COs with POs & PSOs:

CO	**PROGRAMME OUTCOMES (PO)**								**PROGRAMME SPECIFIC OUTCOMES (PSO)**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	M	S	S	M	S	M	M	M	S
CO2	S	S	S	S	M	S	S	S	S	M	S	S	S
CO3	S	S	S	S	S	M	S	S	S	S	S	M	S
CO4	S	S	S	S	S	S	M	S	M	S	S	M	S
CO5	S	S	S	S	S	S	S	M	S	S	S	S	M
CO5	S	S	S	S	S	S	S	M	S	S	S	S	M

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

SEMESTER-II

Course Code	U21ZOT21	INVERTEBRATA - II	L	T	P	C
CORE	III		5	-	-	4
Cognitive Level	K1:Recall K2:Understand K3:Apply					
Learning objective	➢ To understand the systemic and morphological features of invertebrates animals ➢ To identify the simple features of invertebrates ➢ To understand the evolutionary sequence of invertebrates ➢ To acquire knowledge on the general characteristics and classification up to classes of each phylum:. ➢ To acquire knowledge regarding the economic value, affinities of invertebrates					
Unit I	**Annelida:**					
Type Study: Nereis – External morphology, digestive system, Nephridia, Nervous and reproductive system. General topic: Metamerism in Annelids						
Unit II	**Arthropoda:**					
Type Study: Prawn – Penaeus – External Morphology, appendages, digestive system, Excretory system, reproductive system and Development						
Unit III	**Peripatus:**					
General Topic: Social life of beneficial insects Peripatus and its affinities						
Unit IV	**Mollusca:**					
Type Study: Pila – External morphology, Digestive System, Respiratory system, Osphradium and Reproductive system. General Topic: Torsion in Gastropoda, Economic importance of Mollusca						
Unit V	**Echinodermata:**					
Type Study: Starfish – External morphology, Digestive System, nervous system and Reproductive system and development. Pedicellaria, Water vascular system General Topic: Larval forms in Echinodermata						
Text Books	1. Ekambaranatha Ayyar M and Ananthakrishnan.T.N,Manual of Zoology vol.I, S.Viswanathan pvt.Ltd.,Madras, (2001). 2. Agarwal, V.K. ,Invertebrate Zoology. S. Chand & Co. New Delhi, (2010).					

Reference Books	1. P.S. Dhami and J.K. Dhami,R.Chand & Co. Invertebrate Zoology – New Delhi, (2003). 2. Jordan, E.K. and P.S.Verma. Invertebrate Zoology, 12th Edition.S.Chand & Co.Ltd., Ram Nagar, New Delhi, 2010. 3. Kotpal, R.I., Protozoa, Porifera, Coelenterata, Annelida, Arthropoda, Mollusca, Echinodermata, Rastogi Publications, Meerut ,2005. 4. Manual of Zoology Vol. I (Invertibrata). Parts I & II. Ayyar, E.K. and T.N. Ananthakrishnan, S. Viswanathan (Printers and Publishers) Pvt Ltd. Madras. 1992.
E-References link	https://nptel.ac.in/courses/102/106/102106035/
Course out come	Upon completion of this course, the students will be able to

CO	**Course Outcomes**	**Knowledge Level**
CO1	understand the morphological features of invertebrates animals	K1
CO2	learn about the external features, digestive system, excretory system, reproductive system of the invertebrates	K2
CO3	learn the social life of beneficial insects and able to apply apiculture, sericulture etc	K3
CO4	understand the morphology, digestive system, respiratory system, osphradium and reproductive system of mollusca	K2
CO5	gain knowledge on morphology, digestive system, nervous system and reproductive system and development of echinodermata	K2

Mapping of COs with POs & PSOs:

CO	**PROGRAMME OUTCOMES (PO)**								**PROGRAMME SPECIFIC OUTCOMES (PSO)**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	M	S	S	S	S	S	S	M	S	S
CO2	S	M	S	S	S	M	S	S	S	M	S	S	S
CO3	S	S	S	S	M	S	S	S	S	S	S	M	M
CO4	S	S	S	S	M	S	M	S	S	S	M	S	S
CO5	S	S	M	S	S	S	S	M	S	S	M	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

Course Code	U21ZOP22	INVERTEBRATA – II (Practical)	L	T	P	C
CORE	IV		-	-	5	4
Cognitive Level	K2:Understand K3:Apply					
Learning objective	➢ To understand the structural organization of setae and appendages ➢ To correlate the mouth parts of insects to their feeding habit ➢ To mount the important parts of Invertebrate animals. ➢ To analyze the structural organization of the different systems in Earthworm, Prawn, Pila and Starfish. ➢ To apply the knowledge of classification for the identification of specimens of biological importance					
	Mounting & identification • Earthworm - Body and Penial setae • Honey bee / Mosquito mouth parts • Appendages of prawn • Earthworm –digestive system • Earthworm-Nervous system. • **.Cockroach:** • Salivary apparatus and trachea of cockroach • Digestive system • Nervous system • Male Reproductive system • Female Reproductive system • **Pila** - Digestive system, Radula • Starfish- Water vascular system. • **Relate structure and function:** • Neanthes – Parapodium • Penaeus – Petasma • Pila -Osphradium • Starfish - Tube feet **Classify giving reasons up to order, salient features and its biological significance** • Annelids - Aphrodite, Nereis, Chaetopterus, Arenicola, Hirudinaria • Arthropods - Limulus, Palaemon, Balanus, Eupagurus, Scolopendra, Peripatus, Silkworm – Life History Stages, • Termite and Honey bee – members and castes of colony • Molluscs – Pila, Dentalium, Patella, Chiton, Solen Sepia, Octopus, Nautilus. • Echinoderms - Asterias, Ophiura, Clypeaster, Echinus, Cucumaria and Antedon					

Text books	1. Arumugam, Practical Zoology-Invertebrares, Saras publications. 2015 2. Verma, PS..A Manual of Practical Zoology-Invertebrares, S Chand Publications, New Delhi. 2010. 3. Lal, S.S , A Text Book of Practical Zoology: Rastogi, Meerut.2014.
Reference books	1. Kotpal, R.L., Agarwal, S,K. and Khetarpal, R.P.R., Modern Text Book of Zoology, Rastogi Publications, Meerut. 2005,
E-references	1. http://assets.vmou.ac.in/MBO10.pdf 2. http://www.agrifs.ir/sites/default/files/A%20text%20book%20of%20practical%20botany%201%20%7BAshok%20Bendre%7D%20%5B8171339239%5D%20%281984%29.pdf
Course out come	Upon completion of this course, the students will be able to

CO	Course Outcomes	Knowledge Level
CO1	mount the important parts of invertebrate animals.	K2
CO2	demonstrate the internal anatomy of Invertebrate animals.	K2
CO3	examine the various characteristic features and adaptations of higher invertebrates.	K3
CO4	understand the functional features of higher invertebrates.	K2
CO5	learn the biological significance of mollusca and echinoderms	K2

Mapping of COs with POs & PSOs:

CO	PROGRAMME OUTCOMES (PO)								PROGRAMME SPECIFIC OUTCOMES (PSO)				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	S	S	S	M	S	S	M	S	S	S	S	M
CO2	S	S	S	S	M	S	M	S	M	S	M	S	S
CO3	S	S	S	S	S	M	S	S	S	S	S	M	M
CO4	M	S	S	S	S	S	S	M	S	M	S	S	S
CO5	S	S	S	S	S	S	S	M	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

Course Code	U21BOA22	BOTANY (PRACTICAL)	L	T	P	C
ALLIED	II		-	-	5	4
Cognitive Level	K1:Recall K2:Understand K3:Apply					
Learning objective	➢ To learn sectioning and mounting skills ➢ To observe the morphological feature for understanding the taxonomy ➢ To know the structure, reproduction & classification of lower plants ➢ To identify the plants as either monocotyledons or dicotyledons ➢ To gain knowledge on internal structure of plants by sectioning					
	Algae Oscillatoria (Harmogonia) Sargassum (Morphology) Fungi - Puccinia (T.S of Wheat leaf uredospore Teleutospore) Bryophytes - Funnaria (Habit) Pteridophyte – Lycopodium (Morphology,T.s of Stem, L.S. of cone) Gymnosperm - Gentum (morphology, T.S. of Stem showing secondary growth, Gentum , male cone, Female cone. **Taxonomy** Identification and description of the families those are included in the theory 1. Rubiaceae 2. Caesalpinaceae 3. Asclepidaceae & 4. Poaceae **Anatomy** Study of Apical meristem (shoot apex) Tissues - Parenchyma, Collenchymas, Sclerenchyma, T.S of Dicot stem **Embryology** T.S of mature Anther, structure of Dicot Embryo, Structure of Ovule **Plant physiology** Experiments to demonstrate i. Osmosis -Thistle funnel experiment ii. Evolution of oxygen during photosynthesis iii. Ganongs's light screen experiment.					

Reference Books	1. Sivakumar, K. Algae- A Practical Approach. MJP Publishers, Chennai, India. 2016. 2. Gupta, V.K., Tuohy, M.G., Ayyachamy, M., Turner, K.M. and O'Donovan, A. Laboratory Protocols in Fungal Biology: Current Methods in Fungal Biology. Springer, London, UK. 2013. 3. Chmielewski, J. G. and Krayesky, D. General Botany laboratory Manual. AuthorHouse, Bloomington, USA. 2013. 4. Bendre, A. M. A Text Book Of Practical Botany – Rastogi Publications, Meerut, India. 2010.
Course out come	Upon completion of this course, the students will be able to

CO	**Course Outcomes**	**Knowledge Level**
CO1	identify and differentiate algae, Fungi, Bryophytes and Pteridophytes	**K3**
CO2	identify and classify the rubiaceae, caesalpinaceae , asclepidaceae & poaceae family plants	**K3**
CO3	Observe the various plant tissues and differentiate Monocot and Dicot plants through sectioning	**K2**
CO4	understand the parts of plant embryo	**K2**
CO5	get practical knowledge on thistle funnel experiment and other physiological experiments	**K1**

Mapping of COs with POs & PSOs:

CO	**PROGRAMME OUTCOMES (PO)**								**PROGRAMME SPECIFIC OUTCOMES (PSO)**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	M	M	S	S	M	S	S	S	M	S
CO2	S	S	S	S	M	S	S	S	S	M	S	S	M
CO3	S	S	S	S	S	M	S	M	S	S	S	M	S
CO4	S	S	S	S	S	S	M	S	M	S	S	M	S
CO5	S	S	S	S	S	S	S	M	S	S	S	S	M
CO5	S	M	M	S	S	S	S	M	S	M	S	S	M

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

SEMESTER-III

Course Code	U21ZOT31	BASICS OF CELL AND MOLECULAR BIOLOGY	L	T	P	C
CORE	V		5	-	-	4
Cognitive Level	K1:Recall K2:Understand K3:Apply K5: Analyse					
Learning objective	➢ To learn the ultra structure and functions of cells and cellular organelles and the molecular mechanisms involved in various cellular processes. ➢ To remember and understand the structural and functional aspects of nuclear components and cell cycle events ➢ To analyze the structure, replications and transcriptions of DNA ➢ To know the different molecular and biologic techniques ➢ To differentiate prokaryotic and eukaryotic protein synthesis mechanism.					
Unit I	**Introduction to Cell:**					
Cell type – prokaryotic and eukaryotic Microscopy: Detailed study of Compound, X – ray diffraction, Phase contrast microscope. Polarsing microscope, Cytological Techniques: Fixation- processing- staining methods of DNA, RNA, Protein, Lipids and Polysaccharides- Ultracentrifugation.						
Unit II	**Structure and functions of cell organelles:**					
Ultra structure and functions of plasma membrane. Mitochondria, Golgi apparatus, Endoplasmic reticulum and Ribosomes. Lysosomes, Centrioles, nucleus and nucleolus, Chromosomes – Structure and types. Cell Divisions – mitosis and mitotic apparatus, meiosis and Synaptonemal complex.						
Unit III	**Molecular Genetics:**					
DNA as genetic material – Transformations – Conjugations – Transductions - DNA Structure, DNA repair mechanisms – direct reversal, Excisions repair, SOS repair, recombination's, types and replications Fine structure of gene - cistrons, recons and muton Mutations – Physical and Chemical Stages - Molecular basis of mutations. Sickle cell anemia, Inborn errors of Metabolisms: Phenylketonuria – Alkaptonuria – Albinism.						
Unit IV	**Central dogma of Molecular Biology:**					
Central dogma of Molecular Biology - Protein biosynthesis – Transcriptions - Types of DNA, Different types of RNA – sRNA, tRNA, rRNA, Processing of the precursor of SRNA, Processing of RNA Molecules						
Unit V	**Proteins synthesis:**					
Genetic code, Proteins synthesis - Transcriptions is prokaryotes,Translations, Ribosome, Polyribosome, Steps in proteins synthesis. The lac operon; Positive and Negative control. PCR- Sanger's DNA Sequencing Method. Gene bank and libraries. Human Genome Project.						

<table>
<tr><td>Text Books</td><td colspan="3">1. Powar, C.B., Cell Biology, Himalayas Publishing House, Bombay.2011
2. Berry .A.K. A Text book of Cell Biology, Emkay-Publications,Delhi,2012
3. Arumugam.N.Cell Biology. Saras Publication, (2014).</td></tr>
<tr><td>Reference Books</td><td colspan="3">1. Gupta, M.L. and Jangir, M.L., , Cell Biology Fundamentals and Application, Student Edition, Jothpur.2012
2. DeRobertis, E.D.P. and DeRobertis, E.M.E., 2010, Cell and Molecular Biology VIII Ed. Lea and Febger, Philadelphia.
3. Jeyanthi, G.P ,Molecular biology, MJP Publishers, Chennai. 2009,</td></tr>
<tr><td>E-references</td><td colspan="3">1. http://compbio.case.edu/koyuturk/teaching/eecs600/slides/Molecular_and_Systems_Biology.pdf
2. file:///C:/Users/ACER/Downloads/Full.pdf
3. https://www.fmed.uniba.sk/uploads/media/Introduction_to_Medical_and_Molecular_Biology.pdf</td></tr>
<tr><td>Course out come</td><td colspan="3">Upon completion of this course, the students will be able to</td></tr>
<tr><td></td><td>CO</td><td>Course Outcomes</td><td>Knowledge Level</td></tr>
<tr><td></td><td>CO1</td><td>differentiate and analyse the structure of prokaryotic and eukaryotic cells, macromolecules, and membranes</td><td>K5</td></tr>
<tr><td></td><td>CO2</td><td>know how these cellular components are used to generate and utilize energy in cells and cell division</td><td>K2</td></tr>
<tr><td></td><td>CO3</td><td>know the structure and functions of cell divisions, physiological changes and alterations of cell functions brought about by mutations.</td><td>K1</td></tr>
<tr><td></td><td>CO4</td><td>analyse the central dogma of life</td><td>K5</td></tr>
<tr><td></td><td>CO5</td><td>understand genetic role in protein synthesis mechanism.</td><td>K2</td></tr>
</table>

Mapping of COs with POs & PSOs:

CO	PROGRAMME OUTCOMES (PO)								PROGRAMME SPECIFIC OUTCOMES (PSO)				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	M	S	S	S	S	M	S	S	S	M	M
CO2	S	M	S	S	M	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	M	S	S	S	S	S	S	S	S	S	S
CO5	S	S	M	S	S	S	M	S	S	S	S	S	S

Strongly Correlating (S) - 3 marks

Moderately Correlating (M) - 2 marks

Weakly Correlating (W) -1 mark

No Correlation (N) - 0 mark

Course Code	U21CHA33	CHEMISTRY	L	T	P	C
ALLIED	III		5	-	-	4
Cognitive Level	K1:Recall K2:Understand K3:Apply					
Learning objective	➢ To understand the handling of chemicals and errors in chemical analysis ➢ To get knowledge in chemical bonding and hybridization ➢ To acquire knowledge in volumetric analysis ➢ To understand the basic concept of chemistry of Thermodynamics and Kinetics					
Unit I	**Handling of chemicals and Data analysis**					
a) Storage and handling of chemicals: Handling of acids, ethers, toxic and poisonous chemicals. Antidotes, threshold vapour concentration and first aid procedure. b) Errors in chemical analysis: Accuracy, precision. Types of error-absolute and relative errors.Methods of eliminating and minimizing errors. c) Separation techniques–Solvent extraction. Principle of adsorption and partition chromatography, column chromatography, thin layer chromatography (TLC), paper chromatography and their applications.						
Unit II	**Chemical bonding**					
a) Ionic Bond: Nature of Ionic bond. Structure of NaCl, KCl and CsCl. Factors influencing the formation of ionic bond. b) Covalent Bond: Nature of covalent bond. Structure of CH_4, NH_3, H_2O based on hybridization. c) Coordinate Bond: Nature of coordinate bond. Coordination complexes. Werner'stheory. Geometrical and optical isomerism in square planar and octahedral complexes. Mention of structure and functions of chlorophyll and hemoglobin. d) Hydrogen Bond: Theory and importance of hydrogen bonding. Types of hydrogenbonding. Hydrogen bonding in carboxylic acids, alcohol, amides, polyamides, DNA and RNA. e) van der Waal's forces: Dipole – dipole and dipole - induced dipole interactions.						

<table>
<tr><td>Unit III</td><td colspan="3">Volumetric analysis</td></tr>
<tr><td colspan="4">a) Methods of expressing concentration: normality, molarity, molality, ppm.
b) Primary and secondary standards: preparation of standard solutions
c) Principle of volumetric analysis: end point and equivalence points.
d) Strong and weak acids and bases - Ionic product of water, pH, pKa, pKb. Buffer solutions -pH of buffer solutions. Mention of Henderson equation & its significance.</td></tr>
<tr><td>Unit IV</td><td colspan="3">Kinetics & Thermodynamics</td></tr>
<tr><td colspan="4">Chemical Kinetics: Rate, rate law, order and molecularity. Derivation of rate expressions for I and II order reactions.

Catalysis-Homogeneous and heterogeneous catalysis. Enzyme catalysis, enzymes in biological system and in industry.

Thermodynamics: Introduction, Scope and importance of thermodynamics- system and surrounding-isolated, closed and open systems- state of the system- intensive and extensive variables. Thermodynamic process- reversible and irreversible, isothermal and adiabatic process- First law of thermodynamics- statement- definition of internal energy (E), enthalpy (H), applications of first law of thermodynamics.</td></tr>
<tr><td>Unit V</td><td colspan="3">Chemistry of Biomolecules</td></tr>
<tr><td colspan="4">a) Fats – Occurrence and composition. Hydrolysis of fats.

b) Vitamins – Source, provitamin, properties and classification. Structure and function of vitamin A, C, D, K and E

c) Hormones – Thyroxin, adrenaline and sex hormones (structure and functions only)</td></tr>
<tr><td>Text Books</td><td colspan="3">1.R. Gopalan, S. Sundaram, Allied Chemistry, Sultan Chand and Sons, 1995.</td></tr>
<tr><td>Reference Book</td><td colspan="3">1.U. Sathyanarayana, Biochemistry, Books and allied (p) Ltd, 1999.

2.B.R.Puri and L.R.Sharma, Principles of physical chemistry, ShobanLalNagin Chand and Co. 33rd ed., 1992.</td></tr>
<tr><td>Course out come</td><td colspan="3">Upon completion of this course, the students will be able to</td></tr>
<tr><td></td><td>CO</td><td>Course Outcomes</td><td>Knowledge Level</td></tr>
<tr><td></td><td>CO1</td><td>gain the knowledge on the handling of chemicals and errors in chemical analysis</td><td>K1</td></tr>
<tr><td></td><td>CO2</td><td>learn chemical bonding and hybridization</td><td>K2</td></tr>
</table>

	CO3	learn the calculations of preparing standard solutions	K2
	CO4	understand and appreciate the advanced concepts and rate equations in chemical kinetics.	K2
	CO5	calculate the change in thermodynamic properties, equilibrium constants, partial molar quantities, chemical potential	K3

Mapping of COs with POs & PSOs:

CO	PROGRAMME OUTCOMES (PO)								PROGRAMME SPECIFIC OUTCOMES (PSO)				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	M	M	S	S	M	S	M	M	M	S
CO2	S	M	S	S	M	S	S	S	S	S	S	S	S
CO3	S	S	M	S	S	M	S	S	S	S	M	M	M
CO4	M	S	S	S	S	M	M	S	M	S	S	M	S
CO5	S	M	S	S	S	S	S	M	S	S	S	S	M
CO5	S	S	S	S	S	S	S	M	S	M	S	S	M

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

Course Code	U21ZOE311	WILD LIFE BIOLOGY	L	T	P	C
Elective	I		4	-	-	3
Cognitive Level	K2:Understand K3:Apply K5:Analyse					
Learning objective	➢ To understand the Principles of wild life management ➢ To learn the technique of making survey in forest. ➢ To understand the importance of Biological food chain and its managements ➢ To learn the laws and ethics of wildlife act and also wild life organization ➢ To understand the animal behaviour in natural habitat.					
Unit I	**Introduction to Wild life:**					
Wild life -wealth of India and threatened wildlife- threats to survival of Red panda, Musk deer, and great Indian Bustard Olive Ridley turtle. Values of wildlife Principles of wild life management						
Unit II	**Wild life senses:**					
Wild life senses technique - objective direct and indirect methods with reference to Herpeto fauna, birds and mammal. Project Tiger Elephant & Snow.						
Unit III	**Wild life conservation:**					
Wild life conservation approaches and limitations management of rare and endangered species. Control and management of over abundant wild life population. Ecological monitoring and animal species and restoration programmes						
Unit IV	**Wild life laws ethics:**					
Wild life laws ethics, Wild life Protection Act in India. Endangered fauna, mammals, Birds and reptiles in India. Introduction to Organization- The World Conservation Union. (IUCN) World Wildlife Fund (WWF) Indian Board for Wildlife (IBWL).						
Unit V	**Animal behaviours:**					
Animal behaviours – Aggressive behaviour, Altruism- communication and signaling, mating behaviour social system of mammals. Insect socio- biology the man behaviours and its genitive traits						

Text Books	1. Arumugam NA and Natarajan P. Animal Behaviour – Ethology, Saras Publication Nagercoil,Tamilnadu, 2011. 2. Ridley M. Animal Behaviour - A concise Introduction , Blackwell Scientific Publications, Oxford. (2003).
Reference Books	1. David McFarland. Animal Behaviour, Pitman Publishing Limited, London, UK. 2001. 2. Manning A and Dawkins MS. An Introduction to Animal Behaviour, 6th edition, Cambridge University Press, UK. 2005. 3. Wallace R A. The Ecology and Evolution of Animal Behaviour, Goodyear Publishing Company Inc., Santa Monica, California. 1979
E-References	1. http://swayam.gov.in/nd1_noc20_bt04/ preview 2. http://nd1.iitkgp.ac.in
Course outcome	Upon completion of this course, the students will be able to

CO	**Course Outcomes**	**Knowledge Level**
CO1	values and apply the principles of wild life for wild life management	**K3**
CO2	improve the awareness of wild life senses	**K2**
CO3	gain the knowledge on wild life conservation approaches	**K2**
CO4	acquire the knowledge of ethics and wild life and apply for the protection of wild life	**K3**
CO5	analyse the Animal behaviors, Insect socio-biology and its genetic traits	**K5**

Mapping of COs with POs & PSOs:

CO	**PROGRAMME OUTCOMES (PO)**								**PROGRAMME SPECIFIC OUTCOMES(PSO)**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	M	S	S	S	S	S	S	M	S	S	M	S	M
CO2	S	S	M	S	S	S	S	M	S	M	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	M	S	S	S	S	S	S	S
CO5	M	S	S	S	S	M	S	M	S	S	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

Course Code	U21ZOE312	ANIMAL BEHAVIOUR	L	T	P	C
Elective	II		4	-	-	3
Cognitive Level	K1:Recall K2:Understand K3:Apply					
Learning objective	➢ To know about basic concepts of animal behaviour ➢ To understand the pattern of behaviour of animals ➢ To understand the importance of society and social insects ➢ To learn the sexual behaviour of animals ➢ To distinguish different type of biological rhythms.					
Unit I	**Introduction to Ethology:**					
Origin and history of Ethology : Brief Profiles of Karl 1 Von Frish, Ivan, Pavlov, Kornrad Lorenz, Nilco Tinbergen, Proximate and ultimate causes of behaviour. Methods and recording the behaviours.						
Unit II	**Stereotyped behaviors:**					
Stereotyped behaviors- Individual behaviours patterns. Instinct Vs. Learnt behavior Associative learning, classical and operant conditioning Habituation, Imprinting.						
Unit III	**Social Behaviors**					
Social Behaviors- concepts & society: communication and the senses Altruism: Insects Society with honey bee as example foraging in honey bee and advantages of the waggle dance.						
Unit IV	**Sexual behaviour**					
Sexual behaviour- Asymmetry of sex, sexual dimorphism, mate choice, intra, sexual selection, inter- sexual selection, sexual Conflict in parental care.						
Unit V	**Biological Rhythm :**					
Type and characters short and long term Rhythms: circadian rhythm, tidal rhythm lunar rhythms photoperiod and regulation seasonal reproduction in vertebrates						
Text Books	1. Dewsbur, D.A Comparative animal behavior. McGraw Hill Book Company. 2001. 2. Alcock, J. Animals Behaviour: An evolutionary approach. Sinauer Assoc., Sunderland, Mass. 2015.					

Reference Book	1. Bradbury, J,W., and S.L Vehrencamp. Principles and animals communication sinauer Assoc., Sunderland, Mass, USA.1999. 2. Eibl –Eibesfeldt, I.Ethology: the biology of behavior. Holt, Rinehart & Mc Graw Hill 16. 1970 3. Drickamer , L.C. S.H. Vessey and E.M. Jakob Animals Behavior. Mc Graw Hill. 2002.
E-references	1. http://nd1.iitkgp.ac.in/ 2. http://www.swayamprabha.gov.in/index.php/program/archive/9 3. http://www.mooc-list.com/tage/animals- behaviour 4. http://unaab.edu.ng/funaab-ocw/attachments/Animal%20Behaviour%201.pdf 5. https://www.ewingdigital.com/text_content/115885834145eafdbf6969b2.pdf
Course out come	Upon completion of this course, the students will be able to

CO	**Course Outcomes**	**Knowledge Level**
CO1	understand different type of animal behavior and its significance.	**K2**
CO2	get an insight to the students about the stereotyped behaviors	**K2**
CO3	know the social behaviour	**K2**
CO4	understand the sexual behavior	**K2**
CO5	understand the type and characters of short and long term rhythms: circadian rhythm,	**K2**

Mapping of COs with POs & PSOs:

CO	**PROGRAMME OUTCOMES (PO)**								**PROGRAMME SPECIFIC OUTCOMES (PSO)**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	M	S	M	S	S	S	M
CO2	S	M	S	S	S	M	M	S	M	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	M	S	M	S	M	S	S	S	M

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

Course Code	U21ZON3I1	PUBLIC HEALTH AND HYGIENE	L	T	P	C
NME	I		2	-	-	2
Cognitive Level	K1: Recall K2: Understand K3: Apply					
Learning objective	➢ To gain awareness on Public Health and Hygiene ➢ To create knowledge on Health Education and hazards. ➢ To identify the communicable diseases and their control measures ➢ To learn about non-Communicable diseases and their preventive measures ➢ To comprehend the health education of India					
Unit I	**Scope of Public health and Hygiene:**					
Scope of Public health and Hygiene – nutrition and health – classification of foods – Nutritional deficiencies - Vitamin deficiencies.						
Unit II	**Environment and Health hazards:**					
Environment and Health hazards – Environmental degradation – Pollution and associated health hazards.						
Unit III	**Communicable diseases:**					
Communicable diseases and their control measures such as Measles, Polio, Chikungunya, Rabies, Plauge, Leprosy, AIDS and Corona.						
Unit IV	**Non-Communicable diseases:**					
Non-Communicable diseases and their preventive measures such as Hypertension, Coronary Heart diseases, Stroke, Diabetes, Obesity and Mental ill-health.						
Unit V	**Health Education in India:**					
Health Education in India – WHO Programmes – Government and Voluntary Organizations and their health services – Precautions, First Aid and awareness on sporadic diseases.						
Text Books	1. Park and Park,: Text Book of Preventive and Social Medicine – Banarsidas Bhanot Publ. Jodhpur – India. 2010 2. Dubey, R.C and Maheswari, D.K.: Text Book of Microbiology – S. Chand & Co. Publ. New Delhi – India. 2007 3. Park, J.E. and Park, K. Textbook of Community Health for Nurses.2010					

Reference Books	1. Jatin V. Modi and Renjith S. Chawan. Essentials of Public Health and Sanitation –Part I- IV .Murray, C. J. L. and A.D. Lopez. The Global Burden Of Disease. World Health Organization.1996. 2. Verma, S. Medical Zoology, Rastogi publ. – Meerut – India .1998 3. Singh, H.S. and Rastogi, P. : Parasitology, Rastogi Publ. India.2009
E-Reference link	1. http://oms.bdu.ac.in/ec/admin/contents/316_16SNMEZO2_20200521043611 75.pdf 2. http://keralamarinelife.in/Journals/Vol21/03%20Madhumita%20Mukherjee.pdf 3. https://content.kopykitab.com/ebooks/2013/11/2328/sample/sample_2328.pdf
Course outcome	Upon completion of this course, the students will be able to

CO	**Course Outcomes**	**Knowledge Level**
CO1	communicate awareness on public health and Hygiene	**K3**
CO2	gather knowledge on health education and hazards.	**K2**
CO3	identify the communicable diseases and their control measures	**K3**
CO4	learn about non-Communicable diseases and their preventive measures	**K1**
CO5	Control communicable diseases by using appropriate disease control measures	**K3**

Mapping of COs with POs & PSOs:

CO	**Pos**								**PSOs**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	M	M	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S	S	M	S
CO3	S	S	S	S	S	S	S	M	S	M	S	S	S
CO4	S	S	S	S	S	S	M	S	S	S	S	S	M
CO5	S	S	S	S	S	M	S	S	S	M	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Code	U21ZON312	ORNAMENTAL FISH CULTURE	L	T	P	C
NME	II		2	-	-	2
Cognitive Level	K1: Recall K2: Understand K3: Apply K4: Evaluate					
Learning objective	➢ To know the importance and scope of ornamental fish culture ➢ To be familiar with popular ornamental fishes ➢ To learn the breeding behavior, feeding, Aquarium design and fish keeping techniques ➢ To acquire thorough knowledge on the common infections and treatment ➢ To become self employed citizen/ entrepreneur					
Unit I	**Scope of ornamental fish culture:**					
Importance and scope of ornamental fish culture – Economic potential, commercial and aesthetic value of ornamental fish culture, trends in ornamental fish farming in the world and in India. Taxonomy of important freshwater and marine ornamental fish of indigenous and exotic species.						
Unit II	**Popular ornamental fishes:**					
Beta, Colisa, Macropodus, Trichogaster leeri, T. italics microlepis, Zebra fish. Gold fish varieties: Koi, Puntius, tetra, Glass fish, cichilids, angel fish, molly, guppy. Marine species: Hippocampus, scat, Biology, habits and patterns of reproduction of Gold fish and Zebra fish.						
Unit III	**Fish farms:**					
Fish farms - mass production of fancy fishes, preparations for breeding – breeding behaviour of chosen fishes: carp, fighter fish – induced breeding – food and feeding – live feeds: rotifers, tubifex and artificial feeds.						
Unit IV	**Disease management:**					
Common bacterial, viral, fungal, protozoan and crustacean infections - treatment and control.						
Unit V	**Aquarium design, Construction and preparation:**					
Size, shape, substrate, ornamental aquatic plants. Construction and functions of Bio-filters; aerators – accessories for fish tanks – hood and 30 light, nets, suction tube and maintenance of water quality: controlling ammonia build up, pH, feeding regimes						
Text Books	1. Jameson, J.D. Alangara Meen Valarpu (in Tamil). National Book House, New Delhi. 2005.					

Reference Books	1. Baradach, JE, JH Ryther and WO Mc Larney. Aquaculture. The Farming and Husbandry of Freshwater and Marine Organisms. Wiley Interscience, New York. 1972. 2. Jameson, J.D. and R.Santhanam. Manual of ornamental fisheries and farming technology. Fisheries College and Research Institute, Thoothukudi. 1996. 3. Mitchell Beazley, The complete guide to tropical aquarium fish care. Read and Consumes Book Ltd., London. 1998.
E-Reference	http://oms.bdu.ac.in/ec/admin/contents/316_16SNMEZO2_2020052104361175.pdf http://keralamarinelife.in/Journals/Vol21/03%20Madhumita%20Mukherjee.pdf https://content.kopykitab.com/ebooks/2013/11/2328/sample/sample_2328.pdf
Course outcome	Upon completion of this course, the students will be able to

CO	**Course Outcomes**	**Knowledge Level**
CO1	know the importance and scope of ornamental fish culture	**K1**
CO2	list out the popular ornamental fishes and its marketing	**K2**
CO3	practice Aquarium fish culture	**K3**
CO4	identify the common infections disease of fish and management	**K3**
CO5	design aquarium to become potential entrepreneur	**K4**

Mapping of COs with POs &PSOs:

CO	**Pos**								**PSOs**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	M	S	S	S	S	M	S
CO2	S	S	S	S	S	S	S	M	S	S	S	M	S
CO3	S	S	S	S	S	S	S	M	S	M	S	S	S
CO4	S	S	S	S	S	S	M	S	S	S	S	S	M
CO5	S	S	S	S	S	M	S	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

SEMESTER IV

Course Code	U21ZOT41	CHORDATA	L	T	P	C
CORE	VI		4	-	-	4
Cognitive Level	K2:Understand K3:Apply					
Learning objective	➢ To understand the systemic and functional morphology of various forms of vertebrates ➢ To discuss the affinities and adaptations of chordates to different modes of life. ➢ To understand the origin and evolutionary relationship in different subphylum of chordates ➢ Make the student to enlighten the concept of diversity, adaptations, organization and taxonomic status of Chordates. ➢ Student can be able to Characteristics and Outline of Classification of Origin of Chordata.					
Unit I	**General characters and Classification of Chordata:**					
up to orders with a few examples Affinities and systematic position of cephalochordate, Hemichordates and Urochordata.						
Unit II	**Pisces:**					
Type Study: Shark -External morphology, Digestive System, Respiratory system, nervous, excretory and Reproductive system. General Topic: Accessory respiratory organs in Fishes						
Unit III	**Amphibia**					
Type Study: Frog- External morphology, Digestive System, Respiratory system,circulatory, nervous, excretory, Reproductive system and metamorphosis. General Topic: Parental care in Amphibia						
Unit IV	**Reptilia**					
Type Study: Calotes versicolor – External morphology, Digestive System, Respiratory, circulatory, nervous, excretory, pectoral and pelvic Girdle only General Topic: South Indian Poisonous and non- Poisonous snakes. Identification – Poison apparatus, biting mechanism, Nature of venom, first aid and treatment.						
Unit V	**Aves**					
Type study – Pigeon External morphology, Digestive System, Respiratory system, circulatory, nervous, excretory, exoskeleton and flight mechanism General Topic: Migration of birds **Mammalia:** Type Study – Rabbit External morphology, Digestive System, Respiratory system, circulatory,						

nervous, excretory, Reproductive system. General Topic: Dentition in Mammals, Adaptation of Aquatic mammals	
Text Books	1. T.N. Ranganathan .Chordata Zoology, Rainbow printers, Palayamkottai.1996.
References	1. A Manual of Zoology, volume II – Chordata. Parts I & II. M.Ekambatanatha Ayyar, T.N. Anantha Krishnan, S.Viswanathan (Printers and Publishers) Pvt.Ltd, Madras. 1992. 2. Chordate Zoology, Jordan E. L & Verma P. S., S. Chand & Company Ltd. 1998.
E-references	1.https://www.britannica.com/animal/chordate 2. https://www.uou.ac.in/sites/default/files/slm/BSCZO-201.pdf 3. http://assets.vmou.ac.in/MZO06.pdf 4. study-note-animal-kingdom-part-02-01%20(2).pdf
Course out come	Upon completion of this course, the students will be able to

CO	**Course Outcomes**	**Knowledge Level**
CO1	understand the General characters and classification of Chordata	**K2**
CO2	learn about the morphology, digestive System, respiratory system, nervous, excretory and reproductive system of shark	**K2**
CO3	know the parental care in amphibia	**K2**
CO4	understand the internal organ of Reptilia, differentiate and snake venom	**K3**
CO5	gather knowledge on migration of birds, dentition in mammals and adaptation of aquatic mammals	**K2**

Mapping of COs with POs & PSOs:

CO	**PROGRAMME OUTCOMES (PO)**								**PROGRAMME SPECIFICOUTCOMES (PSO)**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	M	S	M	M	N	S	S	S	S	S	M	S	S
CO2	S	M	S	S	M	M	M	S	M	M	S	S	S
CO3	M	S	S	S	M	S	S	S	S	S	S	M	M
CO4	S	S	S	M	M	S	M	S	M	M	M	S	S
CO5	S	M	M	S	S	S	M	M	S	S	M	N	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

Course Code	U21ZOP42	CHORDATA (Practical)	L	T	P	C
CORE	VII		-	-	4	4
Cognitive Level	K2:Understand K3:Apply					
Learning objective	➢ To learn the skills in mounting of scales and parasitic identification in pisces ➢ To develop practical knowledge on identification and classification of chordates ➢ To understand the systemic and functional Morphology of various groups of vertebrates ➢ To learn the biodiversity, habitat, adaptations organizations of chordates ➢ To interpret the affinities, evolutionary relationships and their economic importance					
	I. Mounting & identifications Placoid , Cycloid, Ctenoid, Ganoid scales of Pisces Two parasites identifications in any fish digestive tract. Mounting of Weberian ossicles Feathers identifications - Quill feather, down feathers **II. Diagram and description of** Frog and Calotes - Arterial System, venous system, Brain – dorsal and ventral view digestive and urinogenital system of Tilapia, Virtual dissection of brain and pituitary in frog **III. Draw and classify giving reasons:** Amphioxus, Ascidia, Balanglossus, Tornaria larva. Petromyzon Scoliodon, Trygon, Narcine, Clarias, Gambusia, Echeneis, Hippocampus (M Exocoetus, Anabas, Protopterus, Rana, Alytes, Hyla, Salamander, Ichthyophis, Axolotal larva Calotes, Draco, Varanus, Naja naja, Vipera russellii, Enhydrina, lycodon , C King fisher, Psittacula, Columba, Duck , Sparrow, Myna Ornithorhynchus, Rattus, Pteropus, Oryctolagus, Loris. Whale. Porpoise. **IV Draw labelled Diagram** **OSTEOLOGY** – Pigeon synsacrum, Frog and Rabbit- skull of frog. Pectoral and Pelvic girdle Bones of fore limb and hind limb **Dentition** –- Rabbit and Man					

A record of lab work should be maintained and submitted at the time of the practical examinations Study tour to different habitat for one day for species collection & exposing the students to ecosystem and animal farms is compulsory.

Text Books	1. Lal, S.S , A Text Book of Practical Zoology: Rastogi, Meerut.2014. 2. Arumugam N. A manual of Practical Chordates, Saras Publication, Nagercoil,2015
References Books	1. Verma PS.*Chordate Zoology*, S Chand Publishers, New Delhi, (2013).
Course out come	Upon completion of this course, the students will be able to

CO	**Course Outcomes**	**Knowledge Level**
CO1	practice the techniques of mounting and identifications of different cells and feathers	K2
CO2	identify the poisonous animals like snake	K3
CO3	analyse the various types of animal cells and Molecular structures with their characteristic features and detailed functions	K3
CO4	understand the techniques of various internal systems present in the chordates.	K2
CO5	gain the knowledge on the structure, functions of selected organisms through the observations of both living and preserved specimens.	K2

Mapping of COs with POs & PSOs:

CO	**PROGRAMME OUTCOMES (PO)**								**PROGRAMME SPECIFIC OUTCOMES(PSO)**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	M	S	S	S	M	S	S	S	S	S	M
CO2	S	S	M	S	S	S	M	S	S	S	S	S	S
CO3	S	S	S	M	S	S	S	M	S	M	S	M	S
CO4	S	S	S	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	M	S	S	M	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

<table>
<tr><td>Course Code</td><td>U21CHA44</td><td rowspan="2">CHEMISTRY (Practical)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>ALLIED</td><td>IV</td><td>-</td><td>-</td><td>4</td><td>4</td></tr>
<tr><td>Cognitive Level</td><td colspan="6">K1:Recall K2:Understand K3:Apply</td></tr>
<tr><td>Learning objective</td><td colspan="6">➢ To enable the students to acquire knowledge in Organic Estimation
➢ To understand basics and gain knowledge in organic analysis</td></tr>
<tr><td>Unit I</td><td colspan="6">Acidimetry and alkalimetry:Titration acids used: hydrochloric acid, sulphuric Standard solutions prepared: sodium carbonate, sodiumbicarbonate, oxalic acid.

Oxidation and reduction titration: Oxidising agents: Potassium permanganate (permanganimetry). Reducing agents: Ferrous sulphate, ferrous ammonium Sulphate, oxalic acid

Standard solutions prepared: Ferrous Sulphate, ferrous ammonium Sulphate and oxalic acid.

Iodometry titrations: titrations of liberated iodine against sodium thiosulphate using acidified potassium permanganate, potassium dichromate and copper Sulphate solutions.

Standard solutions: potassium dichromate, copper sulphate.</td></tr>
<tr><td>Text Books</td><td colspan="6">1.Sundaram, Krishnan, Raghavan, Practical Chemistry (Part II), S. Viswanathan Co. Pvt., 1996.
2. B.S. Furniss, A.J. Hannaford, P.W. G. Smith, A.R. Tatchell, Vogel’s Text Book of Practical Organic Chemistry. 5th Edn., Pearson Education, 2005.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1.N.S. Gnanapragasam and G. Ramamurthy, Organic Chemistry – Lab manual, S. Viswanathan Co. Pvt., 1998.
2. Practical Chemistry by A.O. Thomas, Scientific Book Centre, Cannanore, 2003.
3.Basic Principles of Practical Chemistry, V. Venkateswaran, R.Veeraswamy, A. R. Kulandaivelu, Sultan Chand & Sons, New Delhi, 2nd Edn., 2004.</td></tr>
<tr><td>Course out come</td><td colspan="6">Upon completion of this course, the students will be able to</td></tr>
<tr><td></td><td>CO</td><td colspan="3">Course Outcomes</td><td colspan="2">Knowledge Level</td></tr>
<tr><td></td><td>CO1</td><td colspan="3">understand the acidimetry and alkalimetry titrations</td><td colspan="2">K1</td></tr>
<tr><td></td><td>CO2</td><td colspan="3">learn titrations the concept of oxidation and reduction</td><td colspan="2">K2</td></tr>
</table>

	CO3	prepare the standard solutions for analysis	**K3**
	CO4	learn the calculations of molarity, molality and normality of the solutions	**K2**
	CO5	gain hands on skill in iodometry titrations	**K3**

Mapping of COs with POs & PSOs:

CO	**PROGRAMME OUTCOMES (PO)**								**PROGRAMME SPECIFIC OUTCOMES (PSO)**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	M	M	M	S	M	S	M	M	M	S
CO2	S	S	M	S	M	S	M	S	S	M	S	S	M
CO3	S	S	S	S	S	M	S	S	S	S	M	M	S
CO4	S	S	S	S	S	M	M	S	M	S	S	M	S
CO5	S	S	S	S	M	S	S	M	S	M	M	S	M
CO5	S	S	S	M	S	S	M	M	S	M	S	S	M

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

Course Code	U21ZOE411	ANIMAL HANDLING & GUIDELINES	L	T	P	C
Elective	II		3	-	-	3
Cognitive Level	K1:Recall K2:Understand K3:Apply					
Learning objectives	• To demonstrate competency in handling a variety of livestock and laboratory animal species. • To understand the importance of animal handling and ethical animal care					
Unit I	**Animal Handling and Restraining:**					
Animal Handling and Restraining – safe animal handling techniques for different animals and situations, Working safely with animals,Sanitation and cleanliness- Injection and Biopsy collection , briefing about setting up breeding cage and weaning. Emergency situations: such as animal escapes, animal chokes						
Unit II	**Animal Safety:**					
Procedure room usage SOP- Biosafety Cabinet- Anesthesia Setup- Euthanasia Setup and Animal discard bin, Procedure Room trolley- First Aid Kit and emergency situations -Animal bites, Needle prick and Inj. Splash.						
Unit IV	**Animal care:**					
Animal care and technical personnel, physical relationship of animal facilities to laboratories, Parasites and Pests of Companion Animals - Common Diagnostic and Therapeutic Procedures and Terms. Emergency exit plan (natural calamities/ fire accidents/or any other)						
Unit IV	**Animal Breeding:**					
Mice, Rats, Rabbits-Breeds-uses- Behaviour-Anatomical and physiological features-Breeding and reproduction-husbandry-techniques						
Unit V	**Guidelines:**					
In-vivo Animal Handling Guidelines for Handling of animal, CPCSEA Guidelines, Maintenance of animal, Animal house, Laboratory, Administration of drugs, Routes of administration, dissection procedures, Safety procedures. Toxicity & Research- Guidelines for toxicity-cytotoxicity -Ethical clearance -ethical issues						
Text Books	Animal Handling and Physical Restraint, ISBN 9780367028329, CRC Press-2019.					
Reference Books	1. Livestock Management (LSM) Vocational Higher Secondary Education (VHSE) , State Council of Educational Research and Training (SCERT), KERALA 2016. 2. The Animals (Scientific Procedures) Act (Amendment) Order 1993". August 23, 1993. Retrieved February 22, 2013. 3. National Research Council,Guide for the Care and Use of Laboratory Animals, Publisher National Academic Press,2010 4. Karen Hrapkiewicz, Lesley A. Colby, Patricia Denison.A Clinical Laboratory Animal Medicine: An Introduction, Publisher Wiley–Blackwell,2013					

E-Reference	https://scert.kerala.gov.in/wp-content/uploads/2020/06/13-live%20stock%20management.pdf
Course outcome	Upon completion of this course, the students will be able to

CO	Course Outcomes	Knowledge Level
CO1	learn the animal handling skill	**K1**
CO2	know the SOP of animal handling and safety	**K2**
CO3	understand and practice the safe animal transport	**K3**
CO4	know about the handling of animal during natural calamities, common diagnostic procedure	**K2**
CO5	gain knowledge about CPCSEA guidelines	**K2**

Mapping of COs with POs & PSOs:

CO	PROGRAMME OUTCOMES (PO)								PROGRAMME SPECIFIC OUTCOMES (PSO)				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	M	S	S	S	S	M	S	M	S	M	S	M
CO2	M	S	S	S	S	S	S	S	S	M	S	S	S
CO3	S	S	M	S	S	M	S	M	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	M	S	S	M	S	M	S	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

Course Code	U21ZOE412	INSECT VECTORS AND DISEASES	L	T	P	C
Elective	II		3	-	-	3
Cognitive Level	K1:Recall K2:Understand K3:Apply					
Learning objectives	• To comprehend the various insect vectors and disease spreading mechanism • To learn the various diseases caused by the insect vector and its control measures					
Unit I	**Introduction to Insects:**					
General Features of Insects, Morphological features, Head – Eyes, Types of antennae, Mouth parts - feeding habits						
Unit II	**Concept of Vectors:**					
Concept of Vectors - Brief introduction of Carrier and Vectors (mechanical and biological vector),Reservoirs, Host-vector relationship, Vectorial capacity, Adaptations as vectors, Host Specificity						
Unit III	**Insects as Vectors:**					
Insects as Vectors - Classification of insects up to orders, detailed features of orders with insects as vectors – Diptera, Siphonaptera, Siphunculata, Hemiptera- Dipteran as Disease Vectors - Dipterans as important insect vectors – Mosquitoes, Sand fly, Houseflies						
Unit IV	**Study of mosquito:**					
Study of mosquito-borne diseases – Malaria, Dengue, Chikungunya, Viral encephalitis, Filariasis; Control of mosquitoes Study of sand fly-borne diseases –Visceral Leishmaniasis, Cutaneous Leishmaniasis, Phlebotomus fever; Control of Sand fly Study of house fly as important mechanical vector, Myiasis, Control of house fly.						
Unit V	**Siphonaptera:**					
Siphonaptera as Disease Vectors Fleas as important insect vectors; Host-specificity, Study of Flea-borne diseases Plague, Typhus fever; Control of fleas - Siphunculata as Disease Vectors-Human louse (Head, Body and Pubic louse) as important insect vectors; Study of louse-borne diseases – Typhus fever, Relapsing fever.						
Text Books	1. Imms, A.D. . A General Text Book of Entomology. Chapman & Hall, UK.1977. 2. Chapman, R.F. . The Insects: Structure and Function. IV Edition, Cambridge University Press, UK.1998					

Reference Books	1. Pedigo L.P. Entomology and Pest Management. Prentice Hall Publication.2002. 2. Mathews, G. Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases. Wiley-Blackwell-2011
E-Reference	https://www.who.int/tdr/diseases-topics/vectors/en/#:~:text=Mosquitoes%20are%20the%20best%20known,%2C%20Chikungunya%2C%20Rift%20Valley%20fever.
Course outcome	Upon completion of this course, the students will be able to

	CO	**Course Outcomes**	**Knowledge Level**
	CO1	understand the general features of insects	**K1**
	CO2	know the concept of vectors	**K2**
	CO3	classify the insects vectors	**K3**
	CO4	know about mosquito borne diseases	**K2**
	CO5	gain knowledge about Siphonaptera as Disease Vectors	**K2**

Mapping of COs with POs & PSOs:

CO	**PROGRAMME OUTCOMES (PO)**								**PROGRAMME SPECIFIC OUTCOMES (PSO)**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	M	S	S	S	S	M	S	M	S	M	S	M
CO2	S	S	S	S	S	S	S	S	S	M	S	S	S
CO3	S	S	M	S	M	M	S	M	S	S	S	M	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	M	S	S	M	S	M	S	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

Course Code	U21ZON421	VERMICOMPOSTING	L	T	P	C
NME	I		2	-	-	2
Cognitive Level	K1: Recall K2: Understand K3: Apply K5: Analyse					
Learning objective	➢ To get the thorough knowledge on making vermicompost and vermiculture. ➢ To learn about South Indian and North Indian species used in Vermicomposting and Culture techniques of earthworms ➢ To study the vermicompost production ➢ To encourage the self employment practice and save the human being by the way of minimizing the use of chemical fertilizers. ➢ To understand the interaction of earthworms with other organisms					
Unit I	**Taxonomy of Earthworm:**					
Earthworm taxonomy – Morphological and anatomical – Classification of earthworms – Food habits – Digestive system – Excretion – Reproduction and Life cycle – Earthworm as farmer‟s friend.						
Unit II	**Types of earthworm:**					
Types of earthworm – Exotic and native species – South Indian and North Indian species used in Vermicomposting – Collection and Preservation of earthworms for vermicomposting – Culture techniques of earthworms						
Unit III	**Vermicompost production:**					
Vermicompost production – Requirements – Different methods of Vermicomposting – Heap method – Pot method and Tray method – changes during Vemicomposting.						
Unit IV	**Role of Earthworms in soil fertility:**					
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.						
Unit 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						

<table>
<tr><td>Text Books</td><td>1. Sreenivasan Ettammal, Handbook of Vermicomposting Technology the Western India technology, Council for Advancement of People's Action and Rural Technology, New Delhi, India. 40 pp. 1997.
2. Vermicology: The Biology of Earthworms, (Ismail, S.A.) Orient Longman. 92pp. 1997.
3. Ismail, S.A Mannpuzhu: Valarppum, Tozhilnutpamum, Payankalum. Orient Longman. 115pp. 2001.
4. Alvares,C., Shiva,V., Ismail, S.A., Vijayalakshmi, K., Mathen, K., and Declercq, B The Organic Farming Reader, ARISE and Other India Press, India. 1999. 298 pp.
5. Ismail, S.A The Earthworm Book, Other India Press, Goa. 2005.</td></tr>
<tr><td>Reference Books</td><td>1. Talashilkar.S.C. and A A K Dosani, Earthworms in Agriculture ISBN 10: 8177542494 / ISBN 13: 9788177542493, Agrobios, Jodhpur, 2005
2. S.C. Talashikar and Dosani, Earthworm in Agriculture –, Agrobios Publications, Near Nasarani Cinema, Jodhpur, 342 002. 2010.
3. Ismail. SA , "Vermicology: Biology of Earthworms", Orient Longman Ltd, Chennai, India. 1997.Hall Publication.</td></tr>
<tr><td>E-Reference</td><td>1. https://clarkcountycomposts.org/images/class_3_-_red_worm_composting.pdf
2. https://www.free-ebooks.net/academic-science/Handbook-of-Vermicomposting/pdf?dl&preview
3. file:///C:/Users/ACER/Downloads/5c55d33672e19.pdf
4. https://www.uvm.edu/sites/default/files/Extension-Master-Gardener/compostingwithworms.pdf
5. https://ag.tennessee.edu/EPP/Redbook/Apiculture%20(Beekeeping).pdf
6. https://drive.google.com/file/d/1rpz8Qhqyy6UoOOVpLjIVDZP3ZXqjNBte/view
7. http://studymaterial.unipune.ac.in:8080/jspui/bitstream/123456789/7420/1/Apiculture.pdf</td></tr>
<tr><td>Course outcome</td><td>Upon completion of this course, the students will be able to</td></tr>
</table>

	CO	Course Outcomes	Knowledge Level
	CO1	gain knowledge about taxonomy of earthworms	**K2**
	CO2	know the types of earthworms and species used in vermicomposting	**K2**
	CO3	understand and analyse the different methods of vermicomposting	**K3**
	CO4	apply the knowledge on earthworms in soil fertility.	**K5**
	CO5	gather information about influence of chemical inputs on earthworm activities and Large scale manufacture of Vermicompost	**K1,K2**

Mapping of COs with POs &PSOs:

CO	Pos								PSOs				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	M	M	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S	S	M	S
CO3	S	S	S	S	S	S	S	M	S	M	S	S	S
CO4	S	S	S	S	S	S	M	S	S	S	S	S	M
CO5	S	S	S	S	S	M	S	S	S	M	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Code	U21ZON422	APICULTURE	L	T	P	C
NME	II		2	-	-	2
Cognitive Level	K2:Understand K3:Apply					
Learning objective	➢ To gain knowledge about the honey bees, its life style and social behaviour. ➢ To learn apiculture, and recognize the list of honey bees ➢ To know the economic importance of bee products ➢ To understand the biological features of honey bee and economic importance and get self employment.					
Unit I	**Introduction to Apiculture**					
Introduction to Apiculture – Scope of Apiculture. Honey bee – Classification, types of honey bees – *Apis dorsata, Apis florae, Apis indica* and Dammer bee, Bee colony- function of members – Different kinds of cells, Bee hive and its architecture, communication in bees.						
Unit II	**Bee colony**					
Bee colony- function of members – Different kinds of cells, Bee hive and its architecture, communication in bees.						
Unit III	**Apis indica**					
Apis indica – social life in Indian honey bee. Morphology of Queen, Drones and Workers.						
Unit IV	**Bee keeping**					
Bee keeping – methods of bee keeping in India – Primitive hives – wall type, movable type, bamboo hive. Modern hives – longs troth frame hive, Newtons hive. Appliances use in bee keeping.						
Unit V	**Economic importance of bee products**					
Economic importance of bee products – chemical composition, Nutritive value and medicinal uses of honey, bee wax, bee venom and disease of honey bees.						
Text Book	1. Dr. N. Arumugam, Applied Zoology Saras Publication, Nagerkovil, 2014. 2. Ravindranathan. K. R, A text book of Economic Zoology Dominant Publishers and distributors, New Delhi.2005.					

Reference Book	1. M. S. Nalina sundari, Entomology M. J. P Publications, Chennai, 2006. 2. Sharma P.L & Singh S. Hand book of Bee Keeping, Agrobius Publ, India, 2001. 3. Ravindranathan K. R. A text book of Economic Zoology. Dominent Publishing & distributors, New Delhi, 2005
E-references	1.http:// www.fao.org>docrep>pdf 2.http:// www.uaex.edu>special-programs>bee keeping
Course out come	**Upon completion of this course, the students will be able to**

CO	**Course Outcomes**	**Knowledge Level**
CO1	comprehend the scope of apiculture and honey bees classification	**K2**
CO2	learn bee colony and different kinds of cells	**K2**
CO3	acquire the knowledge Apis indica and morphology of queen, drones and workers	**K2**
CO4	understand biological features of bee keeping	**K2**
CO5	know the nutritive value and economic importance to become potential entrepreneur	**K3**

Mapping of COs with POs & PSOs:

CO	**PO**								**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	M	S	S	S	M	S	S	S	M	S	S	M	M
CO2	S	S	S	M	S	S	M	S	S	M	M	S	S
CO3	S	S	M	S	S	S	S	S	S	M	S	S	M
CO4	S	S	S	S	S	S	S	S	M	M	S	S	M
CO5	S	S	M	S	S	S	M	S	S	M	S	S	M

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

SEMESTER-V

Course Code	U21ZOT51	FUNDAMENTALS OF ANIMAL PHYSIOLOGY	L	T	P	C
CORE	VIII		5	-	-	4
Cognitive Level	K1:Recall K2:Understand K4:Evaluate					
Learning objective	➢ To learn the digestion, respiration and circulatory system ➢ To study the structure and function of internal organs ➢ To know the excretory mechanism and its significance ➢ To get knowledge about the nerve, muscle and receptors of human body. ➢ To aware of hormonal roles in reproductive process.					
Unit I	**Physiology of Digestion**					
Structural organization and functions of gastrointestinal tract Mechanical and chemical digestion of food; Absorptions of food Hormonal control of secretion of enzymes in Gastrointestinal tract.						
Unit II	**Respiration Circulation**					
Respiration – Types of respiratory organs – Respiratory pigments – transport and exchange of gases control of respiration – biological oxidation anaerobiosis respiratory quotient. Structure and function of human Heart, haemodynamics, ECG, Blood pressure						
Unit III	**Excretion:**					
Structure of kidney and its functional unit; Mechanism of urine formation; 10 Regulation of water balance; Regulation of acid-base balance. Origin and Types of Nitrogenous wastes – Ammonotelism, Ureotelism and Uricotelism						
Unit IV	**Receptors and effectors:**					
Structure of neuron, resting membrane potential, conduction of action potential across the myelinated and unmyelinated nerve fibers; Types of synapse, Synaptic transmission and, Neuromuscular junction; Reflex action and its types - reflex arc. Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit, summation and tetanus						
Unit V	**Endocrine System and Reproductive Physiology:**					
Types of endocrine glands – pituitary, thyroid, parathyroid, adrenal and sex glands – their secretions and physiological role, Human reproductive cycle and the role of hormones.						
References	1. Text Book of Medical Physiology, Elsevier Inc. Hall, J.E., 2013,					

Text Books	1. Animal Physiology- P.S Verma, B.S.Tyagi, V.K. Agarwal, II edt, 1978, S.Chand & Company Ltd. Ram Nagar, New Delhi – 110 055. 2.General comparative physiology by Hoar, S. William, 3rd edt, 1987, Prentice Hall of India Pvt. Ltd. New Delhi, 18 BN-0-87692-337-6.
E-References	Animal Physiology : https://www.classcentral.com/course/swayam-animal-physiology-12894 Animal Physiology : https://swayam.gov.in/nd1_noc20_bt42/preview Respiration in the Human Body: https://www.classcentral.com/course/edx-respiration-in-the-human-body-3050
Course out come	Upon completion of this course, the students can able to

CO	**Course Outcomes**	**Knowledge Level**
CO1	know the physiological process of digestion respiration and circulation and diseases associated with them.	**K1**
CO2	attain knowledge on respiratory organ and blood circulation systems	**K2**
CO3	comprehend he structure and function of of excretory system	**K4**
CO4	interpret the association between the nerve coordination and muscle physiology.	**K4**
CO5	gain a deep knowledge on endocrine and reproductive system	**K2**

Mapping of COs with POs & PSOs:

CO	**PROGRAMME OUTCOMES (PO)**								**PROGRAMME SPECIFIC OUTCOMES (PSO)**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	M	S	M	S	S	S	S	M	M	S	S	M
CO2	S	S	S	M	S	S	S	S	S	M	S	S	S
CO3	S	S	S	S	S	S	S	S	M	M	S	S	S
CO4	S	S	S	S	S	S	S	S	M	M	S	S	S
CO5	S	S	S	M	S	S	M	S	S	M	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

Course Code	U21ZOT52	GENETICS & BIOSTATISTICS	L	T	P	C
CORE	IX		5	-	-	4
Cognitive Level	K1:Recall K2:Understand K3:Apply					
Learning objective	➢ To study the basic concept of gene interaction ➢ To learn sex chromosome, syndromes and gene transformation ➢ To get thorough knowledge on gene transformation ➢ To know the biological data collection, tabulation and sampling methods ➢ To acquire the knowledge of biological data and statistical tool for excellent presentation					
Unit I	**Mendel's Experiments:**					
Mendel's Experiments. Interaction of genes -- Epistasis, Complementary and supplementary. Multiple alleles – Blood groups - inheritance. Polygenic inheritance – Inheritance of skin colour.						
Unit II	**Linkage & Crossing over in Drosophila:**					
Linkage & Crossing over in Drosophila. Chromosomal maps. Sex chromosomes and sex chromatins Sex determination in Man Sex linked inheritance, sex influenced genes and sex limited genes. Extra – chromosomal inheritance.						
Unit III	**Bacterial transformation**					
Bacterial transformation – Conjugation -- Transduction – Gene regulation – Genetic Code Bacteriophages – Structure and Replication.						
Unit IV	**Population Genetics**					
Population Genetics – Hardy Weinberg law. Syndromes: Down, Klinefelter, Turner. Inbreeding, Out breeding and Heterosis. Eugenics, Euthenics and Genetic Counselling.						
Unit V	**Statistical Methods**					
Statistical Methods- Collection of data; Sampling methods, presentation of data; Frequency analysis, parts of a table frequency distribution. frequency polygon, frequency polycurve, Histogram, bar charts, pie diagrams.– Chi square analysis. Probability. Analysis of data; measure of central value calculation of mean, mode, median, standard deviation and standard error. Coefficient of Variation.						
Text Books	1.Genetics by P.K. Gupta, Rastogi Publications, 3rd edt, ISBN-81-7133-842-9, Meerut ,. 2015 2.Ramakrishnan P. Biostatistics ,Saras Publication Nagercoil, Tamilnadu. 2015.					

References Books	1. Gardner Eldon, J., D. Peter Snustad**.** . Principles of Genetics, 8th Edition. John Wiley & Sons.2012. 2. Genetics by Verma P.S. and Agarwal V.K., revised edt, ISBN-81-219-3114-2. S. Chand & Co. New Delhi –2010, 3. Primrose SB and Twyman R. Principles of Gene Manipulation and Genomics, John Wiley & Sons, London, UK. 2006 4. Pandey M. Biostatistics Basic and Advanced, Publishers Viva Books, New Delhi .2015.
E-references	1. http://www.maths.lth.se/matstat/kurser/statgen/book/StatisticsInGenetics-20031125.pdf 2. http://www.bionica.info/biblioteca/AnonimoxxxIntroductionMolecularGenetics.pdf
Course out come	Upon completion of this course, the students will be able to

CO	Course Outcomes	Knowledge Level
CO1	know the basic concepts of genetics, multiple alleles and polygenic inheritance	**K1**
CO2	acquire thorough knowledge on linkage & crossing over in Drosophila	**K2**
CO3	learn the types and mechanism bacterial transformation	**K2**
CO4	know the population genetics, Eugenics, Euthenics and Genetic counseling.	**K2**
CO5	understand the hypothesis testing, significance of correlation and application of this tool in biology.	**K3**

Mapping of COs with POs & PSOs:

CO	PROGRAMME OUTCOMES (PO)								PROGRAMME SPECIFIC OUTCOMES (PSO)				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	M	S	S	S	S	M	S	M	S	M	S	M
CO2	M	S	S	S	S	S	S	S	S	M	S	S	S
CO3	S	S	M	S	S	M	S	M	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	M	S	S	M	S	M	S	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

Course Code	U21ZOT53	BASICS BIOCHEMISTRY	L	T	P	C
CORE	X		5	-	-	4
Cognitive Level	K2:Understand K3:Apply					
Learning objective	➢ To know the structure and properties of biomolecules. ➢ To understand the role of carbohydrates, Protein and lipids ➢ To study the different metabolic cycles ➢ To know the importance of enzymes, vitamins ➢ To understand the role of nucleic acids & vitamins					
Unit I	**Introduction to Biomolecules:**					
Bimolecules - Introduction and bonding –Strong and weak bonds– pH and buffers. Acid-Base balance,Buffer concept and significance– Henderson – Hassel Bach equation. Metabolism- Anabplism, catabolism.						
Unit II	**Carbohydrates**					
Carbohydrates – Classification structure, Biological importance, carbohydrate metabolism – Glycolysis, TCA, Cycle, Glycogenesis, glycogenolysis gluconeogenesis, HMP Shunt pathway						
Unit III	**Amino acids:**					
Structure and properties of Amino acids – Zwitterions. Protein classification. Properties and importance's – Level of Organization – Primary, Secondary, Ramachandran Plot, tertiary and quaternary structure of protein						
Unit IV	**Lipids**					
Classification, properties and biological importance, Biosynthesis of cholesterol and B-Oxidation of lipids. Enzymes- Classification and mechanism of action, Factors affecting enzyme action, enzyme inhibition						
Unit V	**Nucleic acids**					
Nucleoproteins & nucleosides, Nucleotides, chemical structure of DNA & RNA Their importance Role of Vitamins in biological system.						

Text Books	1. Ambika Shanmugam, Fundamentals of Biochemistry for Medical students, Published by the Author, Madras. 2012, 2. Rastogi, S.C. Biochemistry, 3rd Edition Tata Mc Graw Hill Edition, New Delhi. 2010.
Reference Books	1. Harpers Illustrated Biochemistry, 30th Edition The McGraw- Hill Education,2011. 2. Nelson, D.L., Leninger, A.L. and Cox, M.M.., Lehninger Principles of Biochemistry, W.H. Freeman Co.,2012. 3. Deb, AC. Fundamental of Biochemistry, 10th Edition New Central Book Agency. Pvt.Ltd ,Kolkata, 2011.
E-References	1. http://swayam.gov.in / nd1.noc19_bt19/preview 2. http://www.swayam.gov.in/nd1_noc20_bt11/ Preview 3. http://ndl.iitkgp.ac.in/
Course out come	Upon completion of this course, the students will be able to

CO	Course Outcomes	Knowledge Level
CO1	gain basic knowledge on biomolecules	**K2**
CO2	understand the biological importance and metabolism of carbohydrate	**K2**
CO3	get thorough knowledge on the metabolism and importance of aminoacids	**K2**
CO4	know the classification, properties and biological importance of lipids	**K2**
CO5	illustrate the structure of DNA & RNA their importance	**K3**

Mapping of COs with POs & PSOs

CO	PROGRAMME OUTCOMES (PO)								PROGRAMME SPECIFIC OUTCOMES(PSO)				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	M	M	M	S	M	S	S	M	M
CO2	S	S	S	S	S	S	M	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	M	S	S	S	S
CO5	S	S	S	S	S	S	M	S	M	S	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

Course Code	U21ZOT54	FUNDAMENTAL CONCEPTS OF DEVELOPMENTAL BIOLOGY	L	T	P	C
CORE	XI		5	-	-	4
Cognitive Level	K2:Understand K3:Apply					
Learning objective	➢ To know the various stages involved in the embryo development ➢ To study the process of fertilization and its development like organogenesis ➢ To enlighten about the embryo formation and development ➢ To learn the organogenesis process of C.elegans ➢ To understand the teratogenesis and stem cell therapy					
Unit I	**Introduction to Developmental Biology:**					
Definition, History of Developmental Biology - Theories of Preformation – epigenesis – Von Baer's law and biogenetic theory. Gametogenesis – Spermatogenesis and Oogenesis. Structure of egg and sperm of Amphioxus, frog, Chick and rabbit.						
Unit II	**Fertilization:**					
Fertilization, Physicochemical, Cytological and Biochemical aspects of fertilization, Cleavage and its pattern in Vertebrates; Morula – Types of blastula. Gastrulation morphogenetic, Movements – Neurula. Organogenesis – Development of heart, brain, and eye in chick.						
Unit III	**Embryonic adaptation:**					
Foetal membranes in Chick – placenta in mammals. Experimental embryology: Organizer Concept – field and gradients - amphibian metamorphosis and its hormonal. Control. Regeneration in planarians and Amphibian.						
Unit IV	**Late Development in invertebrate /vertebrate models** :					
Organogenesis- development of ectodermal organs, mesodermal organs, endodermal organs, vulval formation in C.elegans						
Unit V	**Medical implications:**					
Germ cell specification& migration , Medical implications of developmental biology - genetic errors/ teratogenesis/ stem cell therapy etc						
Text Book	1. Developmental Biology - Arumugam N. Saras Publicaion – kottar. 2007. 2. Modern Experimental Zoology by Preeti Guptha and Mridula Chaturvedi. 2000.					

References	1. Modern Experimental Zoology by Preeti Guptha and Mridula Chaturvedi. 2010. 2. An introduction to embryology, – Balinsky B.I- W.B.Saunders Co.., Philadelphia, 2008 3. Strickberger, Evolution, Jones and Barlett Publishers Inc., London, 2010.
E-References	1. https://mobot-biodiversity-jc.weebly.com/uploads/1/8/6/0/18603232/the_evolutionary_biology_of_species_by_t_g_barraclough_2019.pdf 2. http://bgc.org.in/pdf/study-material/developmental-biology-7th-ed-sf-gilbert.pdf 3. https://www.blackwellpublishing.com/ridley/EVOC20.pdf
Course out come	Upon completion of this course, the students will be able to

CO	**Course Outcomes**	**Knowledge Level**
CO1	understand the history of developmental biology and gametogenesis, spermatogenesis and oogenesis process	**K2**
CO2	learn the fertilization, physicochemical, cytological and biochemical aspects of fertilization, cleavage and its pattern in vertebrates	**K2**
CO3	illustrate the process of embryonic adaptation	**K3**
CO4	know the organogenesis process of C.elegans	**K2**
CO5	Gain knowledge on teratogenesis and stem cell therapy	**K2**

Mapping of COs with POs & PSOs:

CO	**PROGRAMME OUTCOMES (PO)**								**PROGRAMME SPECIFIC OUTCOMES (PSO)**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	M	S	S	S	S	M
CO2	S	S	M	S	S	S	S	M	S	S	S	S	S
CO3	S	S	M	S	S	S	M	M	S	S	S	S	S
CO4	S	M	M	M	S	S	S	S	S	S	S	S	S
CO5	S	S	M	S	S	S	S	M	S	S	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

Course Code	U21ZOP55	ANIMAL PHYSIOLOGY, DEVELOPMENTAL BIOLOGY, GENETICS & BIOSTATISTICS AND BASICS BIOCHEMISTRY(Practical)	L	T	P	C
CORE	XII		-	-	5	4
Cognitive Level	K2:Understand K3:Apply					
Learning objective	➢ To understand various stages involved in cell division ➢ To observe and learn the structure of Giant chromosomes ➢ To gain knowledge about different stages of frog embryo ➢ To learn the significance of living fossils ➢ To understand mendelian genetics and statistical tool					

ANIMAL PHYSIOLOGY

Mounting Estimation and Observations

- Preparation of human blood smear
- ABO blood grouping
- Counting of different types of blood cells using haemocytometer - Demonstration of. W.B.C. & R.B.C. count
- Differential leukocyte count
- **Blood** Analysis – Hb Estimation (Sahli's Sethod)
- Use of Kymograph unit,
- Demonstration of blood pressure in Sphygmomanometer. , Respirometer.
- Survey of Digestive enzymes in cockroach.
- Estimations of excretory products of fish, bird and mammal and detections of ammonia, urea and uric acid.
- Urine Analysis – Detections of Albumins, Sugar and Deposits.
- Observations & Study of mantoux test, widal test

DEVELOPMENTAL BIOLOGY:

1. Chick blastoderm mounting
2. Observation of chick blastoderm
   i. 24 hrs ii. 72 hrs iii.. 96 hrs
3. Placental types – Diffuse, Cotyledonary, Discoidal and Zonary

EVOLUTION

1.Variation – Finger Prints.

2 .Vestigial Organ.

3.Examples of evolutionary significance of Peripatus, Limulus and Archaeopteryx.

Animals with adaptive colouration. (Stick insect & Chamaeleon).

<table>
<tr><td></td><td colspan="3">GENETICS AND BIOSTATISTICS:

1. Observation and record of simple mendelian traits
2. Pedigree analysis – chart preparation
3. Problems based on gene frequency – Hardy Weinberg Law
4. Calculation of mean, mode, median, variance and standard deviation Using leaves
5. Problems related to Student T test, Chi Square test

BIOCHEMISTRY
1.Qualitative analysis of Carbohydrate, lipid and protein
2. Protein estimation by Lowry methods
3. DNA estimation
4. Separation techniques-Circular paper chromatography

A record of lab work should be maintained and submitted at the time of the practical examination.
Study tour to the minimum of 1 day duration to be conducted compulsory.</td></tr>
<tr><td>Text Books</td><td colspan="3">1. Lal, S.S, A Text Book of Practical Zoology: Rastogi, Meerut.2014.
2. Verma, PS.A Manual of Practical Zoology-third volume S Chand Publications, New Delhi. 2010,
3. Rajamanickam, C. Experimental protocols in basic molecular biology, Osho Scientific Publications, Madurai. 2001</td></tr>
<tr><td>Reference Books</td><td colspan="3">1. Nigam and A.Ayyagai Lab Manual in Biochemistry, Immunology and Biotechnology. Tata McGraw- Hill Publication, New Delhi, 2007.
2. Zar, J.H. Biostatistical Analysis, Low Price Edition Pearson Education, India, 2008.</td></tr>
<tr><td>E-References</td><td colspan="3">1. http:// www.ecoursesonline.iasri.res.in
2. http:// www.onlinelibrary.wiley.com</td></tr>
<tr><td>Course out come</td><td colspan="3">Upon completion of this course, the students will be able to</td></tr>
<tr><td></td><td>CO</td><td>Course Outcomes</td><td>Knowledge Level</td></tr>
<tr><td></td><td>CO1</td><td>analyse the various stages of cell divisions</td><td>K5</td></tr>
<tr><td></td><td>CO2</td><td>understand the various stages of embryo development</td><td>K2</td></tr>
<tr><td></td><td>CO3</td><td>learn and interpret the development and evolution process</td><td>K3</td></tr>
<tr><td></td><td>CO4</td><td>develop skill in observing, analyzing and calculating various biological data</td><td>K3</td></tr>
<tr><td></td><td>CO5</td><td>gain knowledge on Mendelian characters, probability tests and Biostatistical calculation</td><td>K3</td></tr>
</table>

Mapping of COs with POs & PSOs:

CO	PROGRAMME OUTCOMES (PO)								PROGRAMME SPECIFIC OUTCOMES (PSO)				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	M	S	S	S	S	M
CO2	S	M	S	S	M	S	S	M	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	M	M	S	S	S	S	S	S	M	S	M	S
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

Course Code	U21ZOE521	CANCER BIOLOGY	L	T	P	C
Elective	III		3	-	-	3
Cognitive Level	K1:Recall K2:Understand K3:Apply					
Learning objective	➢ To distinguish normal cell and cancer cell. ➢ To understand the various methods of diagnosis of cancer ➢ To obtain the knowledge of staging the cancer cells ➢ To know about different types of cancer ➢ To obtain the knowledge about treatments for cancer.					
UNIT – I	Cancer Cell:					
Properties of normal cell and cancer cell, benign tumor and malignant tumor. Type of cancer common symptoms, causative factors Definition of primary and secondary cancer.						
UNIT – II	Diagnosis of cancer:					
Classification and diagnosis of cancer by tissue type - Solid tumor, Histopathological diagnosis. Immunohistochemistry Hematological malignancies, morphological diagnosis Biopsy its types. Clinical examinations.						
UNIT – III	Cancer classification:					
TNM classification Purpose types of staging. TNM System, Stage grouping. Factors affecting the stage and staging system.						
UNIT – IV	Sporadic cancers:					
Sporadic cancers, hereditary cancers, examples of cancer susceptibility syndromes, Immune suppression related malignancies, transplantation related malignancies.						
UNIT –V	Cancer treatments-					
Surgery and its types, Radiation, Chemotherapy, Biological therapy, Hormone therapy, transplantation. Targeted therapy, Gene therapy and other treatment methods						
Text Books	1. Renganathan, T.S.. A text book of Human Anatomy. VI edn. S. Chand and Company Ltd., New Delhi. 2002 2. Robert A. Weinberg.(Author), Roberts A Weinberg (Author).The Biology of cancer, 2nd Edition 2nd Edition,2005					

Reference Books	1. Vander, A.J. Sherman, J.H. and Luciano, D.S.. Human Physiology: The mechanism of body functions, VI edn. Mc Graw-Hill Publications, New York. 1994 2. Lewis J.Kleinsmith. Principles of cancer Biology, Ie first Edition English, Paperback, 2001 3. Robert G.Mc kinnell Ralph E. Parchment Alan O.Perantoni .The Biological Basis of Cance.r Second edition English, Soft Cover,1998 4. Hesteth Dr Robin HeskethIntroduction to Cancer Biology English, Paperback,2000
E-References	1. http://csbl.bmb.uga.edu/mirrors/JLU/DragonStar2017/download/introduction-to-cancer-biology.pdf 2. https://sphweb.bumc.bu.edu/otlt/MPH-Modules/PH/PH709_Cancer/A10-Cancer.pdf
Course out come	Upon completion of this course, the students will be able to

CO	**Course Outcomes**	**Knowledge Level**
CO1	differentiate between normal cell and cancer cell.	**K3**
CO2	understand the classification and diagnosis of cancer by tissue type	**K2**
CO3	gain the knowledge of classification of cancer	**K1**
CO4	understand the sporadic cancers, hereditary cancers and examples of cancer susceptibility syndromes	**K2**
CO5	acquire the knowledge of cancer treatments like radiation, chemotherapy, biological therapy, hormone therapy and transplantation	**K2**

Mapping of COs with POs & PSOs:

CO	**PROGRAMME OUTCOMES (PO)**								**PROGRAMME SPECIFIC OUTCOMES (PSO)**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	M	S	M	S	S	M	S	S	S	M
CO2	S	S	S	S	S	M	S	S	M	S	S	M	S
CO3	S	S	S	S	S	M	S	S	S	S	S	S	S
CO4	S	M	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	M	S	S	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

Course Code	U21ZOE522	PARASITOLOGY	L	T	P	C
Elective	III		3	-	-	3
Cognitive Level	K1:Recall K2:Understand					
Learning objectives	• To understand the concept of parasitology • To know the morphology of parasite • To understand the biological description of all types of parasites					
Unit I	Introduction to Parasitology					
Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector) Host parasite relationship						
Unit II	Parasitic Protists					
Study of Morphology, Life Cycle, Prevalence, Epidemiology,Pathogenicity, Diagnosis, Prophylaxis and Treatment of Entamoeba histolytica, Giardia intestinalis, Trypanosoma gambiense, Leishmania donovani, Plasmodium vivax						
Unit III	Parasitic Platyhelminthes					
Study of Morphology, Life Cycle, Prevalence,Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Fasciolopsis buski, Schistosoma haematobium, Taenia solium and Hymenolepis nana						
Unit IV	Parasitic Nematodes					
Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Ascaris lumbricoides, Ancylostoma duodenale, Wuchereria bancrofti and Trichinella spiralis. Study of structure, life cycle and importance of Meloidogyne (root knot nematode), Pratylencus (lesion nematode)						
Unit V	Parasitic Arthropoda					
Biology, importance and control of ticks, mites, Pediculus humanus (head and body louse), Xenopsylla cheopis and Cimex lectularius. Parasitic Vertebrates - A brief account of parasitic vertebrates; Cookicutter Shark, Candiru, Hood Mockingbird and Vampire bat						
Text Books	1. Arora, D. R and Arora, B. Medical Parasitology. II Edition. CBS Publications and Distributors.2001. 2. Parija, S. C. Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi-1998					

Reference Books	1. Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. Biology of Disease. Taylor and Francis Group.2007. 2. K. D. Chatterjee. Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd.2009.
E-Reference	https://www.nature.com/subjects/parasitology#:~:text=Parasitology%20is%20the%20scientific%20discipline,host%20response%20to%20these%20agents.
Course outcome	Upon completion of this course, the students will be able to

	CO	**Course Outcomes**	**Knowledge Level**
	CO1	understand the general introduction about parasitism	**K1**
	CO2	know the morphological feature of parasites	**K2**
	CO3	comprehend the platyhelminthes parasitic life	**K2**
	CO4	acquire knowledge on nematode parasites	**K2**
	CO5	gain knowledge about vertebrate parasites	**K2**

Mapping of COs with POs & PSOs

CO	**PROGRAMME OUTCOMES (PO)**								**PROGRAMME SPECIFIC OUTCOMES (PSO)**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	M	S	S	S	S	S	S	M	S	S	M	S	M
CO2	S	S	M	S	S	S	S	M	S	M	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	M	S	S	S	S	S	S	S
CO5	M	S	S	S	S	M	S	M	S	S	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

Course Code	U21ZOS531	POULTRY FARMING	L	T	P	C
SBE	III		2	-	-	2
Cognitive Level	K2:Understand K3:Apply					
Learning objective	➢ To study the poultry nutrition and physiology ➢ To learn the nutritive value of egg ➢ To understand the poultry health and management ➢ To learn the techniques in poultry science ➢ To acquire the skill to become entrepreneur					
Unit I	**Poultry Nutrition and Physiology:**					
Essential amino acids, proteins, fatty acids, vitamins and minerals their inter-relationships. Functional regulation of digestion, absorption and metabolism of nutrients.						
Unit II	**Feed formulation for different species and groups:**					
Different systems of feeding wet mash, dry mash, crumble and pellet feeding. Feed Passage rate in G.I. tract in relation to digestion and absorption efficiency; Characteristics features of endocrine glands. Endocrine control and variable factors influencing growth process						
Unit III	**Poultry Products technology:**					
Structure, chemical composition and nutritive value of egg. Various measures of egg quality. Shell, albumen and yolk quality assessment. Factors influencing egg quality traits. Mechanism of deterioration of egg quality. Different methods of preservation of table eggs and their relative merits and demerits. Physical, chemicals, microbial and organoleptic evaluation of meat quality						
Unit IV	**Poultry Health Management:**					
Common diseases of poultry – bacterial, viral, fungal, protozoan, parasitic and other emerging diseases of poultry, their prevention control and treatment. Metabolic and nutrient deficiency diseases and disorders.						
Unit V	**Vaccination programmes and Deworming programmes:**					
Control of coccidiosis, worms, ectoparasites and flies. Medication procedures. Cleaning and disinfection of poultry houses. Drinking water sanitation						
Text Books	1. P.V. Sreenivasaiah Text book of Poultry Science,2002 2. Nilotpal Ghosh - A text book by Poultry Science and practice,2010					

Reference Books	1. Benjamin Macclare- Advances in Poultry science,1999 2. Carlos Hassey- Poultry sciences- Breeding, Rearing and Management of animals,2000		
E-references	1. http://www.fao.org/3/y5169e/y5169e.pdf 2. http://dahd.nic.in/sites/default/filess/Excerpts%20of%20Poultry%20Farmn%20Manual-ilovepdf-compressed.pdf		
Course out come	Upon completion of this course, the students will be		
	CO	**Course Outcomes**	**Knowledge Level**
	CO1	learn the nutrition and physiology of poultry	**K2**
	CO2	understand the feed formulation for different species and groups	**K2**
	CO3	develop the skills in analyzing poultry eggs	**K3**
	CO4	identify and manage the microbial infections in poultry	**K3**
	CO5	gather knowledge about metabolic and nutrient deficiency diseases and disorders	**K2**

Mapping of COs with POs & PSOs:

CO	**PROGRAMME OUTCOMES (PO)**								**PROGRAMME SPECIFIC OUTCOMES(PSO)**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	M	S	M	S	S	S	M
CO2	S	M	S	S	S	S	M	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S	S	S	M
CO4	S	S	S	S	S	M	S	S	S	S	S	S	M
CO5	S	S	S	S	M	S	M	S	M	S	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

Course Code	U21ZOS532	SERICULTURE	L	T	P	C
SBE	III		2	-	-	2
Cognitive Level	K2:Understand K3:Apply					
Learning Objective	➢ To enlighten the students about sericulture a profitable culture practice. ➢ To enhance the skills, competitiveness and employability of the students ➢ To gain the knowledge of silk production, disease management, quality of silk and marketability. ➢ Non major elective student can become entrepreneur.					
Unit I	**Introduction to sericulture& moriculture**					
Classification of Mulberry, Methods of cultivation. Biology and diseases of Silkworms Life cycle, External morphology and biology of mulberry silkworm. Internal morphology of Silkworm – Digestive, Respiratory, Nervous, Excretory and Reproductive systems.						
Unit II	**Seed /silkworm eggs**					
Structure – Commercial and reproductive, Seeds, Voltinism, Hibernating and Non hibernating eggs. Diseases of *Bombyx mor*i -Viral, bacterial protozoan and fungal, Preventive and control measures. Insect and vertebrate Pests of silkworm and their management.						
Unit III	**Rearing**					
Rearing house and appliances, Rearing processes. Chawki worm rearing – optimum feeding, optimum Environmental conditions, care during rearing and cleaning. Selection of ripe worm, spinning, mounting, Harvesting, storage and transport. Reeling – Stifling, reeling appliances – types of reeling machines, Country charka, cottage basin, filature units, Applications of silk.						
Text Books	1. M. S. Nalina sundari, Entomology M. J. P Publications, Chennai, 2006. 2. Sharma P.L & Singh S. Hand book of Bee Keeping, Agrobius Publ, India, 2001. 3. Ravindranathan K. R. A text book of Economic Zoology. Dominent Publishing & distributors, New Delhi, 2005					

Reference Books	1. Ganga & J. Sulochana Chetty, An introduction to sericulture (Oxford & IBH bubl.Co.Pvt. Ltd.) 2001. 2. Hand Book of Practical Sericulture by Ullal and Narsimhanna. CSB. Bangalore.2002
E-References	1. http://www.survivorlibrary.com/library/silk_culture-a_manual_with_complete_instructions_1885.pdf 2. https://n-modell.hu/11kopjts/178679-introduction-to-sericulture-pdf
Course out come	Upon completion of this course, the students will be to

CO	**Course Outcomes**	**Knowledge Level**
CO1	acquire knowledge about sericulture and moriculture	**K2**
CO2	learn the commercial and reproductive system of silkworm eggs and pests of silkworm and their management	**K2**
CO3	gain knowledge of rearing house and appliances	**K2**

Mapping of COs with POs & PSOs:

CO	**PROGRAMME OUTCOMES (PO)**								**PROGRAMME SPECIFIC OUTCOMES(PSO)**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	M	S	S	M	M	M	S	S	S	M
CO2	S	S	S	M	S	S	M	M	M	S	M	S	S
CO3	S	S	S	M	S	S	M	M	S	M	M	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

SEMESTER VI

Course Code	U21ZOT61	GENETIC ENGINEERING & BIOTECHNOLOGY	L	T	P	C
CORE	XIII		5	-	-	4
Cognitive Level	K2:Understand K3:Apply K6: Create					
Learning objective	• To know the concepts of biotechnology and familiarize with the tools and techniques of Biotechnology • To acquire knowledge on tissue culture and learn the fundamentals of patenting of biological products. • To be familiar with microbial degradation of bioremediation and biomining process. • To understand the production and application of stem cell production • To elucidate the production of transgenic animals and their importance.					
Unit I	**Introduction to Genetic Engineering**					
History and scope of Genetic Engineering and biotechnology, Basic steps in Gene cloning, Restriction enzymes. Cloning Vectors -Bacterial plasmids (p BR 322) Bacteriophage Vector – (Lambda) Animal vector – (SV 40)						
Unit II	**Introduction of DNA into cells**					
Bacteria – Transformation, Plants –Electroporation, Animals – shot gun method, Liposome mediated fusion. Identification of recombinant hosts – Bacteria, Transgenic plants a brief note. Application of Recombinant DNA in medicine and industry, Biohazards of recombinant DNA.						
Unit III	**Animal cell and Tissue culture**					
Animal cell, culture media physical, chemical functions of different constituents of culture medium, Role of carbon dioxide, growth factors, Glutamine in culture medium, serum and protein free media and their applications. Types of cell culture; Primary and established culture, Organ culture Disaggregation of tissue, cell separation cell synchronization, Cryopreservation.						
Unit IV	**Environmental Biotechnology**					
Pollution control –Waste Treatment Anaerobic, Aerobic Waste Treatment, Biodegradation, Microorganism in Pollution Control. Bioremediation, Biosensors and Biofuels						
Unit V	**Transgenic animals**					
Production, application advantages. Transgenic animals in livestock improvement, PCR, DNA finger printing, Ethical issues in animal Biotechnology. Stem cell culture - production and application.						

Text Books	1. P. K. Gupta Rastogi and Co, Elements of Biotechnology. Meerut. 2016. 2. S.K. Agarwal, Environmental Biotechnology APH Publication Co, New Delhi – 2010. 3. V. Kumaresan ,Biotechnology – Saras Publication , (2015)
Reference Books	1. R.C Dubey, A Text book of Biotechnology. III Ed.,S.Chand& company Ltd. 2003. 2. H.K.Das Text book of Biotechnology . III Ed., Wiley India (P) Ltd. ,2004. 3. S.C.Rastogi, Biotechnology – Principles and Applications – I Ed., Narosa Publishing house. 2007.
E-References	1. https://thunderbooks.files.wordpress.com/2009/05/introduction-to-biotechnology-and-genetic-engineering-infinity-2008.pdf 2. http://www.ifsc.usp.br/~ilanacamargo/FFI0740/2.pdf 3. https://ingeniumcanada.org/sites/default/files/2019-01/education-genetics-and-biotechnology-eak.pdf
Course out come	Upon completion of this course, the students can able to

CO	Course Outcomes	Knowledge Level
CO1	understand the genetic engineering tools and gene cloning.	**K2**
CO2	know the transformation mechanism of gene	**K2**
CO3	comprehend the values of animal tissue culture	**K2**
CO4	apply the knowledge of genetic engineering in environmental management	**K3**
CO5	learn the techniques and create new transgenic animals	**K6**

Mapping of COs with POs & PSOs:

CO	PROGRAMME OUTCOMES (PO)								PROGRAMME SPECIFIC OUTCOMES(PSO)				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	M	S	S	S	S	M	S	S	M	M	S	S	M
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S
CO3	S	M	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	M	S	S	S	M	S	S	S
CO5	S	S	S	S	S	S	S	S	M	M	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

Course Code	U21ZOT62	MICROBIOLOGY AND IMMUNOLOGY	L	T	P	C
CORE	XIV		5	-	-	4
Cognitive Level	K1:Recall K2:Understand K3:Apply					
Learning objective	➢ To provide the knowledge with the latest information in scientific microbiological methods. ➢ To learn the microbial culture and maintenance techniques ➢ To get skills of microbial culture and application of this knowledge to well being of human health and environmental health. ➢ To provide the knowledge of auto immune diseases ➢ Acquire the knowledge to understand the science of immunology for the new invention of vaccine for some deadly diseases.					
Unit I	**Introduction**					
History and scope of Microbiology. Outline classification of microorganisms. General structure of microbes - Bacteria, fungi, Virus algae and protozoa. **Bacterial growth:** Culture media and selective media; continuous and batch culture technique; growth curve.						
Unit II	**Applied Microbiology**					
Food Microbiology: Food poisoning, food spoilage and preservation. Industrial Microbiology: Production of antibiotic with reference & penicillin production. . Soil microbiology: Role of soil microbes in N_2 fixation.						
Unit III	**Medical Microbiology**					
Diseases caused by bacteria in different system of man as given below. Dermal – streptococcal inflammation-upper respiratory tract streptococcal. Respiratory – Tuberculosis. Gastro – intestinal – dysentery. Reproductive – Gonorrhea. Viral disease with reference to causative organisms, symptoms, impact on the host and control measures						
Unit IV	**Immunology**					
History and scope of immunology Immunity – Types of Immunity – Innate and acquired, passive and active. Lymphoid organs – primary and secondary (Thymus, Bone Marrow, Bursa of fabricius, spleen, tonsil, lymph node, payer's patches).						
Unit V	**Immunology:**					
Immunoglobulin structure and function, biological properties of lg classes. Interaction of antigen and antibody, complement activation. Immunopathology: - Major histocompatibility complex and its significance. HLA. Hypersensitivity - Types of hypersensitivity. AIDS and immunity.						

Text Books	1. P.K Gupta, Immunology, Rastogi publication, meerut, 2016. 2. Ananda narayanan, T. and Jayram Paniker, C.K., Textbook of Microbiology, 6th Ed. 3. Orient Longman Ltd., Chennai. 2010. 4. Kannan, I., Immunology, MJP publishers, Chennai. 2011.
Reference Books	1. Microbiology. Michel J. Pelezar, JR., E.C.S. Chan, Noel R. Krieg, 5th edt. Tata MaGraw- Hill Publishing Company Ltd, New Delhi.2001. 2. Immunology & Immunotechnology, Ashim K. Chakravarth, Published in India by oxford university press, Jai Singh Road, New Delhi.2006. 3. Arora, M.P. Immunology, Ane Books Pvt. Ltd., New Delhi, 2010. 4. Immunology & Immunotechnology, Ashim K. Chakravarth, Published in India by oxford university press, Jai Singh Road, New Delhi. 2006.
E-References	1. https://labscientists.files.wordpress.com/2017/12/microbiology-immunology-1.pdf 2. http://lib.rudn.ru/file/Immunology_Microbiology_Catalogue_eBook.pdf 3. https://www.moscmm.org/pdf/Ananthanarayan%20microbio.pdf 4. https://alraziuni.edu.ye/book1/Laboratories/microbiology%20immunology.pdf
Course out come	Upon completion of this course, the students will be able to

CO	Course Outcomes	Knowledge Level
CO1	gain knowledge with microbial culture and maintenance techniques	**K2**
CO2	learn the food poisoning, food spoilage and preservation and production of antibiotics	**K1**
CO3	Know the diseases caused by bacteria in different system of man	**K2**
CO4	acquire the knowledge of auto immune diseases	**K2**
CO5	attain the knowledge to understand the structure and function of immunoglobulin	**K3**

Mapping of COs with POs & PSOs:

CO	PROGRAMME OUTCOMES(PO)								PROGRAMME SPECIFIC OUTCOMES(PSO)				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	M	S	M	S	S	S	S	M	M	S	S	M
CO2	S	S	S	M	S	S	S	S	S	M	S	S	S
CO3	S	S	S	S	S	S	S	S	M	M	S	S	S
CO4	S	S	S	S	S	S	S	S	M	M	S	S	S
CO5	S	S	S	M	S	S	M	S	S	M	S	M	S

Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

Course Code	U21ZOT63	EVOLUTION	L	T	P	C
CORE	XV		5	-	-	4
Cognitive Level	K2:Understand K3:Apply					
Learning objective	➢ To know the various stages involved in the embryo development ➢ To study the process of fertilization and its development like organogenesis ➢ To enlighten about the embryo formation and development ➢ To learn the evolutionary process and understand the importance of fossils ➢ To understand the evolutionary theories and speciation process.					
Unit I	**Introduction to Evolution:**					
Introduction- Origins of evolutionary thought, Early ideas of evolution, Concept of Evolution, Origin of Life, Origin of Prokaryotes and Eukaryotes.						
Unit II	**Theories of Evolution:**					
Theories of Evolution – Lamarckism, Darwinism, Neo – Lamarckism, Neo – Darwinism, Mutation theory of Devries modern synthetic theory. Isolating mechanism.						
Unit III	**Evidences of evolution:**					
Morphological, Embryological, Physiological, Geographical and Geological, immunological evidences for evolution. Fossils, Geological time scale						
Unit IV	**Species Concepts:**					
Species Concepts and Species Attributes, The "Modern Synthesis" The nature of evolutionary units; Species concepts- Speciation (Allopatric & sympatric). A general theory of speciation						
Unit V	**The causes of evolution:**					
Hardy-Weinberg equilibrium – Mutation Geneflow, Genetic drift Nonrandom breeding. Natural selection I: Stabilizing, directional, and disruptive selectio- Natural selection II: The general selection model.- Group selection, kin selection, and sociobiology.						
Text Book	1. Developmental Biology - Arumugam N. Saras Publicaion – kottar. 2007. 2. Modern Experimental Zoology by Preeti Guptha and Mridula Chaturvedi. 2000.					

References	1. Modern Experimental Zoology by Preeti Guptha and Mridula Chaturvedi. 2010. 2. An introduction to embryology, – Balinsky B.I- W.B.Saunders Co.., Philadelphia, 2008 3.Strickberger, Evolution, Jones and Barlett Publishers Inc., London, 2010.
E-References	1. https://mobot-biodiversity-jc.weebly.com/uploads/1/8/6/0/18603232/the_evolutionary_biology_of_species_by_t_g_barraclough_2019.pdf 2. http://bgc.org.in/pdf/study-material/developmental-biology-7th-ed-sf-gilbert.pdf 3. https://www.blackwellpublishing.com/ridley/EVOC20.pdf
Course out come	Upon completion of this course, the students will be able to

CO	**Course Outcomes**	**Knowledge Level**
CO1	understand the history of developmental biology and gametogenesis, spermatogenesis and oogenesis process	**K2**
CO2	learn the fertilization, physicochemical, cytological and biochemical aspects of fertilization, cleavage and its pattern in vertebrates	**K2**
CO3	illustrate the process of embryonic adaptation	**K3**
CO4	know the theories of evolution	**K2**
CO5	identify and conserve genetic resources mutation theory of devries modern synthetic theory	**K3**

Mapping of COs with POs & PSOs:

CO	**PROGRAMME OUTCOMES (PO)**								**PROGRAMME SPECIFIC OUTCOMES (PSO)**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	M	S	S	S	S	M
CO2	S	S	M	S	S	S	S	M	S	S	S	S	S
CO3	S	S	M	S	S	S	M	M	S	S	S	S	S
CO4	S	M	M	M	S	S	S	S	S	S	S	S	S
CO5	S	S	M	S	S	S	S	M	S	S	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

Course Code	U21ZOT64	ENVIRONMENTAL BIOLOGY	L	T	P	C
Core	XVI		4	-	-	4
Cognitive Level	K1:Recall K2:Understand K3:Apply K4:Evaluate					
Learning objective	➢ To know the factors involved in the environment ➢ To comprehend the relationship occurs between the organism ➢ To understand the population, community ecology and function of ecosystems ➢ To list biotic and abiotic factors that affect, the distribution, dispersal, and behaviour of organisms. ➢ To describe the structure and function of ecological systems and explain how ecological systems work at different spatial and temporal scales.					
Unit I	**Light:**					
Physico-chemical factors: Light: Spectra (composition of light), Light on land, light in water. Biological effects of light. Temperature: Range, Diurnal variation, thermal Stratification, temperature tolerance, Classification of Organisms. Adaptation of extreme temperature, Biological effects of temperature. Medium and substratum: Atmosphere and Air; Lithosphere and soil; Hydrosphere and water.						
Unit II	**Inter specific relationships and intra specific relationships**					
Types and example, Colonization, Aggregation, Social organization, Psychological Factors Population Ecology: Types, density, and estimation, natality, mortality, age, distribution, growth pattern, fluctuation and equilibrium biotic potential. Dispersal and distribution, Regulation of population.						
Unit III	**Ecosystem**					
Community, characteristics, diversity dominance, structure, Stratification, periodicity, fluctuation, Ecotone and edge effect, Ecological niche, equivalence, ecotypes, ecological succession Ecosystem: Components, food chain and its types- food web, Ecological pyramids. Energy flow and productivity – Examples (Pond and Forests) – Biogeochemical cycles- carbon, Nitrogen and phosphorous.						
Unit IV	**Habitats**					
Fresh water, Marine, Terrestrial and Estuarine Habitats Pollution: Kinds, sources of pollution, Hazards of pollution to human, animals, plants and Buildings. /control and remedial measures. Practical Application of ecology in fishery, management, agriculture And forestry. Wild life conservation in India.						
Unit V	**Biodiversity**					
Types and Levels- Species diversity, values of biodiversity. Causes of erosion of biodiversity. Conservation of biodiversity, Application of remote Sensing in biodiversity.						

Text Books	1. P. D. Sharma, Environmental Biology: Rastogi Publications, Meerut, 2016. 2. Gupta PK. *Cytology, Genetics and Evolution*, Rastogi Publications, Meerut,2016. 3. Arumugam N. *Concepts of Ecology*, Saras Publication, Nagercoil, Tamilnadu,2014.
Reference Books	1. P.S. Verma & V.K.Agarwal, Environmental Biology (Principles of ecology) ISBN- 81-219-0859-0S. Chand &Co. Ram nagar, New Delhi , 2010. 2. Sharma P.D, 7th edt, Elements of Ecology Rastogi Publication, Meerut,2010.
E- Reference	1. http://www.uilis.unsyiah.ac.id/oer/files/original/1c18821adec76287db06550e04d69314.pdf 2. https://www.hzu.edu.in/bed/E%20V%20S.pdf 3. http://assets.cambridge.org/97805217/87277/excerpt/9780521787277_excerpt.pdf
Course out come	Upon completion of this course, the students will be able to

CO	**Course Outcomes**	**Knowledge Level**
CO1	learn the physico-chemical factors and biological effects of light	**K1**
CO2	understand the Inter specific relationships and intra specific relationships of ecosystem	**K2**
CO3	elucidate the characteristic features of animal association with various ecosystems and also learn about Energy flow and productivity of ecosystem	**K3**
CO4	learn the different pollution effects	**K2,**
CO5	evaluate the types and application of biodiversity	**K4**

Mapping of COs with POs & PSOs:

CO	**PROGRAMME OUTCOMES (PO)**								**PROGRAMME SPECIFIC OUTCOMES(PSO)**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	M	S	S	S	S	M	M	S	S	M
CO2	S	S	S	S	S	S	S	S	M	S	S	M	S
CO3	S	S	S	S	S	M	S	S	S	S	S	S	S
CO4	S	M	S	S	S	S	S	S	M	S	S	S	S
CO5	S	M	S	M	S	M	S	S	S	S	S	S	S

Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

Course Code	U21ZOP65	ENVI RONMENTAL BIOLOGY MICROBIOLOGY & IMMUNOLOGY, GENETIC ENGINEERING & BIOTECHNOLOGY (Practical)	L	T	P	C
Core	XVII		5	-	-	4
Cognitive Level	K2:Understand	K3:Apply	K4:Evaluate			
Learning objective	➢ To comprehend about the physical and chemical parameter in water sample ➢ To gain knowledge about the adaptations of marine animals ➢ To learn about various microbial techniques ➢ To acquire the practical skill on immunological techniques. ➢ To learn the techniques of ames test					
	Environmental Biology 1. Estimation of dissolved oxygen in tap water and distilled water 2. Estimation of dissolved CO2 in water samples. 3. Measurement of hardness of water by using detergent on distilled water and tap water 4. Estimation of salinity in water sample 5. Sampling of animal population by using quadrate method 6. Detection of transparency of water by Secchi disc method 7. Animal association- symbiosis, parasitism, predation & commensalisms 8. Analysis and mounting of freshwater and marine planktons 9. Adaptation of aquatic animals based on a study of museum specimen such as rocky, sandy, muddy and burrowing animals **Microbiology:** 1. Preparation of media – Natural Broth solid media (Agar) 2. Plating techniques – streak plate, pour plate and spread plate 3. Serial dilution techniques 4. Gram‟s staining 5. Hanging drop experiment 6. Screening of antimicrobial agent (Krby Bauer Method) 7. Observation of Instruments: Water bath, laminar air flow, autoclave, Incubator, Hot air oven, Colony counter. 8. Spotters: - Bacteria, Fungi, Algae, Spirogyra, Agaricus, Rhizopus, Bread mould, Protozoa – paramecium, Yeast.					

<table>
<tr><td></td><td colspan="3">Immunology
1. Observation and study of Lymphoid organs
i. Bone Marrow, Bursa fabricus
ii. Thymus, Lymph node, Spleen
2.Antigen antibody reaction- Any two
3.Observation and study of IgG, IgA and IgM

Biotechnology & Genetic Engineering

1. Observation of E. Coli, Bacteriophage , Plasmid
2. Demonstration of Complementation test
3. Demonstration of AMES test

A record of lab work should be maintained and submitted at the time of the practical examination. Study tour – visit to Labs / Biotechnology units /Animal farm / Microbiology and Immunology lab is compulsory.</td></tr>
<tr><td>Text Books</td><td colspan="3">1. Lal, S.S , A Text Book of Practical Zoology: Rastogi, Meerut.2014.
2. Verma, PS A Manual of Practical Zoology-third volume, S Chand Publications, New Delhi.2010.</td></tr>
<tr><td>Reference Books</td><td colspan="3">1. Janarthanan, S. and Vincent, S. Practical Biotechnology: Methods and protocols, University.Press, 2007.
2. Yogendra, N. and Srivastava, N.. Environmental Pollution, Ashish Publishing House. New Delhi. 2001</td></tr>
<tr><td>Course out come</td><td colspan="3">Upon completion of this course, the students will be able to</td></tr>
<tr><td></td><td>CO</td><td>Course Outcomes</td><td>Knowledge Level</td></tr>
<tr><td></td><td>CO1</td><td>practice water quality analysis</td><td>K4</td></tr>
<tr><td></td><td>CO2</td><td>gain knowledge on animal population methods</td><td>K2</td></tr>
<tr><td></td><td>CO3</td><td>perform the technique of microbial isolation and culturing procedures</td><td>K3</td></tr>
<tr><td></td><td>CO4</td><td>master the immunological techniques to rule out disorders</td><td>K3</td></tr>
<tr><td></td><td>CO5</td><td>interpret the diagnostic tests with health condition.</td><td>K4</td></tr>
</table>

Mapping of COs with POs & PSOs

CO	PROGRAMME OUTCOMES (PO)								PROGRAMME SPECIFIC OUTCOMES (PSO)				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	M	S	S	S	S	S	S	M	S	S	M	S	M
CO2	S	S	M	S	S	S	S	M	S	M	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	M	S	S	S	S	S	S	S
CO5	M	S	S	S	S	M	S	M	S	S	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

Course Code	U21ZOT641	BIOINFORMATICS	L	T	P	C
Elective	IV		3	-	-	3
Cognitive Level	K1:Recall K2:Understand K3:Apply					
Learning objective	➢ To gain the knowledge about computer and its devices ➢ To learn about the programming languages and its application ➢ To learn the basic concept of bioinformatics and its application in various fields ➢ To learn the use of nucleic acid and protein data banks ➢ To understand the methods of representation for evolutionary analysis tree					
Unit I	**Introduction to Computer**					
History development and types of computers general awareness of computer systems. hard ware and soft ware(CPU and other peripheral devices)						
Unit II	**Programming languages**					
Machine language assembly languages. Higher level language- introduction, email, world wide web – surfing						
Unit III	**Sequence analysis**					
need and importance pairwise alignments- dynamic programming - Global and local – Alignment concepts- Database searching tools Entrez, BLAST, FASTA, Multiple alignment cluster construction of phylogenic trees.						
Unit IV	**Use of nucleic acid and protein**					
data banks NCBI, EMBI, DDBJ, SWISSPORT,3D structural analysis of biomolecules – molecular visualization tools Rasmol, chemsketen and SPDBV- Protein Docking						
Unit V	**Evolutionary analysis :**					
Distance clustering methods- Rooted and Un rooted tree representation Bootstrapping strategies, Neutral networks.						
Text Books	1. Introduction of Bioinfomatics –Attwood tand Parry d. Pearson Education Asia. 2012 2. Computer for biologists- A, Fielding. Benjamin/cuming pubi.co 2015					

Reference Books	1. Attwood, T.K. and Parry, D.J – Smith, D.J. Introduction to Bioinformatics,2005. 2. Baxevanis, A.D. and Quellette, B.F.F.. Bioinformatics. A practical guide to harbour Laboratory Press, New York. 2010
E-references	1. http://www.aun.edu.eg/molecular_biology/Procedure%20Bioinformatics22.232015/Xiong%20%20Essential%20Bioinformatics%20send%20by%20Amira.pdf 2. http://www.ru.ac.bd/wpcontent/uploads/sites/25/2019/03/410_01_Lesk
Course out come	Upon completion of this course, the students will be able to

CO	**Course Outcomes**	**Knowledge Level**
CO1	able to know the history development and types of computers	**K1**
CO2	understand the programming languages	**K2**
CO3	apply the knowledge of sequence alignment tools	**K3**
CO4	understand the uses of nucleic acid and protein data banks	**K2**
CO5	know the applications of evolutionary analysis	**K2**

Mapping of COs with POs & PSOs:

CO	**PROGRAMME OUTCOMES (PO)**								**PROGRAMME SPECIFIC OUTCOMES (PSO)**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	W	S	S	M	S	M	S	S	S	S	S	M
CO2	S	W	S	M	S	S	S	M	M	S	S	S	S
CO3	S	M	S	S	S	S	M	S	S	M	S	S	S
CO4	S	S	S	S	M	M	S	S	M	S	S	S	S
CO5	S	S	S	S	S	M	M	S	S	M	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

Course Code	U21ZOE642	GEOINFORMATICS	L	T	P	C
Elective	IV		3	-	-	3
Cognitive Level	K1:Recall K2:Understand K3:Apply					
Learningobjectives	• To understand the concept of GIS • To know the various geographical data • To understand the concept of GPS and Remote sensing					
Unit I	**Introduction to GIS:**					
Definitions, Evolution, Components and Objectives. Overview of GIS Software Packages						
Unit II	**Spatial Data:**					
Types of Geographic Data, Levels of Measurements. Concepts of Space and Time, Layers Coverage. Spatial Data Models, Representation of Geographic Features in Vector, Raster Data Models. Concept of Arc, Node, Vertices and Topology.						
Unit III	**Non-Spatial Data:**					
Advantages of Data Base Management System. Conceptual Implementation Models, Hierarchical, Network, Relational Models. RDBMS: Components, Concept, Database Schema, Tables and Relationships						
Unit IV	**Concepts of GPS:**					
Spherical trigonometry, History, Types, Navigation Systems and Applications, Introduction to IRNSS.						
Unit V	**Introduction to Remote Sensing:**					
Concepts Definition, History Development, Stages in RS-EMR, EMR Spectrum, Types and application of RS.						
Text Books	1. Longley, P. A., Goodchild, M. F., Maguire, D. J.,Rhind, D. W. :Geographical Information Systems and Science, John Wiley & Sons, Chichester .2002. 2. Lo, C. P.,Yeung, A. W: ConceptsTechniques of Geographical Information Systems, PrenticeHall of India, New Delhi.2002.					
Reference Books	1. Chang, K. T. Introduction to Geographic Information Systems, Avenue of the Americas, McGraw-Hill, New York.2008. 2. Ahmed, E. L. Rabbany, Introduction to Global Positioning Systems, ArtechHouse, Boston.2002.					
E-Reference	1. https://geoinformatics.com/ 2. https://www.igi-global.com/dictionary/geoinformatics-in-eco-climatic-studies/42567 3. https://www.igi-global.com/book/advanced-topics-global-information-management/29					

Course outcome	Upon completion of this course, the students will be able to		
	CO	**Course Outcomes**	**Knowledge Level**
	CO1	understand the general concept of GIS	**K2**
	CO2	know the spatial data	**K2**
	CO3	acquire knowledge on non-spatial data	**K2**
	CO4	learn the concept of GPS	**K2**
	CO5	know the concept and uses of remote sensing	**K1**

Mapping of COs with POs & PSOs:

CO	**PROGRAMME OUTCOMES (PO)**								**PROGRAMME SPECIFIC OUTCOMES (PSO)**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	M	M	S	S	S	M	M	M	M	S	S	M	M
CO2	S	M	S	S	S	S	M	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	M	S	M	S	S
CO4	M	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	M	S	S	M	S	S	M	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

Course Code	U21ZOS641	AQUACULTURE	L	T	P	C
SBE	IV		2	-	-	2
Cognitive Level	K1:Recall K2:Understand K3:Apply					
Learning objective	➢ To understand the importance and scope of aquaculture ➢ To gain knowledge in the cultivable fishes and its economic importance ➢ To understand the Preparation of pond and methods of fish cultures ➢ To gain knowledge on aquatic farm management ➢ To Provide in depth knowledge on fish diseases and its diagnosis					
UNIT – I	**Importance of aquaculture –**					
Prospects and scope – Aquaculture farm- site selection, topography, water availability and supply, soil condition and quality design and layout of farms.						
UNIT – II	**Cultivable species-**					
see weeds. Crustacean (Prawns and Lobsters), Mollusces (Mussels and oysters) and fishes – Economic importance's market values and its by products.						
UNIT – III	**Pond Preparation & Production Culture Systems**					
Traditional, Extensive, Semi- Extensive, and Intensive Systems. Composite fish culture, paddy cum fish culture – Integrated fish culture sewage water fish culture						
UNIT – IV	**Water quality management-**					
temperature, salinity ,pH, O2,CO 2, level, nutrients and trace elements. Control of parasites & predators						
UNIT –V	**Diseases in culture ponds**,					
disease diagnosis, ELISA Western blotting, DNA based diagnosis of disease and Fish vaccines.						
Text Books	1. Arumugam, Aquaculture, Saras Publications,2014. 2. K.Pandey & J.P.Shukla, Fish and Fisheries, Rastogi Publication,2016.					
Reference Books	1. Das. M.K. and R.K. Das .Fish and fisheries in India- Diagnosis and control inland Fisheries Society of India, Barrack pore, west Bengal,2011 2. Govindan, T.K.Fish Processing Technology. Oxford & IBH					

	Publishing Co. Pvt.Ltd.,Kolkata.2010 .
E-References	1. https://www.mooc-list.com/course/oceanography-key-better-understand-our-world-coursera 2. https://igor.crew.c-base.org/aquaculture.pdf 3. http://www.agrifs.ir/sites/default/files/AQUACULTURE.pdf 4. https://www.cabi.org/uploads/CABeBooks/CAB-eBooks-Col-Aquaculture-and-Fisheries.pdf 5. https://www.blackwellpublishing.com/pdf/catalogue_2007_online_aquaculture.pdf
Course out come	Upon completion of this course, the students will be able to

CO	Course Outcomes	Knowledge Level
CO1	learn, rear the cultivable aquatic animals	**K1**
CO2	find out the cost benefit analysis in maintaining aqua farms.	**K3**
CO3	know the pond preparation and production culture system	**K2**
CO4	know the importance of quality of the water to maintain the aquaculture	**K2**
CO5	gain knowledge to prevent disease and parasitic infestations	**K3**

Mapping of COs with POs & PSOs:

CO	PROGRAMME OUTCOMES (PO)								PROGRAMME SPECIFIC OUTCOMES (PSO)				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	M	S	S	S	M	M	S	M	S	S	M
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	M	S	S	S	S	S	S	S	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

Course Code	U21ZOE642	ORNITHOLOGY	L	T	P	C
SBE	IV		2	-	-	2
Cognitive Level	K2:Understand K3:Apply					
Learning objective	➢ To give an introduction to bird science ➢ To understand about the method of studying migration ➢ To understand the diversity of foods and foraging ➢ To understand the breeding territories of birds ➢ To know about the bird distribution and its population studies					
Unit I	**Introduction to ornithology**:					
Terminology used in ornithology- types of bills, types of feet- Identification of birds in the field based on tail, bill, crest, leg & color						
Unit II	**Equipments used in the field study:**					
Fields guides- Photography- Identification of calls- feet and beak modification in birds. Bird migration- method of studying migration.						
Unit III	**Diversity of foods and foraging behavior :**					
Social foraging, mating preferences- Pair bonds, courtship and divorce – production and control of the song – functions of bird song.						
Unit IV	**Timing of breeding:**					
Breeding territories nest and nest building egg & clutch size, clutch and egg replacement. Incubation and hatching – caring for young						
Unit V	**Avian population change :**					
Over time and space – methods of estimation- classifying bird species assemblages- recent avian extinctions causes of avian population decline.						
Text Books	1. Salim Ali.S. and Ripley SD. Handbook of the birds of india and Pakistan. Compact edition Oxford University Press and BNHS Mumbai .2011. 2. Chinnasathan and Bal Pandey.The Nesting behavior of Indian Birds, Sugeeth Publication,2001.					

Reference Books	1. Caughley G.Sinclair.AR.Wildlife ecology and management. Back well Science.2000. 2. Dewsbur, D.A Comparative animal behavior. McGraw Hill Book Company. 1998. 3. Drickamer , L.C. S.H. Vessey and E.M. Jakob Animals Behavior. Mc Graw Hill. 2002.
E-references	1. http://www.jnkvv.org/PDF/13042020153242134201400.pdf 2. https://txmn.org/elcamino/files/2010/03/Ornithology-Basic-Concepts.pdf
Course out come	Upon completion of this course, t3e students will be able to

CO	Course Outcomes	Knowledge Level
CO1	able to know the introduction and terminology of ornithology	**K2**
CO2	know the importance of equipments used in the field to apply for ornithology studies	**K3**
CO3	learn about diversity of foods and foraging behavior	**K2**
CO4	assess their breeding and migration	**K2**
CO5	create awareness to protect them from extinction	**K2**

Mapping of COs with POs & PSOs

CO	PROGRAMME OUTCOMES (PO)								PROGRAMME SPECIFIC OUTCOMES(PSO)				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	M	S	M	M	M	S	S	S	M
CO2	S	S	S	S	M	S	M	S	S	S	S	M	S
CO3	S	S	S	S	S	S	M	S	S	S	S	S	S
CO4	S	S	S	S	S	M	M	S	S	S	S	M	S
CO5	S	M	S	S	S	S	S	S	S	S	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) -1 mark
No Correlation (N) - 0 mark

Course Code	U21ZOV51	FIRST AID AND SAFETY METHODS	Total Hours	C
Value Added Programme			30	2
Cognitive Level	K2:Understand K3:Apply			
Learning objective	➢ To be familiar with the fundamental concept of first aid and safety methods ➢ To learn the skill to manage the medical emergency and action at emergency. ➢ To acquire the knowledge on various accidents and community emergency ➢ To know the causes and symptoms of diabetes mellitus ➢ To study the emergency and to learn community casualty			
UnitI	Fundamental Concepts			
Managing an incident, Action at an emergency, Traffic accidents, Fires, Electrical incidents, Water incidents, Major incident/Mass casualties.				
Unit II	**First aid**			
First aid box, First aid for Drowning, First aid for Fire Injuries, First Aid for Severe Burns, First Aid for Mild Burn, First Aid for Injuries on the Play Field, First aid for snake biting, poisoning and stings, Transporting the Person for Medical Help After Giving First Aid				
Unit III	**Assessing casualties**			
Assessing the sick or injured, mechanism of injury, primary survey, secondary survey, Head to toe examination, monitoring vital sign. Breathing and circulation, life saving priorities, unconscious adults, unconscious child, unconscious infant				
Unit IV	**Medical Emergency**			
Heart attack, Stroke, Diabetes mellitus, Hyperglycemia, Hypoglycemia, Seizures in adults, Seizures in children, Childbirth, Emergency childbirth.				
Unit V	**Community Emergency**			
Fire explosions, Earth quakes, Flood and famine, Burns, Road accidents, Accessing a conscious and unconscious casualty.				
Text Books	First Aid, CPR and AED, 5th ed A. Thygerson, B. Gulli & J.R. Krohmer. Jones & Bartlett. ISBN: 0763742090.2006.			
Reference Books	1. The authorized manual of St. John Ambulance, St. Andrew's Ambulance association and the British red cross society. 2002 2. Dorling Kindersley- First Aid manual, 5th edition, , London.2001 3. Clement ,Text book on First Aid & Emergency Nursing, First edition, JP brothers, 2012			

E-References	1. https://kuiyem.ku.edu.tr/wp-content/uploads/2016/12/American-College-of-Emergency-Physicians-ACEP-First-Aid-Manual.pdf 2. http://www.panola.edu/collegestore.htm 3. http://www.panola.edu/instruction/dl/testing.htm		
Course outcome			
	CO	**Course Out comes**	**Knowledge Level**
	CO1	develop knowledge about the basics measures to be taken during an emergency.	**K3**
	CO2	understand the situation and act accordingly.	**K2**
	CO3	know and Apply the first aid service for various casualties.	**K3**
	CO4	acquire skill to service for medical emergency	**K3**
	CO5	attain knowledge about uncommon health, environmental conditions and mitigation strategies.	**K2**

Mapping of COs with POs & PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	S	S	S	S	S	M	S	S	S	S	M	M
CO2	S	S	S	M	S	S	S	S	S	S	M	M	S
CO3	S	M	M	S	M	S	S	M	S	M	S	M	S
CO4	M	S	M	S	S	M	S	S	M	S	S	S	M
CO5	S	S	S	S	S	S	S	S	S	S	M	S	M

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark