Holy Cross College (Autonomous), Nagercoil

Kanyakumari District, Tamil Nadu.
Accredited with A^{++} by NAAC - V Cycle (CGPA 3.53)

Affiliated to
Manonmaniam Sundaranar University, Tirunelveli

Semester I – VI

UG Guidelines & Syllabus

DEPARTMENT OF ZOOLOGY

2023-2026

(With effect from the academic year 2025-2026)

Issued from

THE DEANS' OFFICE

Vision

Empower the students with Academic skills, Research aptitude and social commitment through holistic education.

Mission

1. Foster knowledge and skills through innovative teaching and instill moral and ethical values.
2. Render opportunities for critical thinking, communication, and collaboration.
3. Create research ambience to promote innovations and contemporary skills relevant to local and global needs.
4. Inspire to explore the natural resources and connect with nature.
5. Promote passion to serve the local community by creating empowered women of
6. Commitment and social consciousness through outreach and exposure programmes.
7. Facilitate life-long learning, participatory leadership, and commitment to society.

Graduate Attributes

Graduates of our College develop the following attributes during the course of their studies.

- **Creative thinking:**

Equipping students with hands-on-training through skill-based courses and promote startup.

- **Personality development:**

Coping with increasing pace and change of modern life through value education, awareness on human rights, gender issues and giving counselling for the needful.

- **Environmental consciousness and social understanding:**

Reflecting upon green initiatives and understanding the responsibility to contribute to the society; promoting social and cultural diversity through student training and service-learning programmes.

- **Communicative competence:**

Offering effective communication skills in both professional and social contexts through bridge courses and activities of clubs and committees.

- **Aesthetic skills:**

Engaging mind, body and emotions for transformation through fine arts, meditation and exercise; enriching skills through certificate courses offered by Holy Cross Academy.

- **Research and knowledge enrichment:**

Getting in-depth knowledge in the specific area of study through relevant core papers; ability to create new understanding through the process of critical analysis and problem solving.

- **Professional ethics:**

Valuing honesty, fairness, respect, compassion and professional ethics among students. The students of social work adhere to the *National Association of Social Workers Code of Ethics*

- **Student engagement in the learning process:**

Obtaining extensive and varied opportunities to utilize and build upon the theoretical and empirical knowledge gained through workshops, seminars, conferences, industrial visits and summer internship programmes.

- **Employability:**

Enhancing students in their professional life through Entrepreneur development, Placement & Career guidance cell.

- **Women empowerment and leadership:**

Developing the capacity of self-management, team work, leadership and decision making through gender sensitization programmes.

Programme Educational Objectives (PEOs)

PEOs	Upon completion of B.A/B.Sc. degree programme, the graduates will be able to	Mission addressed
PEO1	apply appropriate theory and scientific knowledge to participate in activities that support humanity and economic development nationally and globally, developing as leaders in their fields of expertise.	**M1& M2**
PEO2	inculcate practical knowledge for developing professional empowerment and entrepreneurship and societal services.	**M2, M3, M4 & M5**
PEO3	pursue lifelong learning and continuous improvement of the knowledge and skills with the highest professional and ethical standards.	**M3, M4, M5 & M6**

Programme Outcomes (**POs**)

POs	Upon completion of B.Sc. Degree Programme, the graduates will be able to:	PEOs Addressed
PO1	obtain comprehensive knowledge and skills to pursue higher studies in the relevant field of science.	**PEO1**
PO2	create innovative ideas to enhance entrepreneurial skills for economic independence.	**PEO2**
PO3	reflect upon green initiatives and take responsible steps to build a sustainable environment.	**PEO2**
PO4	enhance leadership qualities, team spirit and communication skills to face challenging competitive examinations for a better developmental career.	**PEO1&PEO3**
PO5	communicate effectively and collaborate successfully with peers to become competent professionals.	**PEO2 & PEO3**
PO6	absorb ethical, moral and social values in personal and social life leading to highly cultured and civilized personality	**PEO2 & PEO3**
PO7	participate in learning activities throughout life, through self-paced and self-directed learning to develop knowledge and skills.	**PEO1 & PEO3**

Programme Specific Outcomes (PSOS)

PSOs	Upon completion, B.Sc. Zoology graduates will be able to:	PO addressed
PSO1	deep understanding of the key concepts of Zoology in the areas of Taxonomy, Physiology, Cell Biology, Genetics, Applied Zoology, Aquaculture Ecology and Toxicology, Biochemistry, Biophysics, Biostatistics, Biotechnology, Immunology, Microbiology and Evolution.	**PO1, PO3**
PSO2	perform laboratories experiments with suitable techniques at cellular, molecular, biochemical, physiological, and systematic levels.	**PO2, PO3**
PSO3	apply biological methods to formulate hypothesis, collect, analyze, and evaluate the data to address the problem effectively.	**PO4, PO5**
PSO4	plan their career goals and pursue higher studies in different Zoological disciplines and develop entrepreneurship skills by applying the knowledge gained from courses like	**PO1, PO4, PO6**

	Aquaculture, Sericulture, Apiculture, Poultry, Vermi technology and Clinical Laboratory Technology.	
PSO5	to identify societal and environmental problems and solve them with innovative ideas and technologies, which can be patented.	**PO3, PO6, PO7**

Mapping of POs and PSOs

POs	PSO1	PSO2	PSO3	PSO4	PSO5
PO1	3	3	3	3	3
PO2	3	3	3	3	3
PO3	3	3	2	3	3
PO4	2	2	3	2	2
PO5	3	2	3	3	2
PO6	3	2	2	2	3
PO7	3	3	2	2	3
Total	20	18	18	18	19
Average	2.8	2.5	2.5	2.5	2.7

Eligibility: 10 + 2 pattern

For Admission: A pass in the Higher Secondary Examination (10+2) (Academic / Vocational Stream) conducted by the Government of Tamil Nadu with Zoology or Biology as one of the subjects or an examination accepted as equivalent by the syndicate of Manonmaniam Sundaranar University, Tirunelveli, is eligible for admission.

Duration of the Programme: 3 years

Medium of Instruction: English

Passing Minimum

A minimum of 40% in the external examination and an aggregate of minimum 40% is required. There is no minimum pass mark for the continuous internal assessment.

Components of the B.Sc. Zoology programme

Part III (Core Courses and Elective Courses)

Core Courses	Core-Theory Core Research Project	8 x 100 1 x100	800 100
	Core Lab Course	6 x 100	600
	Discipline Specific Elective-Theory	4 x 100	400
	Total Marks		**1900**
Elective Courses	Theory	4 x 100	400
	Lab Course	4 x 100	400
	Total Marks		**800**
	Total Marks		**2700**

- **Core and Elective Lab Courses carry 100 marks each.**
- **Practical examination will be conducted at the end of each semester for Core and Elective Courses.**

Course Structure Curricular Courses

Distribution of Hours and Credits

Course	S I	S II	S III	S IV	S V	S VI	Total	
							H	C
Part I: Language	6 (3)	6 (3)	6 (3)	6 (3)	-	-	24	12
Part II : English	6 (3)	6 (3)	6 (3)	6 (3)	-	-	24	12
Part III								
Core Course Core Lab Course Core Research Project	6 (6) 2 (2)	6 (6) 2 (2)	6 (6) 2 (2)	6 (6) 2 (2)	5 (4) + 5 (4) 5 (4) 5 (4)	6 (5) + 6 (5) 6 (4)	70	62
Elective /Discipline Specific Elective Courses	4 (3) 2 (2)	4 (3) 2 (2)	4 (3) 2 (2)	4 (3) 2 (2)	4 (3) 4 (3)	5 (3) 5 (3)	42	32
Part IV								
Non-major Elective	2 (2)	2 (2)					4	4
Skill Enhancement Course		2 (2)	2(2) + 2 (2)	2 (2)			8	8
Foundation Course	2 (2)						2	2
Environmental Studies				2 (2)			2	2
Internship					(2)		2	2
Professional Competency Skill					2 (2)	2 (2)	**4**	4
Total	**30 (23)**	**30 (23)**	**30 (23)**	**30 (23)**	**30 (26)**	**30 (22)**	**180**	**140**

Co-curricular Courses

Course	S I	S II	S III	S IV	S V	S VI	Total
LST (Life Skill Training)	-	(1)	-	(1)			2
Skill Development Training (Certificate Course)	(1)						1
Field Project		(1)					1
Specific Value-added Course	(1)		(1)				2
Generic Value-added Course				(1)		(1)	2
MOOC	(2)						2
Student Training Activity: Clubs & Committees / NSS				(1)			1
Community Engagement Activity: RUN				(1)			1
Human Rights, Justice and Ethics					(1)		1
Gender Equity and Inclusivity						(1)	1

Total	14

Total number of Compulsory Credits = Academic credits + Non-academic credits: 140 + 14

COURSES OFFERED

SEMESTER I

Course	Course Code	Title of the Course	Credits	Hours/ Week
Part I	TU231TL1 FU231FL1	Language: Tamil French	3	6
Part II	EU241EL1	English: A Stream	3	6
	EU241EL2	English: B Stream		
	EU241EL3	English: C Stream		
Part III	ZU231CC1	Core Course I: Invertebrata	6	6
	ZU231CP1	Core Lab Course I: Invertebrata	2	2
	ZU241EC1	Elective Course I: Animal Diversity	3	4
	ZU241EP1	Elective Lab Course I: Lab on Animal Diversity	2	2
Part IV	ZU231NM1	Non-Major Elective NME I: Ornamental Fish farming and management	2	2
	ZU241FC1	Foundation Course: Introduction to Zoology	2	2
		Total	**23**	**30**

SEMESTER II

Course	Course Code	Title of the Course	Credits	Hours/ Week
Part I	TU232TL1 FU232FL1	Language: Tamil French	3	6
Part II	EU242EL1	English: A Stream	3	6
	EU242EL2	English: B Stream		
	EU242EL3	English: C Stream		
Part III	ZU232CC1	Core Course II: Chordata	6	6
	ZU232CP1	Core Lab Course II: Lab on Chordata	2	2
	ZU242EC1	Elective Course II: Economic Zoology	3	4
	ZU242EP1	Elective Lab Course II: Lab on Economic Zoology	2	2
Part IV	ZU232NM1	Non-Major Elective NME II: Bio-composting for Entrepreneurship	2	2
	ZU242SE1	Skill Enhancement Course SEC I: Beekeeping	2	2
		Total	**23**	**30**

SEMESTER III

Course	Course Code	Title of the Course	Credits	Hours/Week
Part I	TU233TL1 FU233FL1	Language: Tamil French	3	6
Part II	EU243EL1	English: A Stream	3	6
	EU243EL2	English: B Stream		

	EU243EL3	English: C Stream		
Part III	ZU233CC1	Core Course III: Cell Biology	6	6
	ZU233CP1	Core Lab Course III: Lab on Cell Biology	2	2
	ZU233EC1	Elective Course III: Animal Diversity	3	4
	ZU233EP1	Elective Lab Course III: Lab on Animal Diversity	2	2
Part IV	ZU233SE1	Skill Enhancement Course SEC-II: Sea food processing	2	2
	UG23CSE1	Skill Enhancement Course SEC-III: Fitness for Wellbeing	2	2
		Total	**23**	**30**

SEMESTER IV

Course	Course Code	Title of the Course	Credits	Hours/Week
Part I	TU234TL1 FU234FL1	Language: Tamil French	3	6
Part II	EU244EL1	English: A Stream	3	6
	EU244EL2	English: B Stream		
	EU244EL3	English: C Stream		
Part III	ZU234CC1	Core Course IV: Animal Physiology	6	6
	ZU234CP1	Core Lab Course IV: Lab on Animal Physiology	2	2
	ZU234EC1	Elective Course IV: Economic Zoology	3	4
	ZU234EP1	Elective Lab Course IV: Lab on Economic Zoology	2	2
	UG23CSE2	Skill Enhancement Course SEC-IV: Digital Fluency	2	2
	UG234EV1	Environmental Studies (EVS)	2	2
		Total	**23**	**30**

SEMESTER V

Course	Course Code	Title of the Course	Credits	Hours/Week
Part III	ZU235CC1	Core Course V: Genetics	4	5
	ZU235CC2	Core Course VI: Developmental Biology	4	5
	ZU235CP1	Core Lab Course V: Genetics and Developmental Biology	4	5
	ZU235RP1	Core Research Project	4	5
	ZU235DE1	Discipline Specific Elective I: a) Evolutionary Biology	3	4
	ZU235DE2	Discipline Specific Elective I: b) Vectors, Diseases and Management		
	ZU235DE3	Discipline Specific Elective I: c) Nanobiology		
	ZU235DE4	Discipline Specific Elective II: a) Economic Zoology		

	ZU235DE5	Discipline Specific Elective II: b) Food, nutrition, and health	3	4
	ZU235DE6	Discipline Specific Elective II: c) Bioinstrumentation		
Part IV	UG235PS1	Professional Competency Skill I: Career Skills	2	2
	ZU235IS1	Internship	2	-
		Total	**26**	**30**

SEMESTER VI

Course	Course Code	Title of the Course	Credits	Hours/Week
Part III	ZU236CC1	Core Course VII: Animal Biotechnology	5	6
	ZU236CC2	Core Course VIII: Immunology and Microbiology	5	6
	ZU236CP1	Core Lab Course VI: Animal Biotechnology, Immunology and Microbiology	4	6
	ZU236DE1	Discipline Specific Elective III a) Ecology and Toxicology	3	5
	ZU236DE2	Discipline Specific Elective III: b) History of Indian Science		
	ZU236DE3	Discipline Specific Elective III: c) Agricultural Entomology		
	ZU236DE4	Discipline Specific Elective IV: a) Biochemistry, Biophysics and Biostatistics	3	5
	ZU236DE5	Discipline Specific Elective IV: b) Intellectual Property Rights		
	ZU236DE6	Discipline Specific Elective IV: c) Bioeconomics		
	ZU236PS1	Professional Competency Skill II: Competency in Zoology and Aptitude Skills for Competitive Exams	2	2
		Total	**22**	**30**

Co-curricular Courses

Part	Semester	Code	Title of the Course	Credit
	I & II	UG232LC1	Life Skill Training I: Catechism	1
		UG232LM1	Life Skill Training I: Moral	
	I	UG231C01 –	Skill Development Training (SDT) - Certificate Course	1
	II	ZU232FP1	Field Project	1
	I & III	ZU231V01 -	Specific Value-added Course	1+1
	VI	UG236OC1 & UG236OC2	MOOC	2
	III & IV	UG234LC1	Life Skill Training II: Catechism	1

Part V		UG234LM1	Life Skill Training II: Moral	
	IV & VI	GVAC2401 -	Generic Value-added Course	1 +1
	I - IV	UG234ST1	Student Training Activity – Clubs & Committees / NSS	1
	IV	UG234CE1	Community Engagement Activity - RUN	1
	V	UG235HR1	Human Rights,Justice and Ethics	1
	VI	UG236GE1	Gender Equity and Inclusivity	1
Total				**14**

Specific Value-added Courses:

Semester	Title of the Course	Course Code
I	Pet Keeping and Care	ZU231V01
I	Nutrition and Wellbeing	ZU231V02
I	Introduction to Biofertilizers	ZU231V03
III	Aquarium Keeping	ZU233V01
III	Food Adulteration	ZU233V02
III	Basic Microbial Techniques	ZU233V03

Self-Learning Course:

Semester	Title of the Course	Course Code
III / V	Public Health and Hygiene	ZU233SL1/ZU235SL1
IV/ VI	Dairy Production Technology	ZU234SL1/ZU236SL1

Examination Pattern

Each paper carries an internal component. There is a passing minimum for external component. A minimum of 40% in the external examination and an aggregate of 40% is required.

i. Part I – Tamil, Part II – English, Part III - (Core Course/ Elective Course)

Ratio of Internal and External= 25:75

Continuous Internal Assessment (CIA)

Internal Components and Distribution of Marks

Components	Marks
Internal test (2) - 40 marks	10
Quiz (2) - 20 marks	5
Assignment: (Model Making, Exhibition, Role Play, Seminar, Group Discussion, Problem Solving, Class Test, Open Book Test etc. (Minimum three items per course should be included in the syllabus & teaching plan) (30 marks)	10
Total	**25**

Question Pattern

Internal Test	Marks	External Exam	Marks
Part A 4 x 1(No choice)	4	Part A 10 x 1 (No choice)	10
Part B 2 x 6 (Internal choice)	12	Part B 5 x 6 (Internal choice)	30
Part C 2 x 12 (Internal choice)	24	Part C 5 x 12 (Internal choice)	60
Total	**40**	**Total**	**100**

ii. Lab Course:

Ratio of Internal and External= 25:75

Total: 100 marks

Internal Components and Distribution of Marks

Internal Components	**Marks**
Performance of the Experiments	10
Regularity in attending practical and submission of records	5
Record	5
Model exam	5
Total	**25**

Question pattern

External Exam	**Marks**
Major Practical	75
Minor Practical / Spotters /Record	
Total	**75**

Core Research Project

Ratio of Internal and External = 25:75

Components	**Marks**
Internal	25
External	
Core Research Project Report	40
Viva voce	35
Total	**100**

Part - IV

i. **Non-major Elective, Skill Enhancement Course I & II, Foundation Course** and **Professional Competency Skill**

Ratio of Internal and External = 2**5: 75**

Internal Components and Distribution of Marks

Components	**Marks**
Internal test (2) – 25 marks	10
Quiz (2) – 20 marks	5
Assignment: (Model Making, Exhibition, Role Play, Album, Group Activity, etc. (Minimum three items per course)	10
Total	**25**

Question Pattern

Internal Test	**Marks**	**External Exam**	**Marks**
Part A 2 x 2 (No Choice)	4	Part A 5 x 2 (No Choice)	10
Part B 3 x 4 (Open choice **Three** out of **Five**)	12	Part B 5 x 4 (Open choice any **Five** out of **Eight**)	20
Part C 1 x 9 (Open choice O**ne** out of **Three**)	9	Part C 5 x 9 (Open choice any **Five** out of **Eight**)	45
Total	**25**	**Total**	**75**

ii. **Skill Enhancement Course III & IV**

Digital Fluency

Components	**Marks**
Internal	
Quiz (15 x 1)	15
Lab Assessment (5 x 2)	10
Total	**25**
External	

Practical (2 x 25)	50
Procedure	25
Total	**75**

Fitness and Wellbeing

Components	**Marks**
Internal	
Quiz (15 x 1)	15
Exercise (2 x 5)	10
Total	**25**
External	
Written Test: Part A: Open choice – 5 out of 8 questions (5 x 5) Part B: Open choice – 5 out of 8 questions (5 x 10)	25 50
Total	**75**

iii. Environmental Studies

Internal Components	**Marks**
Project Report	15
Viva voce	10
Total	**25**

External Exam	**Marks**
Part A 5 x 2 (No Choice)	10
Part B 5 x 4 (Open choice any **Five** out of **Eight**)	20
Part C 5 x 9 (Open choice any **Five** out of **Eight**)	45
Total	**75**

iv. Internship

Components	**Marks**
Industry Contribution	50
Report & Viva-voce	50
Total	**100**

v. Professional Competency Skill

Internal Components	**Marks**
Test – 20 marks	5
Individual Activity	10
Group Activity	10
Total	**25**
External Exam	**Marks**
Part A 5 x 2 (No Choice)	10
Part B 5 x 4 (Open choice any **Five** out of **Eight**)	20
Part C 5 x 9 (Open choice any **Five** out of **Eight**)	45
Total	**75**

Co-Curricular Courses:

i. Life Skill Training: Catechism & Moral
Human Rights,Justice and Ethics
Gender Equity Studies
Internal Components

Component	**Marks**

Project - Album on current issues	25
Group Activity	25
Total	**50**

External Components

Component	**Marks**
Written Test: Open choice – 5 out of 8 questions (5 x 10)	50
Total	**50**

ii. Skill Development Training - Certificate Course:

Components	**Marks**
Attendance & Participation	50
Skill Test	50
Total	**100**

iii. Field Project:

Components	**Marks**
Field Work	50
Field Project Report & Viva-voce	50
Total	**100**

iv. Specific Value-Added Courses & Generic Value-Added Courses:

Components	**Marks**
Internal	25
External	75
Total	**100**

v. Student Training Activity: Clubs and Committees

Compulsory for all I & II year students (1 credit).

Component	**Marks**
Attendance	25
Participation	75
Total	**100**

vi. Community Engagement Activity: Reaching the Unreached Neighborhood (RUN)

Components	**Marks**
Attendance & Participation	50
Field Project	50
Total	**100**

vii. Self-Learning Course

Internal Test	**Marks**	**External Exam**	**Marks**
Part A 2 x 2 (No Choice)	4	Part A 5 x 2 (No Choice)	10
Part B 3 x 4 (Open choice **Three** out of **Five**)	12	Part B 5 x 4 (Open choice any **Five** out of **Eight**)	20
Part C 1 x 9 (Open choice O**ne** out of **Three**)	9	Part C 5 x 9 (Open choice any **Five** out of **Eight**)	45
Total	**25**	**Total**	**75**

Outcome Based Education (OBE)

(i) Knowledge levels for assessment of Outcomes based on Blooms Taxonomy

S. No.	**Level**	**Parameter**	**Description**
1	KI	Knowledge/Remembering	It is the ability to remember the previously

			learned
2	K2	Comprehension/Understanding	The learner explains ideas or concepts
3	K3	Application/Applying	The learner uses information in a new way
4	K4	Analysis/Analysing	The learner distinguishes among different parts
5	K5	Evaluation/Evaluating	The learner justifies a stand or decision
6	K6	Synthesis /Creating	The learner creates a new product or point of view

(ii) Weightage of K – Levels in Question Paper

Number of questions for each cognitive level:

Programme	**Assessment**	**Lower Order Thinking**									**Higher order thinking**			**Total number of questions**
		K1			**K2**			**K3**			**K4, K5, K6**			
	Part	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	
I UG	Internal	2	1	-	1	1	1	1	-	1	-	-	-	**8**
	External	5	2	1	3	2	2	2	1	2	-	-	-	**20**
II UG	Internal	1	1	-	1	1	1	1	-	1	1	-	-	**8**
	External	5	1	1	4	1	1	-	3	1	1	-	2	**20**
III UG	Internal	1	-	-	1	-	1	1	1	1	1	1	-	**8**
	External	5	1	1	4	1	1	-	3	1	1	-	2	**20**

The levels of assessment are flexible and it should assess the cognitive levels and outcome attainment.

Evaluation

i. The performance of a student in each course is evaluated in terms of percentage of marks with a provision for conversion to grade points.

ii. Evaluation of each course shall be done by Continuous Internal Assessment (CIA) by the course teacher as well as by an end semester examination and will be consolidated at the end of the semester.

iii. There shall be examinations at the end of each semester, for odd semesters in October/November; for even semesters in April/ May.

iv. A candidate who does not pass the examination in any course(s) shall be permitted to reappear in such failed course(s) in the subsequent examinations to be held in October/ November or April/May. However, candidates who have arrears in practical examination shall be permitted to reappear for their areas only along with regular practical examinations in the respective semester.

v. Viva-voce: Each project group shall be required to appear for Viva -voce examination in defence of the project.

vi. The results of all the examinations will be published in the college website.

Conferment of Bachelor's Degree

A candidate shall be eligible for the conferment of the Degree of Bachelor of Arts / Science / Commerce only if the minimum required credits for the programme thereof (140 + 18 credits) is earned.

Grading System

For the Semester Examination:

Calculation of Grade Point Average for End Semester Examination:

$$\textbf{GPA} = \frac{\text{Sum of the multiplication of grade points by the credits of the course}}{\text{Sum of the credits of the courses (passed) in a semester}}$$

For the entire programme:

Cumulative Grade Point Average (CGPA) $\Sigma_n\Sigma_i C_{ni}G_{ni} / \Sigma_{ni}\Sigma_i C_{ni}$

CGPA = Sum of the multiplication of grade points by the credits of the entire programme / Sum of the credits of the courses of the entire programme

Where,

C_i - Credits earned for course i in any semester

G_i - Grade point obtained for course i in any semester

n - semester in which such courses were credited

Final Result

Conversion of Marks to Grade Points and Letter Grade

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

Overall Performance

CGPA	Grade	Classification of Final Result
9.5-10.0	O+	First Class – Exemplary*
9.0 and above but below 9.5	O	
8.5 and above but below 9.0	D++	First Class with Distinction*
8.0 and above but below 8.5	D+	
7.5 and above but below 8.0	D	
7.0 and above but below 7.5	A++	First Class
6.5 and above but below 7.0	A+	
6.0 and above but below 6.5	A	
5.5 and above but below 6.0	B+	Second Class
5.0 and above but below 5.5	B	
4.0 and above but below 5.0	C	Third Class
0.0 and above but below 4.0	U	Re-appear

*The candidates who have passed in the first appearance and within the prescribed semester are eligible for the same.

SEMESTER I

CORE COURSE I: INVERTEBRATA

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU231CC1	4	1	1	-	6	6	90	25	75	100

Pre-requisite

Students need to know the classification of invertebrates based on their morphology and Anatomy.

Learning Objectives:

1. To distinguish the characteristic features and function, evolutionary position, economic importance, and interaction with the environment of invertebrates.
2. To develop the skill of identification of invertebrates and to promote employability in museum, consultancy firms and educational institutions.

Course Outcome

On the successful completion of the course, student will be able to:		
1	understand the basic concepts of invertebrate animals and recall its structure and functions.	**K1**
2	illustrate and examine the systemic and functional morphology of various groups of invertebrates.	**K2**
3	differentiate and classify the animal's mode of life in various taxa and estimate the biodiversity.	**K3**

K1 - Remember; **K2** - Understand; **K3** – Apply

Units	Contents	No. of Hours
I	**Protozoa:** Introduction to Classification, taxonomy, and nomenclature. General characters and classification of Phylum Protozoa up to classes. Type study: *Paramecium* (Morphology and Reproduction) and *Plasmodium* (Lifecycle) - Parasitic protozoans (*Entamoeba*, *Trypanasoma* & *Leishmania*) - Economic importance Nutrition in protozoa - Host-parasitic interactions in *Entamoeba* and *Plasmodium*- Locomotion in protozoa **Porifera:** General characters and classification up to Classes. Type study: Sycon- Canal system in sponges. Reproduction in sponges. Skeleton in sponges.	**18**
II	**Coelenterata:** General characters and classification up to classes – Type study: *Obelia* (Morphology and lifecycle)- Corals and coral reefs - Economic importance of corals and coral reefs - Polymorphism in Hydrozoa. **Platyhelminthes:** General characters and classification of up to classes. Type study: *Fasciola hepatica* (Morphology and lifecycle)-. Parasitic adaptations. Host-parasitic interactions of Helminthine parasites	**18**
III	.**Aschelminthes** : General characters and classification of up to classes - Type study: *Ascaris lumbricoides* (Morphology and lifecycle), Nematode Parasites and diseases - *Wuchereria bancrofti*, *Enterobius vermicularis*, *Ancylostoma duodenale*. Parasitic adaptations. **Annelida:** General characters and classification up to Classes. Type study: *Nereis* (Morphology) , Metamerism- Modes of life in Annelids. Reproduction in polychaetes.	**18**
IV	**Arthropoda:** General characters and classification of Phylum Arthropoda up to Classes. Type study: *Penaeus indicus* (Morphology	**18**

	and reproduction). Affinities of *Peripatus* – Larval forms in Crustacea. Economic importance of Insects. Insect pests of Agricultural Importance- Pest of rice: Rice stem borer (*Scirpophaga incertulas*) – Pest of Sugarcane: The shoot borer (*Chilo infuscatellus*) – Pest of coconut: The rhinoceros beetle (*Oryctes rhinoceros*). Principles of Integrated Pest Management.	
V	**Mollusca:** General characters and classification of Phylum Mollusca up to Classes. Type study: *Pila globosa*. Foot and torsion in Mollusca. Economic importance- Cephalopods. **Echinodermata:** General characters and classification of Phylum Echinodermata up to Classes. Type study: *Asterias.* Water Vascular system in Echinodermata – Larval forms of Echinoderms.	**18**
	Total	**90**

Self-study	Nutrition in Protozoa; Corals and coral reefs; Nereis; *Penaeus indicus* – Morphology; Economic importance- Cephalopods

Textbooks

1. Ekambaranatha Ayyar, and T. N. Ananthakrishnan, 2000. A Manual of Zoology. Vol 1 (Invertebrata). Part II – Viswanathan Pvt. Ltd.
2. Jordan, E.L. and Verma P.S, 1995. Invertebrate Zoology, 12th edn. S. Chand& Co.
3. Kotpal R.L. 2019. Modern Text Book of Zoology, Invertebrtes 9th Ed., Rastogi Publications, Gangotri, Shivaji Road, Meerut.
4. Vasantharaj David, B. 2001. Elements of Economic Entomology, Popular Book Depot, Chennai.
5. Ruppert and Barnes, R.D. 2006. Invertebrate Zoology, VIII Edition. Holt Saunders International Edition, Belmont, CA: Thomson-Brooks/Cole.

References Books

1. Barrington, E.J.W., 2012, Invertebrate structure and function. Boston – Houghton. Miffin and ELBS, London.
2. Bhamrah, H.S. and KavithaJunea, 2002. A text book of Invertebrates. Alilnol Publications Private Limited, 4374/4B.Ansari Road, Dayaganj, New Delhi.
3. Hyman L.H, 1955. The invertebrates – Vol. I to Vol. VII – McGraw Hill Book Co.
4. Kotpal, 1992. Protozoa, Porifera, Coelenterata, Annelida, Arthropoda, Mollusca, Echinodermata, R.L- Rastogi Publication.
5. Parker, J. and Haswell, 1978. A text book of Zoology Vol. I - Williams and Williams.

Web Resources

1. https://www.nationalgeographic.com/animals/invertebrates/
2. https://bit.ly/3kABzKa
3. https://www.nio.org/
4. https://bit.ly/3lJdUX0
5. https://greatbarrierreef.org/

MAPPING WITH PROGRAMME OUTCOMES

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	1	3	3	1	3	3	3	2	3	2
CO 2	3	2	2	2	2	1	3	3	3	2	2	3
CO 3	3	3	1	2	3	2	3	2	2	3	2	2
TOTAL	**9**	**8**	**4**	**7**	**8**	**4**	**9**	**8**	**8**	**7**	**7**	**7**
AVERAGE	**3**	**2.6**	**1.3**	**2.3**	**2.6**	**1.3**	**3**	**2.6**	**2.6**	**2.3**	**2.3**	**2.3**

3 – Strong, 2 – Medium, 1 - Low

SEMESTER I

CORE LAB COURSE I: INVERTEBRATA

Course Code	L	T	P	S	Credits	Inst. Hours	Total hours	Marks		
								CIA	External	Total
ZU231CP1	-	-	2	-	-	2	30	25	75	100

Pre- requisite:

Students should be aware of invertebrate animals and their living environments

Learning objectives:

1. To enable students to identify different groups of invertebrate animals by observing their external characteristics and understand their adaptations to various environments and modes of life.
2. To develop students' practical skills in invertebrate anatomy through dissection, internal organ display, and mounting of mouthparts and scales, enhancing their understanding of invertebrate structures and functions.

Course outcome

On the successful completion of the course, student will be able to:		
1	identify and label the external features of different groups of invertebrate animals.	**K1**
2	illustrate and examine the circulatory system, nervous system, and reproductive system of invertebrate animals.	**K2**
3	differentiate and compare the structure, function, and mode of life of various groups of animals.	**K3**
4	to compare and distinguish the dissected internal organs of lower animals.	**K4**
5	prepare and develop the mounting procedure of economically important invertebrates.	**K5**

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

Units	Contents	No. of Hours
I	**Major Dissection:** Cockroach: Nervous system, Reproductive system.	30
II	**Minor Dissection:** Cockroach: Digestive system.	
III	**Mounting:** Cockroach: Mouth parts - Honey Bee/ House fly/ Mosquito. Prawn: Appendages	
IV	Record / Observation Note **(Submission Is Mandatory)**	
V	**Spotters:** (i). Protozoa: *Amoeba, Paramecium, Paramecium* Binary fission and Conjugation, *Entamoeba histolytica*, *Plasmodium vivax* (ii). Porifera: Sycon, Gemmule (iii). Coelenterata: Obelia – Colony & Medusa, Aurelia, Physalia, Gorgonia, (iv). Platyhelminthes: Planaria, *Fasciola hepatica*, Fasciola larval forms – Miracidium, Redia, Cercaria, *Taenia solium*, (v). Nemathelminthes: Ascaris (Male & Female), vi). Annelida: Nereis, Chaetopteurs, Hirudinaria, Trochophore larva (vii). Arthropoda: Cancer, Palaemon, Scorpion, Scolopendra, Sacculina, Limulus, Peripatus, Larvae - Nauplius, Mysis, Zoea, (viii). Mollusca: Chiton, Pila, Unio, Pteredo, Murex, Sepia, Loligo, Octopus, (ix). Echinodermata: Asterias, Ophiothrix, Cucumaria, Antedon, Bipinnaria larva.	
	Total	**30**

Textbooks

1. Ekambaranatha Ayyar, and T. N. Ananthakrishnan, 2000. A Manual of Zoology. Vol 1 (Invertebrata). Part II – Viswanathan Pvt. Ltd.

2. Jordan, E.L. and Verma P.S, 1995. Invertebrate Zoology, 12th edn. S. Chand& Co.
3. Kotpal R.L. 2019. Modern Text Book of Zoology, Invertebrates 9th Ed., Rastogi Publications, Gangotri, Shivaji Road, Meerut.
4. Vasantharaj David, B. 2001. Elements of Economic Entomology, Popular Book Depot, Chennai.
5. Ruppert and Barnes, R.D. 2006. Invertebrate Zoology, VIII Edition. Holt Saunders International Edition, Belmont, CA: Thomson-Brooks/Cole.

References Books

1. Barrington, E.J.W., 2012, Invertebrate structure and function. Boston – Houghton. Miffin and ELBS, London.
2. Hyman L.H, 1955. The invertebrates – Vol. I to Vol. VII – McGraw Hill Book Co.
3. Kotpal, 1992. Protozoa, Porifera, Coelenterata, Annelida, Arthropoda, Mollusca, Echinodermata, R.L- Rastogi Publication.
4. Parker, J. and Haswell, 1978. A text book of Zoology Vol. I - Williams and Williams.
5. Srivastava, M.D.L and Srivastava, 1969. A text book of Invertebrate Zoology, U.S-Central Book Depot, Allahabad.

Web Resources

1. https://www.nationalgeographic.com/animals/invertebrates/
2. https://bit.ly/3kABzKa
3. https://www.nio.org/
4. https://bit.ly/3lJdUX0

MAPPING WITH PROGRAMME OUTCOMES

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PO7
CO 1	3	3	1	2	3	1	3	3	3	3	2	2
CO 2	3	2	2	3	2	1	3	2	2	2	3	3
CO 3	3	3	1	2	3	2	2	3	3	2	2	3
CO 4	3	3	1	2	3	1	3	3	3	3	3	2
CO5	2	1	3	2	3	3	2	3	2	3	2	3
TOTAL	**14**	**12**	**13**	**11**	**14**	**8**	**13**	**14**	**13**	**13**	**12**	**13**
AVERAGE	**2.8**	**2.4**	**2.6**	**2.2**	**2.8**	**1.6**	**2.6**	**2.8**	**2.6**	**2.6**	**2.4**	**2.6**

3 – Strong, 2 – Medium, 1 - Low

SEMESTER I

ELECTIVE COURSE I - ANIMAL DIVERSITY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU241EC1	3	1	-	-	3	4	60	25	75	100

Pre-requisite:

Students should be aware of living organisms and their basic morphological differentiations from biological studies.

Learning Objectives

1. To acquire a basic knowledge of diversity and organization of Protozoa, Coelenterates, Helminthes, Annelida, Arthropoda, Mollusca and Echinodermata.
2. To comprehend the taxonomic position and diversity among Protochordata, Pisces, Amphibia, Reptilia, Aves and Mammalia.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	relate the characteristic features in invertebrates and chordates.	K1
2	classify invertebrates up to class level and chordates up to order level.	K2
3	identify the structural and functional organization of few invertebrates and chordates.	K3
4	survey the adaptations and habits of animals to their habitat.	K4
5	assess the taxonomic position of invertebrate and chordate animals.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** – Evaluate

Unit	Contents	Hours
I	Diversity of Invertebrates–I: Principles of taxonomy. Criteria for classification– Symmetry and Coelom–Binomial nomenclature. Classification of Protozoa, Porifera, Coelenterata, Helminthes and Annelida up to classes with two examples.	12
II	Diversity of Invertebrates–II: Classification of Arthropoda, Mollusca and Echinodermata up to class level with examples.	12
III	Diversity of Chordates–I: Classification of Prochordata, Pisces and Amphibia up to orders giving two examples.	12
IV	Diversity of Chordates–II: Classification of Reptilia, Aves and Mammalia up to orders giving two examples.	12
V	Animal organization Structure and organization of (i) Earthworm (ii) Prawn (iii) Rabbit	12
	Total	60

Textbooks

1. Ekamberanatha Ayyar M. 1990. *A Manual of Zoology, Volume I. Invertebrate Part I and Part II.* S. Viswanathan Printers & Publishers Pvt. Ltd.
2. Hickman, C, Keen, S, Larson, A, Eisenhour, D and Roberts, L. 2021. *Animal Diversity* (9th Edition). Graw Hill, Iran.

Reference Books

1. Ekambaranatha Iyer M. and Anantakrishnan T. N. 1990. *A manual of Zoology*. Vol. I. Invertebrata (Part 1 &2). S. Vishwanathan Pvt. Ltd.
2. Ekambaranatha Iyer M. and Anantakrishnan T. N. 1990. *A manual of Zoology*. Vol. II. Chordata S. Vishwanathan Pvt. Ltd.
3. Jordan E. L. and Verma P.S. 1976. *Chordate Zoology*. S. Chand & Co. Jordan E. L. and Verma P.S. 1976. Invertebrate Zoology. S. Chand & Co.

4. Kotpal R. L. 1993. *Protozoa- Echinodermata* (all volumes). Rastogi Publ. Pough H (2004): *Vertebrate life*, VIII Edition, Pearson International.
5. Ruppert and Barnes, R.D. 2006. Invertebrate Zoology, VIII Edition. Holt Saunders International Edition

Web Resources

1. https://blogs.ubc.ca/mrpletsch/2019/09/10/unit-1-1-principals-of-taxonomy/
2. https://byjus.com/biology/animal-kingdom-basis-classification/
3. https://www.britannica.com/animal/arthropod/Classification
4. https://www.geeksforgeeks.org/phylum-chordata/
5. https://www.brainkart.com/article/Phylum-Chordata-and-Diversity-and-General-Characters-of-Chordates_587/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	2	3	2	1	1	2	2	1	2	3	1	1
CO 2	3	1	1	3	1	1	3	2	1	1	2	2
CO 3	2	2	2	1	1	3	3	3	3	1	1	3
CO 4	2	2	3	3	2	2	1	2	1	3	1	1
CO 5	1	1	2	1	2	1	3	1	2	2	3	2
Total	10	9	9	9	7	9	12	9	9	10	8	9
Average	2	1.8	1.8	1.8	1.4	1.8	3	1.8	1.8	2	1.6	1.8

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

SEMESTER I

ELECTIVE LAB COURSE I: LAB ON ANIMAL DIVERSITY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU241EP1	-	-	2	-	2	2	30	25	75	100

Pre-requisite:

Students should be aware of surrounding living invertebrates and vertebrates and their basic structural differentiations and their habitats.

Learning Objectives

1. To understand the structure and label the various parts of the dissected organisms.
2. Enable the students to understand, identify and classify the various fauna surrounding them.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	compare and distinguish the dissected internal organs of animals.	**K1**
2	prepare and develop the mounting procedure of important invertebrate and chordate anatomical parts.	**K2**
3	identify and label the external features of different groups of invertebrates.	**K3**
4	analyze the ecological roles and significance of the organisms within their ecosystems.	**K4**
5	evaluate evolutionary relationships and broader biological concepts among the spotted organisms.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyse; **K5** - Evaluate

Units	Contents	No. of Hours
1	Cockroach - digestive system	**30**
2	Cockroach - nervous system.	
3	Fish-digestive system.	
4	Prawn appendages	
5	Mouth parts- Cockroach	
6	Mouth parts - Mosquito	
7	Scales - Placoid, Cycloid and Ctenoid	
Spotters :*Paramecium, Plasmodium*, Scypha, *Leucosolenia*, Corals. *Taenia solium* – entire, *Ascaris* male and female. Earthworm, Prawn, Scorpion, Pila, Starfish,Amphioxus, Shark, Frog, Calotes, Pigeon feather, Bat		
	Total	**30**

Textbooks

1. Lal, S.S, 2016. *Practical Zoology Invertebrate*, Rastogi Publications. Meerut, Uttar Pradesh
2. Verma, P. S. 2010. *A Manual of Practical Zoology: Invertebates*, S Chand and Co. Noida, Uttar Pradesh.

References Books

1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. 2002. *The Invertebrates:* A New Synthesis, III Edition, Blackwell Science.
2. Barnes, R.D. 1982. *Invertebrate Zoology*, V Edition. Holt Saunders International Edition.
3. Barrington, E.J.W. 1979. *Invertebrate Structure and Functions*. II Edition, E.L.B.S. and Nelson Wiley-Blackwell, New Jershey, USA.
4. Boradale, L.A. and Potts, E.A. 1961. *Invertebrates:* A Manual for the use of Students. Asia Publishing Home.

5. Lal, S.S. 2005. *A text Book of Practical Zoology: Invertebrate*, Rastogi Publications, Meerut

Web Resources

1. https://nbb.gov.in/
2. http://www.agshoney.com/training.htm
3. https://icar.org.in/
4. http://www.csrtimys.res.in/
6. http://csb.gov.in/

MAPPING WITH PROGRAMME OUTCOMES

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	2	3	1	2	3	3	3	3	2
CO2	3	2	2	3	2	1	3	3	2	2	2	3
CO3	3	3	1	2	3	2	3	2	3	3	2	2
CO4	3	3	1	2	3	1	2	3	3	3	3	3
CO5	2	2	2	3	1	2	2	2	3	2	3	2
Total	**14**	**13**	**12**	**12**	**12**	**7**	**12**	**13**	**14**	**13**	**13**	**12**
Average	**2.8**	**2.6**	**2.4**	**2.4**	**2.4**	**1.4**	**2.4**	**2.6**	**2.8**	**2.6**	**2.6**	**2.4**

3 – Strong, 2 – Medium, 1 - Low

SEMESTER I

NON-MAJOR ELECTIVE NME I: ORNAMENTAL FISH FARMING AND MANAGEMENT

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU231NM1	1	-	1	-	2	2	30	25	75	100

Pre- requisite

Introductory understanding of basic aquaculture principles and fish biology.

Learning Objectives

1. To identify various ornamental fish species, their habitat requirements, and the key factors influencing their health and well-being in captivity.
2. To gain skills on the techniques of ornamental fish breeding, rearing, disease control and economics of ornamental fish farming.

Course Outcome:

On the successful completion of the course, student will be able to:		
1	identify commercially important ornamental fishes, including indigenous and exotic varieties.	**K1**
2	explore food and feeding habits in ornamental fishes, including formulated feed and live feed.	**K2**
3	gain expertise in the maintenance of aquariums and water quality management.	**K3**

K1 - Remember; **K2** - Understand; **K3** - Apply

Units	Contents	No. of Hours
I	Introduction to ornamental fish keeping. Scope and importance of ornamental fish culture. Domestic and global scenario of ornamental fish trade and export potential. Commercially important ornamental fishes - Indigenous and exotic varieties.	**6**
II	Biology of egg layers and live bearers. Food and feeding in ornamental fishes. Formulated feed and Live feed; Live feed culture. Breeding, hatchery and nursery management of egg layers (e.g. Goldfish) and live bearers (e.g. Guppy).	**6**
III	Aquarium design and construction; Accessories - aerators, filters and lighting. Aquarium plants and their propagation. Maintenance of aquarium and water quality management. Ornamental fish diseases, their prevention, control and treatment methods.	**6**
IV	Conditioning, packing, transport, and quarantine methods. Economics, trade regulations, domestic and export marketing strategies.	**6**
V	**Practical** 1) Identification of locally available ornamental fishes - Egg layers and live bearers. 2) Identification of locally available live feed organisms.	**6**
	Total	**30**

Self-Study	Scope and importance of ornamental fish culture, Food and feeding in ornamental fishes, Aquarium construction; Accessories - aerators, filters and lighting, Export marketing strategies

Textbooks

1. Swain SK., Sarangi N. and Ayyappan S. 2010. Ornamental fish farming. ICAR, New Delhi.
2. Living Jewels – A handbook on freshwater ornamental fish, MPEDA, Kochi.
3. Dey V.K.A. 1997. A handbook on aquafarming ornamental fishes. MPEDA, Kochi.
4. Ahilan, B., Felix N. and Santhanam R. 2008. Text book of aquariculture. Daya Publishing House, New Delhi.

References:

1. Tarit Kumar Banrjee (2016). *Applied Zoology*. London: New Central Agency (P) Ltd.
2. Supriti Sarkar, Gautam Kundu, Korak Kanti Chaki (2016). *Introduction to Economic Zoology* London: New Central Agency (P) Ltd.
3. Nagendra S. Pawar. (2008). *Applied Zoology*. New Delhi: Adhyayan Publishers.
4. Sukumar De. (2005). *Outlines of Dairy Technology*. New Delhi: Oxford University Press.
5. Williamson. G and Payne. J. A. (1978). *An introduction to Animal Husbandry in the Tropics*. London: Longman Group Limited.

Web links:

1. http://ecoursesonline.iasri.res.in/course/view.php?id=297
3. https://www.ofish.org/
4. https://krishijagran.com/agripedia/income-generation-by-ornamental-fish-culture/
5. https://99businessideas.com/ornamental-fish-farming/

MAPPING WITH PROGRAMME OUTCOMES
MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	1	3	1	3	3	3	3	3	2
CO2	3	3	3	3	3	3	1	3	2	2	2	3
CO 3	1	1	2	2	2	3	3	2	3	3	2	2
TOTAL	**7**	**6**	**7**	**6**	**8**	**7**	**7**	**8**	**8**	**8**	**8**	**8**
AVERAGE	**2.3**	**2**	**2.3**	**2**	**2.6**	**2.3**	**2.3**	**2.6**	**2.6**	**2.6**	**2.6**	**2.6**

S - Strong; M - Medium; L-Low

SEMESTER I
FOUNDATION COURSE: INTRODUCTION TO ZOOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total hours	Marks		
								CIA	External	Total
ZU241FC1	1	1	-	-	2	2	30	25	75	100

Pre-requisite:

Students should know the basic concepts of biology such as systemic classification, Grades in organization, parts of the cell, role of environment, culture of different organisms.

Learning objectives

1. To provide the knowledge of fundamental principles in zoology that will be a foundation for their later advanced courses in more specific biological subjects.
2. Familiarize with animal classification schemes and diagnostic characteristics as well as developing an understanding of and ability to apply basic zoological principles.

Course Outcomes

On the successful completion of the course, students will be able to:		
1	describe the basic concepts of taxonomy, organization, structure and role of cell, environmental issues, importance of culturing organisms.	**K1**
2	apply classification principles and identify animals, its organ system based on its function, environmental problems, benefits of culturing organisms.	**K2**
3	enhance leadership qualities, team spirit, participate in learning activities and communicate effectively among the peer.	**K3**
4	analyze the functional roles of different cell organelles and the integration of various organ systems.	**K4**
5	critically evaluate the interrelationships and functional significance of physiological systems, cellular structures, environmental factors, and applied zoological practices.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** – Analyze; **K5** - Evaluate

Unit	Contents	No. of Hours
I	**Systematic and binomial system of nomenclature**: Systematic, classification a nomenclature, Systematics**:** Kingdom Protista- Salient features, examples; Kingd Animalia-**Introduction to different Phyla**: Protozoa, Porifera, Coelenterata, Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Mollusca, Echinoderma and Chordata	**6**
II	**Physiology**: Introduction to organ systems- Digestive, Respiratory system, and Circulatory system and Reproductive system.	**6**
III	**General structure Cell**: Ultrastructure of prokaryotic and eukaryotic cell. Different cell organelles- endoplasmic reticulum, Golgi bodies, mitochondria, lysosome, nucleus, nucleolus.	**6**
IV	**Environmental Biology:** Principal layers of atmosphere- Ecosystem, Abiotic and biotic factors. Global warming, greenhouse effects, acid rain.	**6**
V	**Applied Zoology**: Aquaculture - Pisciculture and Pearl culture, Sericulture, Apiculture.	**6**
	Total	**30**

Self-Study	Binomial system of nomenclature, Organisation - organ systems, Differentiation of Prokaryotic and Eukaryotic cell, Outline of greenhouse effects, acid rain.

Textbooks

1. Ekambaranatha Iyer, 2000. *A Manual of Zoology*, 10th edition, Viswanathan, S.,

Printers & Publishers Pvt Ltd.
2. Kumar P. and Mina U. (2018) *Life Sciences: Fundamentals and Practice*, Part-I, 6th Edn., Pathfinder Publication. p.608.

Reference Books

1. Jordan, E.L. and Verma P.S, 1995. *Invertebrate Zoology*, 12th edn. S. Chand& Co
2. Kotpal R.L. 2019. *Modern Text Book of Zoology, Invertebrtes* 9th Ed., Rastogi Publications, Gangotri, Shivaji Road, Meerut, 1004 pp.
3. Rastogi, S.C., *Cell Biology*, 2008, New Age International (P) Limited, Publishers, New Delhi, 2nd Ed.,
4. Goel, K. A. and K.V. Sastry. 1998, *A Text Book of Animal Physiology*, 6th Revised edition. Rastogi Publications
5. Sreekumar, S. 2010. *Basic physiology*, PHI learning private ltd., New Delhi.210 pp

Web Resources

1.https://byjus.com/biology/animal-kingdom-animalia-subphylum/
2.https://www.verywellhealth.com/organ-system-1298691
3.https://biologydictionary.net/organ-system/
4.https://www.noaa.gov/jetstream/atmosphere/layers-of-atmosphere

MAPPING WITH PROGRAMME OUTCOMES

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	2	3	2	2	3	3	3	3	2
CO2	3	2	2	3	2	3	3	3	3	2	3	3
CO3	3	3	3	2	3	2	3	3	3	3	3	2
CO4	2	2	2	3	2	3	2	3	2	2	3	3
CO5	2	2	2	3	3	3	2	2	3	2	3	3
Total	**13**	**12**	**12**	**1.3**	**13**	**13**	**12**	**14**	**14**	**12**	**15**	**13**
Average	**2.6**	**2.4**	**2.4**	**2.6**	**2.6**	**1.6**	**2.4**	**2.8**	**2.8**	**2.4**	**3**	**2.6**

3 – Strong, 2 – Medium, 1 - Low

SEMESTER I

SPECIFIC VALUE-ADDED COURSE: PET KEEPING AND CARE

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU231V01	1	-	1	-	1	2	30	25	75	100

Pre requisite:

A foundational knowledge of animal behaviour, basic care practices, and an interest in the welfare of animals is important.

Learning Objectives:

1.To provide comprehensive knowledge about pet ownership and promote awareness of ethical responsibilities towards pets.

Course Outcomes

On completion of this course, students will be able to:		
1	identify legal regulations and guidelines related to pet ownership	K1
2	interpret pet behaviour and communication cues	K2
3	utilize grooming routines and implement basic first aid and emergency care techniques.	K3
4	analyze the impact of legal regulations on animal welfare and responsible pet care.	K3
5	assess living conditions and space availability and the appropriateness of nutrition and feeding plans.	K5
6	design strategies for responsible pet selection based on living conditions and lifestyle.	K6

Unit	Content	Hours
I	**Introduction to Pet Keeping**: Importance of pets in Indian culture and society - commonly kept pets in India and their roles - Legal regulations and guidelines for pet ownership - Cultural considerations in pet care - Ethical responsibilities towards pets and animal welfare.	6
II	**Selecting the Right Pet:** Assessing living conditions and space availability - Choosing pets based on lifestyle and family dynamics - Pros and cons of popular pet choices - Identifying local and indigenous pet breeds.	6
III	**Practical Aspects of Pet Care:** Nutrition and feeding practices - Grooming routines - common health concerns specific to India - Basic first aid and emergency care.	6
IV	**Nurturing Healthy Relationships with pets:** Pet behaviour and communication - Training techniques for pets and households - promoting mental and physical stimulation for pets.	6
V	**Community Engagement and Advocacy:** Promoting responsible pet ownership in local communities - organizing and participating in pet care workshops - Collaborating with local animal welfare organizations - raising awareness about pet-related issues in India.	6
	Total	30

Reference books:

1. David Alderton: The complete book of pets & pet care: the essential family reference guide to pet breeds and pet care
2. Selvam R.K. Veera. 2010. Handbook of per care and management. Soujanya Books. 1st edn. Jaipur.
3. Dash, S.K. 2008. Hand book of veterinary practices. 1st edition. Kalyani Publishers.
4. Sapre, V A. and Dakshinkar, N.P. 2020. Hand book for veterinary physician. 17th edn. CBS Publishers.
5. Bhikane, A.U. and Kawithar, S.B. 2022. Handbook for veterinary clinicians. Agribiovet Press.

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	3	2	3	2	3	3	2	3
CO2	3	3	3	3	3	2	3	3	3	3	3	3
CO3	3	2	2	3	3	3	3	3	3	3	2	3
CO4	3	3	2	2	3	3	3	3	3	3	2	3
CO5	3	3	2	3	3	3	3	3	3	3	2	3
Total	**15**	**14**	**11**	**14**	**15**	**13**	**15**	**14**	**15**	**15**	**11**	**15**
Average	**3**	**2.8**	**2.2**	**2.8**	**3**	**2.6**	**3**	**2.8**	**3**	**3**	**2.2**	**3**

3 – Strong, 2 – Medium, 1 – Low

SEMESTER I

SPECIFIC VALUE-ADDED COURSE: NUTRITION AND WELL-BEING

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU231V02	1	-	1	-	1	2	30	25	75	100

Pre requisite:

A basic knowledge of food and nutrients.

Learning Objectives:

1. To provide the basic principles of nutrition, including the classification of nutrients into food groups.
2. To understand the causes of nutritional disorders and weight management.

Course Outcomes:

On completion of this course, students will be able to:		
1.	understand the fundamental principles of nutrition and their roles in maintaining health	**K1**
2.	identify different nutrients and its importance.	**K2**
3.	apply recommended dietary allowances and guidelines to plan balanced diets	**K3**
4.	identify and address the unique nutritional needs of different age groups	**K4**
5.	analyze the causes of malnutrition by applying the food and safety regulations of India, and recommend an appropriate diet plan.	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** – Evaluate

Unit	Content	No. of Hours
I	**Nutrients:** Basic concept of nutrition - Food groups - carbohydrates, fats, proteins, water- vitamins and minerals. Dietary fibre.	6
II	**Dietary guidelines:** Recommended Dietary Allowances (RDA) and guidelines. Balanced diet - Food guide pyramid - Meal planning for the family.	6
III	**Nutritional and food requirements of different age groups** – infants, Pre Schoolers, Schoolers, Adolescents, Adults, Pregnant and lactating women and during old age.	6
IV	**Malnutrition**: Causes and prevention of malnutrition - under nutrition and its effects. Obesity and underweight, Body Mass Index (BMI), Weight management guidelines for a dietitian.	6
V	**Therapeutic Diets**: Importance of diet in disease - therapeutic diet planning. Dietary management of Fever – Constipation- Diarrhoea Effect of cooking on the nutritive value of food. Supplementary and novel food.	6
	Total	30

Self-study	Malnutrition and dietary requirements

Textbooks

1. Swaminathan, M. (2006). *Handbook of Food and nutrition.* The Bangalore Printing and Publishing Co. Ltd., Bangalore.
2. Ray, P.K. 2017. Health, Hygiene and Nutrition - 3 Tiers of a Good Living : Know Your Health. Notion Press; 1st edition, Chennai.

Reference Books

1. Pooja Verma (2015). *Food, Nutrition and Dietetics.*: CBS Publishers Distributors Pvt.

Ltd., Chennai
2. Srilakshmi, B. (2014). *Dietetics* (7th ed). New Delhi: New Age International (P) Ltd.
3. Sumati Mudambi, R. (2012). *Fundamentals of Foods and Nutrition* (6th ed.), New Age International (P) Ltd., New Delhi.
4. Sangeeta Karnik (2010). *Nutrition and Diet therapy*. Biotech Pharma Publications, Chennai.
5. Joshi S.A. *(*2001). *Nutrition and Dietetics.* Tata McGraw Hill Publishing Ltd. New Delhi.

Web Resources:

1. https://byjus.com/biology/nutrients/
2. https://www.nin.res.in/downloads/DietaryGuidelinesforNINwebsite.pdf
3. https://egyankosh.ac.in/bitstream/123456789/47979/1/Unit-3.pdf
4. https://www.youtube.com/watch?v=OjbYAgCKxA4
5. https://slideplayer.com/slide/6201214/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3	2	3	3	2	2	2	2
CO2	2	3	2	2	3	3	3	2	2	2	3	3
CO3	3	3	3	3	3	2	2	2	2	3	3	2
CO4	3	3	3	3	3	2	3	2	2	2	2	2
CO5	3	3	3	2	3	2	3	2	2	2	2	3
Total	**14**	**15**	**13**	**12**	**15**	**11**	**14**	**11**	**10**	**11**	**12**	**12**
Average	**2.8**	**3**	**2.6**	**2.4**	**3**	**2.2**	**2.8**	**2.2**	**2**	**2.2**	**2.4**	**2.4**

3 – Strong, 2 – Medium, 1 - Low

SEMESTER I

SPECIFIC VALUE-ADDED COURSE: INTRODUCTION TO BIOFERTILIZERS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU231V03	1	-	1	-	1	2	30	25	75	100

Prerequisite:

Basic understanding of biology and chemistry.

Learning Objectives:

1. To understand the principles and importance of biofertilizers in sustainable agriculture.
2. To learn about the types of biofertilizers, their mode of action, and application methods**.**

Course Outcomes

COs	On completion of this course, students will be able to	
1	identify different types of biofertilizers and their sources.	K1
2	define biofertilizers and explain their role in enhancing soil fertility.	K2
3	demonstrate the proper methods for the production and application of biofertilizers.	K3
4	compare the advantages and limitations of different biofertilizer formulations.	K4
5	evaluate the effectiveness of biofertilizers in improving crop yield.	K5

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** – Evaluate

Unit	Content	No. of Hours
I	**Introduction to Biofertilizers:** Definition of biofertilizers, Historical background and evolution of biofertilizer use, Importance of biofertilizers in sustainable agriculture, Comparison with chemical fertilizers, Global trends and adoption rates**.**	6
II	**Types and Sources of Biofertilizers:** Nitrogen-fixing biofertilizers , Phosphate-solubilizing biofertilizers, Potassium-mobilizing biofertilizers, Sources of biofertilizer inoculants and formulations.	6
III	**Mechanisms of Action:** Nitrogen fixation and assimilation Phosphorus solubilization and uptake, Potassium mobilization and nutrient availability. Enhancement of soil microbial activity and nutrient cycling, Indirect effects on plant health and stress tolerance.	6
IV	**Production and Application:** Isolation and characterization of biofertilizer strains, Fermentation and mass production techniques Methods of inoculation: seed treatment, soil application, foliar spray, Timing, and dosage considerations for optimal efficacy.	6
V	**Benefits & limitations**: Environmental benefits of biofertilizers: soil health, biodiversity, water quality. Risks: contamination, pathogen transmission, imbalance in soil microbial communities.	6
	Total	30

Self-study	Applications of Biofertilizers

Textbooks:

1. Krishnendu Acharya, Surjit Sen, Manjula Rai. 2019. *Biofertilizers and Biopesticides*. Techno World; First Edn., India.
2. Kannaiyan, S., Kumar, K., Govindarajan, K. 2013. Biofertilizers Technology. Scientific Publishers, 1st edn., India

Reference Books:

1. Awani Kr. Singh, 2018. *Handbook of Microbial Biofertilizers*. Agrobios Press, India.
2. Reeta Khosla, 2017. *Biofertilizers and Biocontrol Agents for Organic Farming.* Kojo Press, New Delhi.
3. Eiri Board, 2009. *Hand Book Of Biofertilizers & Vermiculture.* Engineers India Research Institute, India.
4. Rai, M. K. 2006. *Handbook of Microbial Biofertilizers*. International Book Distributing Co, Dehradun, Uttarakhand.
5. Subbarao, N.S. 2017. *Bio-fertilizers in Agriculture and Forestry*. Scientific International Pvt. Daryaganj, New Delhi

Web Resources:

1. https://www.youtube.com/watch?v=kWp0MxO6bg4
2. https://www.youtube.com/watch?v=LvqMMfa8ysM
3. https://www.youtube.com/watch?v=yeGBvpqC5io
4. https://www.youtube.com/watch?v=O1FfEbpaiHw
5. https://www.youtube.com/watch?v=zQvkT0vQdZ0

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	3	2	3	2	3	3	2	3
CO2	3	3	3	3	3	2	3	3	3	3	3	3
CO3	3	2	2	3	3	3	3	3	3	3	2	3
CO4	3	3	2	2	3	3	3	3	3	3	2	3
CO5	3	3	2	3	3	3	3	3	3	3	2	3
Total	**15**	**14**	**11**	**14**	**15**	**13**	**15**	**14**	**15**	**15**	**11**	**15**
Average	**3**	**2.8**	**2.2**	**2.8**	**3**	**2.6**	**3**	**2.8**	**3**	**3**	**2.2**	**3**

3 – Strong, 2 – Medium, 1 – Low

SEMESTER II

CORE COURSE II: CHORDATA

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU232CC1	4	1	1	-	6	6	90	25	75	100

Pre-requisite

Students should know the taxonomical classification of chordates in relation to their functional morphology.

Learning objectives

1. To develop an in-depth knowledge on the structures and distinct features of Phylum Chordata.
2. To identify the animals of each subphylum and class based on their characteristic features.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	recall the name and distinct features of different sub phylum belonging to phylum Chordata.	**K1**
2	explain the structural organization, function and evolutionary aspects of chordates.	**K2**
3	interpret the biological significance and the conservation of chordates.	**K3**

K1 - Remember; **K2** - Understand; **K3** - Apply

Units	Contents	No. of Hours
I	General Characters and Classification of Phylum Chordata: origin of Chordata, differences between non-chordates and chordates, general characters, affinities and systematic position of Hemichordata (*Balanoglossus*), Urochordata (*Ascidia*), Cephalochordata (*Amphioxus*).	**18**
II	Agnatha: Characteristics of subphylum vertebrata. General characters and classification up to class level, Agnatha (*Petromyzon*), - Pisces (*Scoliodon sorrakowah*), circulatory system, sense organs. - types of scales and fins - accessory respiratory organs - air bladder - parental care - migration - economic importance.	**18**
III	Amphibia: General characters and classification up to orders with names of the examples only - Type study –*Rana hexadactyla* - Morphology, Digestive system, respiratory system, Urinogenital system, , Endoskeleton: Skull, typical vertebra, atlas, girdles and limbs. Adaptive features of Anura, Urodela and Apoda - Neoteny in Urodela - Parental care in Amphibia.	**18**
IV	Reptilia: General characters and classification - Type study – (*Calotes versicolor* - Morphology, endoskeleton of *Varanus*). Extinct reptiles. Snakes of South India: Poisonous snakes - *Naja naja*, King cobra and Viper, Non-poisonous snakes - Python, Rat snake (*Ptyas mucosa*) and Wolf snake (*Lycodon aulicus*). Poison apparatus and biting mechanism of poisonous snakes - Skull in reptiles as basis of classification	**18**
V	Aves and Mammalia**:** Aves: general characters and classification – type study - *Columba livia* - exoskeleton - flight adaptations, Migration. Mammalia: general characters and classification - type	**18**

	study - Rabbit - nervous system. Adaptations of aquatic mammals, egg laying mammals, marsupials, flying mammals. Dentition in mammals.	
	Total	**90**

Self-study	General characters of Chordates, types of scales and fins. Parental care in amphibia, Poisonous snakes and Flight adaptations

Textbooks

1. N. Arumugam, A. Thangamani, S. Prasanna Kumar, L.M. Narayanan, 2022. Chordate Zoology, Saras Publication, Nagercoil.
2. Kotpal, R. L. 2019. Chordata and Comparative Anatomy. Rastogi publications. Meerut, U.P.

References Books

1. Singh, B.D. A Text Book of Zoology Chordata Paperback – 1. Kedar Nath Ram, Meerut, Uttar Pradesh.
2. Kotpal, R.L. A, 2009. Modern text book of Zoology Vertebrates, Rastogi publications. Meerut, U.P.
3. Young, J. Z., 2004. The Life of Vertebrates. III Edition. Oxford university press.
4. Waterman, Allyn J. et al., 1971. Chordate Structure and Function, Mac Millan & Co., New York.
5. Hall B.K. and Hallgrimsson B., 2008. Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.

Web resources

1. https://byjus.com/biology/phylum-chordata-classification/
2. https://www.uou.ac.in/sites/default/files/slm/BSCZO-201.pdf
3. https://sunyorange.edu/biology/resources/library/prehistoric-life/chordates.html
4. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBC1201.pdf
5. file:///C:/Users/91944/Desktop/Chordata%20Verma%20college.pdf

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	3	3	2	3	3	2	2	2	3
CO2	3	1	2	2	2	2	3	2	2	2	1	2
CO3	3	2	1	2	2	1	3	2	1	1	1	2
TOTAL	**9**	**5**	**5**	**7**	**7**	**5**	**9**	**7**	**5**	**5**	**4**	**7**
AVERAGE	**3**	**1.6**	**1.6**	**2.3**	**2.3**	**1.6**	**3**	**2.3**	**1.6**	**1.6**	**1.3**	**2.3**

3 – Strong, 2- Medium, 1- Low

SEMESTER II

CORE LAB COURSE: LAB ON CHORDATA

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								Internal	External	Total
ZU232CP1	-	-	2	-	2	2	30	25	75	100

Pre-requisite

Students should know the taxonomical classification of chordates in relation to their functional morphology.

Learning Objectives

1. To identify the structures and distinct features of phylum Chordata
2. To distinguish the characteristic features of each subphylum and class

Course Outcomes

On the successful completion of the course, student will be able to:		
1	identify and recall the name and distinct external and internal features of animals belonging to phylum Chordata.	**K1**
2	explain the structural organization of various organs and systems in different classes of vertebrates.	**K2**
3	analyze, compare, and distinguish the morphological features and developmental stages of chordates	**K3**

K1 - Remember; **K2** - Understand; **K3** – Apply

Units	Contents	No. of Hours
I	**Dissections**: Frog (Demo): External features, Digestive system, Arterial system, 5th Cranial nerve, 9th and 10th cranial nerves.	**30**
II	**Mounting**: Fish: Placoid and Ctenoid scales, Frog: hyoid apparatus and brain (Demo).	
III	**Osteology**: Frog: skull, vertebral column, pectoral girdle, pelvic girdle, Forelimb, hindlimb. Chelonia - anapsid skull. Pigeon – skull, synsacrum.	
IV	**Specimen and Slides**: Balanoglossus, Tornaria larva, Amphioxus, Petromyzon, Ammocoetus larva. Pisces: *Torpedo, Channa, Hippocampus, Exocoetus, Echieneis, Catla, Clarius.* Scales: placoid, cycloid, ctenoid Amphibia: Ichthyophis, *Bufo*, Axolotl larva Reptilia : Draco, *Chemaeleon, Gecko, Uromastix, Vipera russelli, Naja, Enhydrina, Typhlops Trionyx, Crocodilus,* Aves: *Psittacul*a, *Bubo, Corvus, Pavo*; Collection and study of different types of feathers: Quill, Contour, Filoplume, Down Mammalia: Ornithorhynchus, Tachyglossus, Pteropus, Funambulus, Loris, Hedgehog	
V	**Embryology**: Life cycle of Frog - Placenta in mammals.	

Textbooks

1. Lal S. 2009. *Practical Zoology Vertebrate*, Rajpal and Sons Publishing, New Delhi.
2. Verma P. S, 2000. *A Manual of Practical Zoology: Chordates*, S. Chand Limited. New Delhi.

Reference Books

1. Robert William Hegner, 2015. *Practical Zoology*, Biblio Life. Macmilla London.
2. Young, J, Z., 1972. *The life of Vertebrates*. Oxford University. London.
3. Kotpal, R.L. A, 2009. Modern text book of Zoology Vertebrates- Rastogi publications.

Meerut, U.P.

Web Resources

1. https://bit.ly/3CzTEy8
2. https://www.youtube.com/watch?v=b04hc_kOY10
3. http://tolweb.org/Chordata/2499
4. https://www.nhm.ac.uk/
5. https://bit.ly/3Av1Ejg

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	3	3	2	3	3	2	2	2	3
CO2	3	1	2	2	2	2	3	2	2	2	1	2
CO3	3	2	1	2	2	1	3	2	1	1	1	2
TOTAL	**9**	**5**	**5**	**7**	**7**	**5**	**9**	**7**	**5**	**5**	**4**	**7**
AVERAGE	**3**	**1.6**	**1.6**	**2.3**	**2.3**	**1.6**	**3**	**2.3**	**1.6**	**1.6**	**1.3**	**2.3**

3 – Strong, 2- Medium, 1- Low

SEMESTER II

ELECTIVE COURSE IV: ECONOMIC ZOOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU242EC1	3	-	-	1	3	4	60	25	75	100

Pre-requisite:

Students should have fundamentals of culture practices of economically important animals.

Learning Objectives:

1. To empower the students with the culture practices of economically important animals.
2. To enable the students to become an entrepreneur.

Course Outcomes

On the successful completion of the course, students will be able to:		
1	recall the principles of api-, seri-, and aquaculture, poultry and dairy farming.	K1
2	explain the tools and techniques used in rearing practices.	K2
3	practice the fundamental concepts of applied zoology in research and animal farms.	K3
4	inspect the quality of honey, silk, egg, milk and fish.	K4
5	evaluate the profitability of animal farms.	K5

K1 - Remember; **K2 -** Understand; **K3** – Apply; **K4 -** Analyse; **K5** – Evaluate

Units	Contents	No. of Hours
I	**Aquaculture:** Aquaculture in India – Important cultivable organisms and their qualities – culture of Indian major carps, Marine prawn culture, Pearl culture. Integrated fish culture (Paddy cum fish culture).	12
II	**Apiculture:** classification and kinds of bees, bees and their society - caste distinction and their functions. Methods of bee keeping (primitive and modern). Honey bee products: honey, bee wax, bee venom.	12
III	**Sericulture:** Moriculture – methods of propagation – Common species of Silkworm – Life cycle of mulberry silkworm (egg, larva, pupa and adult). Rearing of silkworm – mounting – spinning- harvesting of cocoons – silk reeling and marketing.	12
IV	**Poultry Farming:** Poultry housing - types of poultry houses – management of chick, growers, layers and broilers. Sexing in chicks, Nutritive value of egg. Diseases of poultry – Ranikhet, Fowl pox, Coryza, Coccidiosis, Polyneuritis.	12
V	**Dairy Farming:** Breeds of Dairy animals – Establishment of a typical Dairy farm – Management of cow (Newborn, calf, Heifer, milking cow) – Diseases (Mastitis, Rinder Pest, Foot and Mouth Disease). Dairy products (Standard milk, skimmed milk, toned milk and fermented milk - curd, ghee, cheese) Pasteurization.	12
	Total	60

Self-study	Pearl culture, honey, spinning, Fowl pox

Textbooks:

1. Arumugam, N., Murugan, T., Johnson Rajeshwar, J. and Ram Prabhu, R. 2011. *Applied Zoology.*: Saras Publications Nagercoil.

Reference Books:

1. Johnson, J. and Jeya Chandra, I. 2005. *Apiculture.* Olympic Grafix. Marthandam.
2. Ganga, G. and Sulochana Chetty 1997. *An Introduction to Sericulture.* Oxford and IBH

Publishing Co. Pvt. Ltd. New Delhi
3. Gnanamani, M.R. (2005). *Profitable Poultry Farming*. J. Hitone Publications, Madurai.
4. Santhanakumar, G. and Selvaraj, A.M. (2002). *Concepts of Aquaculture.* Meenam Publications. Nagercoil
5. Uma Shankar Singh (2008). *Dairy Farming.* Anmol Publishers. New Delhi

Web Resources:

1. https://ariesagro.com/rise-of-aqua-culture-in-india/
2. https://fisheries.bihar.gov.in/Docs/prawnculture.pdf
3. https://en.wikipedia.org/wiki/Beekeeping
4. https://kvk.icar.gov.in/API/Content/PPupload/k0160_11.pdf
5. https://byjus.com/chemistry/sericulture/#:~:text=Sericulture%20is%20the%20process%20of,used%20silkworm%20species%20in%20sericulture

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	2	3	3	3	3	3	3	3	3	3
CO2	2	3	3	2	3	3	2	3	2	3	2	3
CO3	2	2	2	3	2	2	2	3	3	2	3	2
CO4	2	2	2	2	2	2	2	2	3	3	2	2
CO5	1	3	2	2	1	1	3	3	3	2	3	2
TOTAL	**9**	**13**	**1**	**12**	**11**	**12**	**12**	**14**	**14**	**13**	**13**	**12**
AVERAGE	**1.8**	**2.6**	**2.2**	**2.4**	**2.2**	**2.4**	**2.4**	**2.8**	**2.8**	**2.6**	**2.6**	**2.4**

3 – Strong, 2- Medium, 1- Low

SEMESTER II

ELECTIVE LAB COURSE II: LAB COURSE ON ECONOMIC ZOOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU242EP1	-	-	2	-	2	2	30	25	75	100

Pre-requisite:

Students with basic knowledge on economically important animals.

Learning Objectives:

1. To develop practical skills in basic concepts of biology.
2. To make students to acquire more practical knowledge through industrial visits to agro- based farms.

Course Outcomes

On the successful completion of the course, students will be able to:		
1	identify and classify invertebrates and chordates.	K1
2	estimate the salinity and oxygen content of water samples.	K2
3	identify aquatic culturable organisms and their diseases.	K3
4	develop skill in dissection and microscopy.	K4
5	gain knowledge through field visit.	K5

K1 - Remember; **K2 -** Understand; **K3** – Apply; **K4 -** Analyse; **K5** – Evaluate

Units	Contents	No. of Hours
1.	Dissection of silk gland of *Bombyx mori*.	30
2.	Testing of purity of Honey in three different samples	
3.	Identification of cells in the honey bee comb	
4.	Qualitative analysis of milk - Methylene reductase test	
5.	Estimation of protein in hen's egg.	
6.	Estimation of oxygen in water samples.	
7.	Estimation of salinity in water samples.	
8.	Visit to places having importance related to theory.	
9.	Spotters / Models / Charts / Bookplates	
Honey bee (worker, queen and drone), Newton's bee-hive, silkworm (egg, larva, pupa and adult), Chandrika, Rearing stand, Poultry feeders, Fowl pox, Coccidiosis, *Catla catla*, *Rohu*, *Mrigala*.		

Textbooks:

1. Aminul Islam, 2016. *Textbook of Economic Zoology*. I K International Publishing House Pvt. Ltd, India.
2. Supriti Sarkar, 2014. *Introduction to Economic Zoology*. New Central Book Agency; New edition, India.

Reference Books:

1. Monika Panchani, 2021. *Lab manual applied Zoology.* Panchai Publishing, White Falcon Publishing, India.
2. Rastogi V.B. 1999. *Lower non-chordate* & *Economic Zoology*, Rastogi publications, Meerut, Uttar Pradesh.
3. Plummer D.T., 1988, *An introduction Practical Biochemistry*. 3rd edition, Tata M.C Graw-Hill publishing, New York.

4. Raghuramu, Nair and Kalyanasundaram, 1983. *A Manual of Laboratory, Techniques*, Hyderabad, India.
5. Adate et al., 2023. *A Hand book of practical Zoology*. Bhumi Publishing, Kolhapur, Maharashtra

Web Resourses:

1. https://www.youtube.com/watch?v=agdFb9qPYQs
2. https://www.youtube.com/watch?v=frtln5ZoeNQ
3. https://www.youtube.com/watch?v=R4TdJGeeA30
4. https://www.youtube.com/watch?v=5-5gIRl9uCg

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	2	3	3	3	3	3	3	3	3	3
CO2	2	3	3	2	3	3	2	3	2	3	2	3
CO3	2	2	2	3	2	2	2	3	3	2	3	2
CO4	2	2	2	2	2	2	2	2	3	3	2	2
CO5	1	3	2	2	1	1	3	3	3	2	3	2
TOTAL	**9**	**13**	**1**	**12**	**11**	**12**	**12**	**14**	**14**	**13**	**13**	**12**
AVERAGE	**1.8**	**2.6**	**2.2**	**2.4**	**2.2**	**2.4**	**2.4**	**2.8**	**2.8**	**2.6**	**2.6**	**2.4**

3 – Strong, 2- Medium, 1- Low

SEMESTER II

NON-MAJOR ELECTIVE NME II: BIOCOMPOSTING FOR ENTREPRENEURSHIP

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU232NM1	-	1	1	-	2	2	30	25	75	100

Pre-requisite

Students should aware about the effect of chemical pollution and the importance of organic farming.

Learning Objectives:

1. To highlight the importance of Bio composting for entrepreneurship in waste management.
2. To enable students for setting up Bio compost units and bins for waste reduction.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	define the process of bio composting by earthworms and explain the economic cost of establishing small Biocompost units as a cottage industry.	**K1**
2.	demonstrate composting techniques for various applications like solid waste management, industrial waste recycling using sugarcane bagasse, etc	**K2**
3.	establish a small Biocompost units as a cottage industry.	**K3**

K1- Remember; **K2**- Understand; **K3**- Apply

Units	Contents	No. of Hours
I	Biocomposting – Definition, types; home composting, vermicomposting, aerobic composting, anaerobic composting. Compost Ingredients - ecological importance.	**6**
II	Biocomposting technology: Field pits - ground heaps – tank - large-scale - batch and continuous methods – biology of the composting process. Humification of organic material. Compost enrichment.	**6**
III	Methods of composing - Preparation of Biocompost pit and bed for Bangalore method, Indore method, Coimbatore method, NADEP method.	**6**
IV	Applications of Biocompost in soil fertility maintenance, promotion of plant growth, value added products, waste reduction, etc. Drawbacks of using composts.	**6**
V	Economics of establishment of a small biocompost unit – project report proposal for Self Help Group (Income and employment generation).	**6**
	Total	**30**

Self-study	Biocomposting – Definition, types and ecological importance.

Textbooks

1. Seetha Lekshmy, M. and Santhi. R, 2012. *Vermitechnology.* Nagercoil: Saras Publications, Nagercoil.
2. Mary Violet Christy. A, 2008. *Vermitechnology.* MJP Printers and Publishers Pvt. Ltd., Chennai.

Reference Books

1. Bikas R. Pati& Santi M. Mandal, 2019. Recent trends in composting technology. IK International Publishing House Pvt. Ltd.
2. Dohama, A.K, 2004. *Vermicompost*, New Delhi: Vivekananda Kendra (NARDEP), Kaakumari.
3. Dahama, A.K, 2009. *Organic farming for sustainable Agriculture* (2nded.). Agrobios. Jodhpur
4. Sultan Ahmed Ismail, 2005. *The Earthworm* (2nded.).: Other India Press, Goa.
5. Gupta, P.K, 2003. *Vermicomposting for sustainable Agriculture.* Agrobios, Jodhpur.

Web Resources

1. https://www.dhsgsu.edu.in/images/Community-College/02-COMPOSTING-TECHNIQUES.pdf
2. https://www.trustbasket.com/blogs/composting/methods-of-composting-indoor-method-bangalore-method-coimbatore-method-nadep-method
3. https://aggie-horticulture.tamu.edu/earthkind/landscape/dont-bag-it/chapter-2-composting-fundamentals/
4. https://www.brainkart.com/article/Composting_35265/
5. https://www.epa.gov/recycle/composting-home

MAPPING WITH PROGRAMME OUTCOMES

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	3	2	3	2	3	3	2	3	2
CO2	3	1	1	3	2	3	2	3	3	2	2	3
CO3	3	2	2	2	2	2	2	2	2	3	2	2
TOTAL	**6**	**5**	**4**	**8**	**6**	**8**	**6**	**8**	**8**	**7**	**7**	**7**
AVERAGE	**2.2**	**1.6**	**1.3**	**2.7**	**2.2**	**2.7**	**2.2**	**2.7**	**2.7**	**2.3**	**2.3**	**2.3**

3 - Strong; 2 - Medium; 1 - Low

SEMESTER II

SKILL ENHANCEMENT COURSE SEC-1: BEEKEEPING

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU242SE1	1	1	-	-	2	2	30	25	75	100

Prerequisite

Students should have the basic understanding of honey bees and their economic importance.

Learning Objectives

1. To train the students to learn the techniques of honey bee rearing, optimization of techniques based on climate and geographical regions, and various measures to be taken to maximize the benefits.
2. To help the student to become familiar with the significance of beekeeping as an economically viable industry.

Course Outcomes

On the successful completion of the course, students will be able to:		
1	gain a comprehensive understanding of the key concepts related to the beekeeping.	**K1**
2	impart thorough knowledge about the techniques involved in bee keeping and honey production.	**K2**
3	develop entrepreneurial skills necessary for self-employment in beekeeping sector.	**K3**
4	analyze the damage caused by pest and diseases.	**K4**
5	asses the economic viability, and employment opportunities in small and large-scale beekeeping industries.	**K5**

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

Unit	Contents	No. of hours
I	Biology of Bees: Historical background of apiculture, classification and biology of honey bees, social organization of bee colony, behavioral patterns (bee dance, swarming).	**6**
II	Rearing of Bees: Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth; Bee Pasturage; Selection of bee species for apiculture –*Apis cerana indica*, *Apis mellifera*; Beekeeping equipment methods of extraction of honey (Indigenous and Modern) & processing; Apiary management - Honey flow period and lean period, effects of pollutants on honeybees.	**6**
III	Pesta and Diseases: Wax moths, Ants, Wasps, Wax beetles, Birds, Mites. Bacterial diseases – American foulbrood disease, European foulbrood disease, Viral diseases – Sac brood disease, Thai sac brood disease. Fungal diseases – Chalkbrood disease, Stonebrood disease.	**6**
IV	Bee Economy: Products of apiculture industry (Honey, Bees Wax, Propolis, Royal jelly, Pollen etc.) and their uses; Modern methods in employing artificial Beehives for cross pollination in horticultural gardens- stationary and migratory bee keeping.	**6**
V	Entrepreneurship in Apiculture: Bee keeping industries – Recent advancements, employment opportunities, economics in small and large-scale beekeeping, scope for women entrepreneurs in beekeeping sector, study of development programs and organizations involved in beekeeping in India.	**6**
	Total	**30**

Self-study	Products of apiculture industry (Honey, Bees Wax, Propolis, Royal jelly, Pollen etc.)

Textbooks

1. Jayashree, K.V., Tharadevi, C.S., Arumugam, N. 2023. *Apiculture*, Saras Publication, Nagercoil.
2. Dr. Sheikh, M.S. 2023. *Apiculture*, Global Net Publication, New Delhi.

Reference Books

1. Singh, S. 196). *Beekeeping in India*, Indian Council of Agricultural Research, New Delhi.
2. Mishra, R.C. 1995. *Honeybees and their management in India*. Indian Council of Agricultural Research, New Delhi.
3. Prost, P. J. 1962. *Apiculture*. Oxford and IBH, New Delhi.
4. Rahman, A. 2017. *Beekeeping in India*. Indian Council of Agricultural Research, New Delhi.
5.Gupta, J.K. 2016. *Apiculture*, Indian Council of Agricultural Research, New Delhi.

Web Resources

1. https://unacademy.com/content/neet-ug/study-material/biology/apiculture-definition-types-products-importance/
2. https://www.kharagpurcollege.ac.in/studyMaterial/1286Study-materials-of-Sem3-Hons-SEC1T-Apiculture-07-09-2020.pdf
3. https://gacbe.ac.in/pdf/ematerial/18BZO5EL-U1.pdf
4. https://msme.gov.in/sites/default/files/Beekeeping.pdf
5. https://jncollegeonline.co.in/attendence/classnotes/files/1621510627.pdf

MAPPING WITH PROGRAMME OUTCOMES

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	3	2	3	2	3	3	2	3	2
CO2	3	2	2	3	2	3	3	3	3	2	3	3
CO3	3	2	3	2	2	2	2	3	3	3	3	2
CO4	2	3	3	3	3	2	3	2	3	3	3	3
CO5	3	3	3	3	3	2	3	3	2	3	3	3
Total	**14**	**12**	**13**	**14**	**12**	**12**	**13**	**14**	**14**	**13**	**15**	**13**
Average	**2.8**	**2.4**	**2.6**	**2.8**	**2.4**	**2.4**	**2.6**	**2.4**	**2.8**	**2.6**	**3**	**2.6**

***3 - Strong; 2 - Medium; 1 - Low**

SEMESTER I & II
LIFE SKILL TRAINING I: CATECHISM

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG232LC1	1	-	-	-	1	1	15	50	50	100

Objectives:

1. To develop human values through value education
2. To understand the significance of humane and values to lead a moral life
3. To make the students realize how values lead to success

Course Outcomes

On the successful completion of the course, student will be able to:		
1	understand the aim and significance of value education	K1, K2
2	develop individual skills and act confidently in the society	K3
3	learn how to live lovingly through family values	K3
4	enhance spiritual values through strong faith in God	K6
5	learn good behaviours through social values	K6

K1 - Remember **K2**-Understand; **K3**-Apply; **K6**- Create

Units	Contents	No. of Hours
I	**Value Education:** Human Values – Types of Values – Growth – Components – Need and Importance - Bible Reference: Matthew: 5:3-16	3
II	**Individual Values: Esther** Vanishing Humanity – Components of Humanity – Crisis – Balanced Emotion – Values of Life - Bible Reference: Esther 8:3-6	3
III	**Family Values: Ruth the Moabite** Respecting Parents – Loving Everyone – Confession – True Love Bible Reference: Ruth 2:10-13 **Spiritual Values: Hannah** Faith in God – Wisdom – Spiritual Discipline – Fear in God – Spiritually Good Deeds -Bible Reference: 1 Samuel 1:24-28	3
IV	**Social Values: Deborah** Good Behaviour – Devotion to Teachers – Save Nature – Positive Thoughts – The Role of Youth in Social Welfare - Bible Reference: Judges 4:4-9	3
V	**Cultural Values**: **Mary of Bethany** Traditional Culture – Changing Culture – Food – Dress – Habit – Relationship – Media – The Role of Youth - Bible Reference: Luke 10:38-42	3
	Total	15

Textbook

1. Humane and Values. Holy Cross College (Autonomous), Nagercoil
2. The Holy Bible

SEMESTER I & II
LIFE SKILL TRAINING I: MORAL

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG242LM1	1	-	-	-	1	1	15	50	50	100

Objectives:

1. To develop human values through value education
2. To understand the significance of humane and values to lead a moral life
3. To make the students realize how values lead to success

Course Outcomes

On the successful completion of the course, student will be able to:		
1	understand the aim and significance of value education	K1,K2
2	develop individual skills and act confidently in the society	K3
3	learn how to live lovingly through family values	K3
4	enhance spiritual values through strong faith in God	K6
5	learn good behaviours through social values	K6

K1 - Remember **K2-**Understand; **K3-**Apply; **K6-** Create

Units	Contents	No. of Hours
I	**Value Education:** Introduction – Limitations – Human Values – Types of Values – Aim of Value Education – Growth – Components – Need and Importance	3
II	**Individual Values:** Individual Assessment – Vanishing Humanity – Components of Humanity – Crisis – Balanced Emotion – Values of Life.	3
III	**Family Values:** Life Assessment – Respecting Parents – Loving Everyone – Confession – True Love.	3
IV	**Spiritual Values:** Faith in God – Wisdom – Spiritual Discipline – Fear in God – Spiritually Good Deeds.	3
V	**Social Values:** Good Behaviour – Devotion to Teachers – Save Nature – Positive Thoughts – Drug Free Path – The Role of Youth in Social Welfare. **Cultural Values**: Traditional Culture – Changing Culture – Food – Dress – Habit – Relationship – Media – The Role of Youth.	3
	Total	15

Textbook

1. Humane and Values. Holy Cross College (Autonomous), Nagercoil

SEMESTER III
CORE COURSE III: CELL BIOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU233CC1	4	1	1	-	6	6	90	25	75	100

Pre-requisite

Basic knowledge on cells and its types

Learning Objectives

1. To give a perception on the general structure and functions of cellular organelles.
2. To develop skills on microscopy and cytological techniques.

Course outcomes

On the successful completion of the course, student will be able to:		
1	identify the types of microscopes, cell, cell organelles and cell division.	**K1**
2	outline the role of cell organelles, nucleic acid and their interactions.	**K2**
3	differentiate cell types, chromosomes, cell stages, normal and abnormal cells.	**K3**
4	apply knowledge in cellular research using cytological and modern techniques.	**K4**
5	assess skills in cytological techniques, microscopy, and cell biology experiments.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** – Analyze; **K5** - Evaluate

Unit	Contents	Hours
I	**Cell, Microscope and Micro technique:** Cell theory. Prokaryotic and eukaryotic cells. Cytological techniques - Fixation, sectioning, and staining. Microscopy – Resolving power and uses of Compound, Phase contrast and electron microscope. Micrometry.	**18**
II	**Plasma membrane & Cell organelles:** Cell junctions, Ultrastructure and functions of Plasma membrane. Cell organelles - Mitochondria, Ribosomes, Endoplasmic reticulum, Golgi complex, Lysosomes, Centrosomes.	**18**
III	**Nucleus and nucleic acids:** Ultrastructure and functions of nucleus and nucleolus. Chromosomes - types, structure, giant chromosomes. Nucleic acids – structure, types and functions. Nucleosomes. DNA replication in prokaryotes.	**18**
IV	**Gene expression and regulation:** Properties of Genetic code. Fine structure of gene. Protein synthesis in prokaryotes - transcription and translation. Post translational modifications. Regulation of gene expression -*Lac* operon.	**18**
V	**Cell division and significance:** Cell cycle, Mitosis, Meiosis, Regulation of cell cycle cdk dependent. Cancer - properties, types, diagnosis and treatment. Proto-oncogenes, Oncogenes, tumour suppressor genes. Apoptosis. Cell signaling: signaling molecules and their receptors (types and functions).	**18**
	Total	**90**

Self-study	Introduction to Cell and structure

Textbooks

1. Powar, C.B. 2013. *Cell Biology*. Bombay: Himalaya Publishing House, New Delhi
2. Arumugam, N. 2015. *Cell Biology*. Nagercoil: Saras Publications.

Reference Books

1. Verma, P.S.& Agarwal, V.K. 2016. Cell Biology (Cytology, Biomolecules and Molecular Biology). New Delhi: S Chand and Company Ltd.

2. De Robertis, E. M. F. 2011. Cell Biology (8th ed.). New York: Lippincott Williams &Wilkins Publication.
3. Singh, S. P.& Tomar, B.S. 2014. Cell Biology (10th ed.). Rastogi Publications. New Delhi.
4. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments (6th edition) John Wiley & Sons. Inc.
5. Rastogi, S.C. 2008. Cell Biology (2nd ed.). New Age International (P) Limited Publishers, New Delhi:

Web Resources

1. https://byjus.com/biology/cellsignalling/#:~:text=%E2%80%9CCell%20signalling%20is%20the%20process,signalling%20to%20regulate%20different%20functions.
2. https://www.genome.gov/geneticsglossary/Organelle#:~:text=An%20organelle%20is%20a%20subcellular,and%20ribosomes%2C%20which%20assemble%20proteins.
3. https://www.khanacademy.org/test-prep/mcat/cells/eukaryotic-cells/a/organelles-article
4. https://www.genome.gov/genetics-glossary/Cellcycle
5. https://www.khanacademy.org/science/ap-biology/gene-expression-and regulation/translation/v/rna-transcription-and

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	3	3	3	2	3	2	2	2	2
CO2	3	2	2	3	2	3	2	2	2	3	2	3
CO3	2	2	3	2	2	2	2	3	3	3	3	2
CO4	2	2	3	2	3	3	3	3	3	2	3	3
CO5	2	3	2	3	2	3	3	2	3	2	2	2
Total	**12**	**11**	**12**	**13**	**12**	**14**	**12**	**13**	**13**	**12**	**12**	**12**
Average	**2.4**	**2.2**	**2.4**	**2.6**	**2.4**	**2.8**	**2.4**	**2.6**	**2.6**	**2.4**	**2.4**	**2.4**

***3 - Strong; 2 - Medium; 1 – Low**

SEMESTER III

CORE LAB COURSE III: LAB ON CELL BIOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU233CP1	-	-	2	-	2	2	30	25	75	100

Prerequisite:

Knowledge to handle microscope.

Learning Objectives

1. To study different cell types and their stage of activity,
2. To enhance practical exercises focusing on observation, measurement, identification, and interpretation of cellular phenomena and structures.

Course outcomes

On the successful completion of the course, student will be able to:		
1	identify prokaryotic and eukaryotic cells.	**K 1**
2	prepare and develop the whole mounting procedure.	**K2**
3	apply microscopy techniques for observing mitotic stages.	**K3**
4	demonstrate proficiency in using microscopes and micrometer scales.	**K4**
5	interpret abnormalities in blood cell morphology.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** – Analyze; **K5** – Evaluate

Units	Contents	No. of Hours
1	Observation of mitosis in onion root tip.	**30**
2	Observation of giant chromosomes in *Chironomus* larva.	
3	Measurement of cells using stage and ocular micrometer.	
4	Mounting of squamous epithelial cells.	
5	Drawing of a cell/ organism by using Camera Lucida	
6	Identification of blood cells (human)	
7	Identification of Haemocytes (Cockroach/grasshopper)	
8	Album: Different type of cells.	
9	Prepared slides: Cell Division	
10	Prepared slides: Paramecium	
Charts/ Slides/ Models/ Bookplates/ Instruments		
Compound microscope, Camera Lucida, Mitochondria, Golgi complex, Endoplasmic reticulum, Ribosomes, Lysosomes (polymorphism), Interphase nucleus, DNA (Watson & Crick model), tRNA.		

Textbooks:

1. Renu Gupta, Seema Makhija and, Ravi Toteja. 2018. *Cell Biology: Practical Manual*. Prestige Publishers. 1st edition.
2. Rastogi, S.C. (2008). *Cell Biology* (2nded.). New Age International (P) Limited Publishers, New Delhi:

Reference Books:

1. M.M. Trigunayat & Kritika Trigunayat. 2019. A manual of practical zoology: biodiversity, cell biology, genetics & developmental biology part 1. Scientific Publishers, Jodhpur, Rajasthan.
2. Julio, E. 1997. Cell Biology: A Laboratory Handbook. Academic Pr; 2nd edition, India.
3. Rina Majumdar & Rama Sisodia. Laboratory Manual of Cell Biology. Prestige Publishers, New York.
4. Karp, G. (2010) Cell and Molecular Biology: Concepts and Experiments (6th edition)

John Wiley & Sons. Inc.
5. John Davey & J. Michael Lord. 2003. Essential Cell Biology Vol 1: Cell Structure: 262 (Practical Approach Series). 1st Edn. OUP Oxford publisher.

Web Resources

1. https://www.youtube.com/watch?v=TxB_Hj1BufM
2. https://www.youtube.com/watch?v=56zjXZWMd7w
3. https://www.youtube.com/watch?v=n9ce18RScV4
4. https://www.youtube.com/watch?v=-KcV_JP6iNA
5. https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/files/BT0213%20-%20CELL%20BIOLOGY%20PRACTICAL%20MANUAL.pdf

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	3	2	1	2	2	2	1	2	2	1
CO2	1	2	2	3	1	1	2	2	2	2	3	2
CO3	2	2	1	1	2	3	3	3	1	1	1	1
CO4	2	1	2	2	2	1	2	2	1	3	2	2
CO5	1	2	1	2	1	2	1	1	1	2	1	1
TOTAL	**8**	**8**	**9**	**9**	**7**	**9**	**10**	**10**	**6**	**10**	**9**	**7**
AVERAGE	**1.6**	**1.6**	**1.8**	**1.8**	**1.4**	**1.8**	**2**	**2**	**1.2**	**2**	**1.8**	**1.4**

3 – Strong, 2 – Medium, 1 - Low

SEMESTER III
ELECTIVE COURSE III: ANIMAL DIVERSITY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU233EC1	3	1	-	-	3	4	60	25	75	100

Pre-requisite:

Students should be aware of living organisms and their basic morphological differentiations from biological studies.

Learning Objectives

1. To acquire a basic knowledge of diversity and organization of Protozoa, Coelenterates, Helminthes, Annelida, Arthropoda, Mollusca and Echinodermata.
2. To comprehend the taxonomic position and diversity among Protochordata, Pisces, Amphibia, Reptilia, Aves and Mammalia.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	relate the characteristic features in invertebrates and chordates.	**K1**
2.	classify invertebrates up to class level and chordates up to order level.	**K2**
3.	identify the structural and functional organization of few invertebrates and chordates.	**K3**
4.	survey the adaptations and habits of animals to their habitat.	**K4**
5	assess the taxonomic position of invertebrate and chordate animals.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** – Evaluate

Unit	Contents	Hours
I	Principles of taxonomy. Criteria for classification– Symmetry and Coelom– Binomial nomenclature. Diversity of Invertebrates – I: Classification (up to classes with examples), characteristics, and ecological roles of Protozoa, Porifera and Coelenterata, Helminthes and Annelida.	**12**
II	Diversity of Invertebrates–II: Arthropoda: Salient features, classification (up to classes with example) and Economic importance. Mollusca (Mollusks): classification (up to classes with example) and ecological roles. Echinodermata: classification (up to classes with example) and evolutionary significance.	**12**
III	Chordates: characteristics and evolutionary significance. Protochordates: Characteristic features, classification, feeding mechanisms. Pisces: Salient features, classification, adaptations of fishes to aquatic habitats. Amphibia: Salient features, classification up to orders with examples. Fertilization, metamorphosis, and parental care.	**12**
IV	Reptilia: classification, various forms of locomotion. Identification of Poisonous and non-poisonous snakes. Aves: classification up to orders. Beaks and specialized respiratory systems. Mammalia: Classification up to orders. Mammalian hair/fur, mammary glands and specialized teeth.	**12**
V	Earth worm: Structure and organization (digestive, excretory, and reproductive system). Prawn: Structure and organization (Exoskeleton, excretory and reproductive system. Rabbit: Structure and organization (digestive system, circulatory and endocrine system)	**12**
	Total	**60**

Self-study	Invertebrates and their classification

Textbooks

1. Ekambaranatha Iyer M. 1990. *A Manual of Zoology, Volume I. Invertebrate Part I and Part II.* S. Viswanathan Printers & Publishers Pvt. Ltd. India.
2. Hickman, C, Keen, S, Larson, A, Eisenhour, D and Roberts, L. 2021. *Animal Diversity* (9th Edition). Graw Hill, Iran.

Reference Books

1. Ekambaranatha Iyer M. and Anantakrishnan T. N. 1990. *A manual of Zoology*. Vol. I. Invertebrata (Part 1 &2). S. Vishwanathan Pvt. Ltd., India
2. Ekambaranatha Iyer M. and Anantakrishnan T. N. 1990. *A manual of Zoology*. Vol. II. Chordata S. Vishwanathan Pvt., Ltd. India
3. Jordan E. L. and Verma P.S. 1976. *Chordate Zoology*. S. Chand & Co. Jordan E. L. and Verma P.S. 1976. Invertebrate Zoology. S. Chand & Co., India.
4. Kotpal R. L. 1993. *Protozoa- Echinodermata* (all volumes). Rastogi Publ. Pough H (2004): *Vertebrate life*, VIII Edition, Pearson International, London< England.
5. Ruppert and Barnes, R.D. 2006. Invertebrate Zoology, VIII Edition. Holt Saunders International Edition

Web Resources

1. https://blogs.ubc.ca/mrpletsch/2019/09/10/unit-1-1-principals-of-taxonomy/
2. https://byjus.com/biology/animal-kingdom-basis-classification/
3. https://www.britannica.com/animal/arthropod/Classification
4. https://youtu.be/19dPFqd-H_o
5. https://youtu.be/QRYVvRRmJRU

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	2	3	2	1	1	2	2	1	2	3	1	1
CO 2	3	1	1	3	1	1	3	2	1	1	2	2
CO 3	2	2	2	1	1	3	3	3	3	1	1	3
CO 4	2	2	3	3	2	2	1	2	1	3	1	1
CO 5	1	1	2	1	2	1	3	1	2	2	3	2
Total	**10**	**9**	**9**	**9**	**7**	**9**	**12**	**9**	**9**	**10**	**8**	**9**
Average	**2**	**1.8**	**1.8**	**1.8**	**1.4**	**1.8**	**2.4**	**1.8**	**1.8**	**2**	**1.6**	**1.8**

3 – Strong, 2 – Medium, 1 - Low

SEMESTER III

ELECTIVE LAB COURSE III: LAB ON ANIMAL DIVERSITY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU233EP1	-	-	2	-	2	2	30	25	75	100

Pre-requisite:

Students should be aware of surrounding living invertebrates and vertebrates and their basic structural differentiations and their habitats.

Learning Objectives

1. To understand the structure and label the various parts of the dissected organisms.
2. Enable the students to understand, identify and classify the various fauna surrounding them.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	compare and distinguish the dissected internal organs of animals.	**K1**
2.	prepare and develop the mounting procedure of important invertebrate and chordate anatomical parts.	**K2**
3.	identify and label the external features of different groups of invertebrates.	**K3**
4.	analyze the ecological roles and significance of the organisms within their ecosystems.	**K4**
5.	evaluate evolutionary relationships and broader biological concepts among the spotted organisms.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyse; **K5** - Evaluate

Units	Contents	No. of Hours
1	Cockroach - digestive system	**30**
2	Cockroach - nervous system.	
3	Fish-digestive system.	
4	Prawn appendages	
5	Mouth parts- Cockroach	
6	Mouth parts - Mosquito	
7	Scales - Placoid, Cycloid and Ctenoid	
Spotters		
Paramecium, Plasmodium, Scypha, *Leucosolenia*, Corals. *Taenia solium* – entire, *Ascaris* male and female. Earthworm, Prawn, Scorpion, Pila, Starfish Amphioxus, Shark, Frog, Calotes, Pigeon feather, Bat		

Textbooks

1. Lal, S.S, 2016. *Practical Zoology Invertebrate*, Rastogi Publications. Meerut, Uttar Pradesh
2. Verma, P. S. 2010. *A Manual of Practical Zoology: Invertebates*, S Chand and Co. Noida, Uttar Pradesh.

Reference Books

1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. 2002. The Invertebrates: A New Synthesis, III Edition, Blackwell Science.
2. Barnes, R.D. 1982. Invertebrate Zoology, V Edition. Holt Saunders International Edition.
3. Barrington, E.J.W. 1979. Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson Wiley-Blackwell, New Jershey, USA.
4. Boradale, L.A. and Potts, E.A. 1961. Invertebrates: A Manual for the use of Students. Asia Publishing Home.

5. Lal, S.S. 2005. A text Book of Practical Zoology: Invertebrate, Rastogi Publications, Meerut

Web Resources

1. https://nbb.gov.in/
2. http://www.agshoney.com/training.htm
3. https://icar.org.in/
4. http://www.csrtimys.res.in/
5. http://csb.gov.in/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	2	3	1	2	3	3	3	3	2
CO2	3	2	2	3	2	1	3	3	2	2	2	3
CO3	3	3	1	2	3	2	3	2	3	3	2	2
CO4	3	3	1	2	3	1	2	3	3	3	3	3
CO5	2	2	2	3	1	2	2	2	3	2	3	2
Total	**14**	**13**	**12**	**12**	**12**	**7**	**12**	**13**	**14**	**13**	**13**	**12**
Average	**2.8**	**2.6**	**2.4**	**2.4**	**2.4**	**1.4**	**2.4**	**2.6**	**2.8**	**2.6**	**2.6**	**2.4**

3 – Strong, 2 – Medium, 1 - Low

SEMESTER III

SKILL ENHANCEMENT COURSE SEC-II: SEA FOOD PROCESSING

Course Code	L	T	P	S	Credits	Inst. Hours	Total hours	Marks		
								CIA	External	Total
ZU233SE1	1	-	1	-	2	2	30	25	75	100

Prerequisite

Students should have a foundational understanding of seafood industry, including knowledge of different types of seafood, their seasons, quality standards, and market demands.

Learning Objectives

1.To develop a skill to recognize different types of seafood and their biological characteristics.

2.To apply the innovative approaches to improve seafood process.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall different types of seafood and their characteristics.	**K1**
2.	understand the importance of maintaining proper hygiene and sanitation in seafood processing	**K2**
3.	apply proper techniques for handling, filleting, and packaging different types of seafood	**K3**
4.	analyze the factors affecting seafood quality, such as freshness, texture, and taste	**K4**
5.	evaluate the sustainability of seafood processing practices and propose improvements for minimizing environmental impact.	**K5**

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

Unit	Contents	No. of hours
I	**Introduction to Seafood:** Importance of seafood, Classification of seafood products, Common fish species, Shellfish varieties: mollusks and crustaceans. Sustainable seafood management in Indian coastal communities.	**6**
II	**Seafood Nutrition:** Nutritional composition of seafood: protein, omega-3 fatty acids, vitamins. Health benefits of seafood according to ayurvedic principles and dietary recommendations. Risks associated with seafood consumption: allergies, contaminants.	**6**
III	**Seafood Processing:** Methods of seafood preservation: freezing, canning, smoking. Integration of traditional and modern practices in seafood processing. Quality control and food safety regulations, Innovation in seafood processing techniques. Market Trends.	**6**
IV	**Cookery Techniques:** Cooking methods for different seafood types: grilling, steaming, frying, Flavor pairing and seasoning for seafood dishes, Texture and temperature control in seafood cooking.	**6**
V	**Seafood Showcase:** Cooking demonstrations with seafood. Recipe development and menu planning exercises. Presentation of innovative seafood dishes.	**6**
	Total	**30**

Self-study	Nutrients in seafood

Textbooks:

1. Kobakumar, K. 2006. *Textbook of Fish Processing Technology*. Indian Council of Research. New Delhi.
2. George M Hall. 2010. *Fish Processing: Sustainability and New Opportunities*. First edition, Wiley-Blackwell, Jersey, USA,

Reference Books

1. Cesarettin Alasalvar, Fereidoon Shahidi, and Kazuo Miyashita. 2011. *Handbook of Seafood Quality, Safety and Health Applications*.
2. Mónica Gallego-Fernández and Mar Villamiel. 2019. *Seafood Processing Byproducts: Trends and Applications.*
3. Kewalramani K.M., 1994. Delightful Recipes Fish, Prawns and Sea Foods. Promilla & amp; Co. Publishers.
4. Megha Patil. 2000. *The Fish Cook Book*. Penguin India.
5. Laxmi Khurana. 2004. *A Indian Housewife & 39; s Recipe Book*. Robinson Publications, India

Web Resources

1. https://www.britannica.com/topic/seafood
2. https://aquaculture.ca.uky.edu/sites/aquaculture.ca.uky.edu/files/srac_7300_nutritional_benefits_of_seafood.pdf
3. https://aboutseafood.com/resource/seafood-preparation-by-method/
4. https://uou.ac.in/sites/default/files/slm/BHM-201T.pdf
5. https://docksidehhi.com/9-different-ways-to-cook-fish/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	3	2	3	2	3	3	2	3	2
CO2	3	1	3	3	2	1	2	3	2	2	2	3
CO3	3	2	1	2	2	2	2	2	2	3	2	2
CO4	3	3	3	1	3	3	2	3	3	3	2	3
CO5	3	2	2	2	3	3	2	2	3	2	2	2
Total	**15**	**10**	**10**	**11**	**11**	**12**	**10**	**13**	**13**	**12**	**11**	**12**
Average	**3**	**2**	**2**	**2.2**	**2.2**	**2.4**	**2**	**2.6**	**2.6**	**2.4**	**2.2**	**2.4**

3 -Strong; 2 -Medium; 1 -Low

SEMESTER III / IV

SKILL ENHANCEMENT COURSE SEC-III: FITNESS FOR WELLBEING

Course Code	L	T	P	S	Credits	Total Hours	Marks		
							CIA	External	Total
UG23CSE1	1	-	1	-	2	30	25	75	100

Pre-requisites: Basic understanding of health and wellness concepts

Learning Objectives

1. To understand the interconnectedness of physical, mental, and social aspects of well-being, and recognize the importance of physical fitness in achieving holistic health.
2. To develop proficiency in mindfulness techniques, yoga practices, nutritional awareness, and personal hygiene practices to promote overall wellness and healthy lifestyle.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	know physical, mental, and social aspects of health	K1
2	understand holistic health and the role of physical fitness.	K2
3	apply mindfulness and yoga for stress management and mental clarity.	K3
4	implement proper personal hygiene practices for cleanliness and disease prevention.	K4
5	luate and implement right nutritional choices.	K5

K1-Remember; **K2**-Understand; **K3**-Apply; **K5**-Evaluate

Unit	Contents	No. of Hours
I	**Understanding Health and Physical Fitness** Health – definition- holistic concept of well-being encompassing physical, mental, and social aspects. Physical fitness and its components- muscular strength- flexibility, and body composition. Benefits of Physical Activity- its impact on health and well-being.	6
II	**Techniques of Mindfulness** Mind – Mental frequency, analysis of thought, eradication of worries Breathing Exercises – types and its importance Mindfulness –pain management - techniques for practicing mindfulness - mindfulness and daily physical activities.	6
III	**Foundations of Fitness** Stretching techniques to improve flexibility. Yoga-Definition, yoga poses (asanas) for beginners, Sun Salutations (Surya Namaskar), Yoga Nidra – benefits of yoga nidra.	6
IV	**Nutrition and Wellness** Role of nutrition in fitness - macronutrients, micronutrients - mindful eating practices, balanced diet - consequences of overeating. Components of healthy food. Food ethics.	6
V	**Personal Hygiene Practices** Handwashing- techniques, timing, and importance, oral hygiene- brushing, flossing, and dental care, bathing and showering- proper techniques and frequency, hair care- washing, grooming, and maintaining cleanliness, maintaining personal hygiene, dangers of excessive cosmetic use.	6
	Total	30

Self-study	Balance diet and basic exercises

Textbook:

Bojaxa A. Rosy and Virgin Nithya Veena. V. 2024. *Fitness for Wellbeing*.

Reference Books:

1. Arul Raja Selvan S. R, 2022. *Yogasanam and Health Science*. Self-publisher.
2. Vision for Wisdom. 2016. *Value Education*. The World Community Service Centre Vethathiri Publications.
3. WCSC – Vision for Wisdom. 2016. *Paper 1: Yoga and Empowerment*. Vazhga Valamudan Offset Printers Pvt Ltd 29, Nachiappa St, Erode.
4. Lachlan Sleigh. 2023. *Stronger Together the Family's Guide to Fitness and Wellbeing*. Self Publisher.
5. William P. Morgan, Stephen E. Goldston. 2013. *Exercise And Mental Health*. Taylor & Francis.

Web Resources:

1. https://www.google.co.in/books/edition/Psychology_of_Health_and_Fitness/1lYOAwAABAJ?hl=en&gbpv=1&dq=fitness+for+wellbeing&printsec=frontcover
2. https://www.google.co.in/books/edition/The_Little_Book_of_Active_Wellbeing/aA6SzgEACAAJ?hl=en
3. https://www.google.co.in/books/edition/Physical_Activity_and_Mental_Health/yu96DwAAQBAJ?hl=en&gbpv=1&dq=fitness+for+wellbeing&printsec=frontcover
4. https://www.google.co.in/books/edition/The_Complete_Manual_of_Fitness_and_Well/pLPAXPLIMv0C?hl=en&gbpv=1&bsq=fitness+for+wellbeing&dq=fitness+for+wellbeing&printsec=frontcover
5. https://www.google.co.in/books/edition/The_Wellness_Code/4QGZtwAACAAJ?hl=en

SEMESTER III

SPECIFIC VALUE-ADDED COURSE: AQUARIUM KEEPING

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU233V01	**1**	**-**	**1**	**-**	**1**	**2**	**30**	**25**	**75**	**100**

Prerequisite

Students should have basic interest in aquarium keeping.

Learning Objectives

1. To cultivate practical skills in maintaining a balanced aquatic environment,
2. To promote animal welfare, and fostering an appreciation for aquatic ecosystems.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	identify common aquarium fish species and their basic care requirements.	**K1**
2	demonstrate proficiency in maintaining water quality parameters.	**K2**
3	apply principles of aqua scaping and design to create visually appealing and functional aquarium layouts	**K3**
4	analyze the common health issues and diseases affecting aquarium fish.	**K4**
5	evaluate the ethical considerations involved in aquarium keeping.	**K5**

K1 - Remember; **K2 -** Understand; **K3** – Apply; **K4 -** Analyse; **K5** – Evaluate

Units	Contents	No. of Hours
I	The potential scope of aquarium keeping- Characteristics of ornamental fishes- Types of aquaria- Aquarium maintenance. Setting of aquariums of different sizes.	**6**
II	Aquarium fishes: Gold fish- Angel fish- Molly- Tiger Barb- Zebra fish- Guppy. Common aquarium plants and their multiplication. Aerators and filters.	**6**
III	Different types of ornamental freshwater species, their breeding habits and life history: Rearing of larvae and adults.	**6**
IV	Fish feeds – Supplementary feed– Formulation- Live feeds. Diagnosis of common Aquarium fish diseases- Protozoan, bacterial & viral and treatment.	**6**
V	Packaging and transport of aquarium species – Export units – Marketing strategy. Regulations for export of fish.	**6**
	Total	**30**

Self-study	Different breeds of fishes

Textbooks:

1. Chavan, S.P., Kadam, M.S., Niture S.D. 2008. Aquaculture & Aquarium Keeping, 1st edn.Educational Publisher and Distributors, New Delhi.
2. Saju Ashokan, 2020. Enchanting Aquariums - a practical guide to fish keeping: A step-by-step handbook on fish tank setup, maintenance, automation, fish feeding, diseases, filters, lighting and more. Kindle Edition.

Reference Books

1. Jhingran, V. G. and Sehgel, K. H. 1994. *Coldwater fisheries of India*, *Inland Fish. Soc*., India.
2. Sehgel, K. H. 1987. *Sports fisheries of India*. ICAR Publication, New Delhi.
3. Hem Raj. 2020. *A textbook of aquarium fish keeping*. Publisher: Vinesh & Co.

4. Sanjib Saha. 2022. *Concept of aquarium fish keeping*. Second Edition. Publisher: Techno World.
5. Mundy Obilor Jim, Aquarium Making: Fish-keeping and Maintenance. JimArts; 2nd edition, Africa.

Web Resources:

1. https://www.tetra-fish.com/learning-center/getting-started/a-beginners-guide.aspx
2. https://www.petlandtexas.com/10-key-tips-to-keeping-a-healthy-aquarium/
3. https://www.youtube.com/watch?v=bgtUQa-4G2s
4. https://www.aqueon.com/articles/dos-donts
5. https://www.thesprucepets.com/routine-aquarium-maintenance-1381084

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	2	3	3	3	3	2	3
CO2	3	3	3	3	3	2	3	3	3	3	3	3
CO3	3	3	2	3	3	2	3	3	3	3	3	3
CO4	2	3	3	2	3	2	3	3	2	3	2	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3
Total	**14**	**15**	**14**	**14**	**15**	**11**	**15**	**15**	**14**	**15**	**13**	**15**
Average	**2.8**	**3**	**2.8**	**2.8**	**3**	**2.2**	**3**	**3**	**2.8**	**3**	**2.6**	**3**

3 – Strong, 2 – Medium, 1 - Low

SEMESTER III

SPECIFIC VALUE-ADDED COURSE: FOOD ADULTERATION

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU233V02	1	-	1	-	1	2	30	25	75	100

Prerequisite:

Students should have a basic knowledge on basic food chemistry and biology.

Learning Objectives

1. To educate learners on identifying, understanding of food adulteration.
2. To classify the food additives, as well as comprehend food safety laws and regulations.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	classify food additives based on their functions	**K1**
2.	explain key food safety laws and regulations in India	**K2**
3.	determine common adulterants in various food items.	**K3**
4.	analyze the practical applicability and effectiveness in addressing food adulteration concerns.	**K4**
5.	evaluate the redressal measures of consumer complaints.	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** – Evaluate

Units	Contents	No. of Hours
I	**Adulteration in common foods:** Definition –Types; Common Food Adulterants - Poisonous substances, cheap substitutes, Spoiled parts. General Impact of food adulterants on Human Health.	**6**
II	**Detection of adulteration in common food:** Detection of Adulterants in Milk and milk products, Oil, Grain, Sugar, Spices and condiments, processed food, Fruits and vegetables. Additives and sweeteners, Mitigation measures for addressing food adulteration.	**6**
III	**Food Additives: C**lassification, and use of additives in food flavour enhancers, humectants and anti-caking agents, nutrient supplements, non-nutritive sweeteners, pH control agents, stabilizers and thickeners.	**6**
IV	**Food Safety Laws and Regulations:** Prevention of Food Adulteration Act 1954, Food Safety and Standards Act (2006), Food Safety and Standards Authority of India (FSSAI) - Bureau of Indian Standards (BIS), Food Products Order (FPO), The Agricultural and Processed Food Products Export Development Authority (APEDA).	**6**
V	**Consumer Education:** Food Standards, role of voluntary agencies such as, Agmark, I.S.I.; consumers problems rights and responsibilities, copra 1986, tips for wise purchasing, redressal measures how to give complaints and proforma of complaints	**6**
	Total	**30**

Self-study	Common food adulterants

Textbooks:

1. Anupama Rani. 2010. *Food adulteration and hygiene*. Saujanya Books. Delhi
2. Shyam Narayan Jha, 2015. *Rapid Detection of Food Adulterants and Contaminants: Theory and Practice.* Academic Press, Cambridge, UK.

Reference Books

1. Anitha Gautam & Neetu Singh. 2022. *Detect food adulteration with low-cost methods*, Narendra Publishing House, Delhi.
2. Alankar Shrivashtava. 2018. *Adulteration Analysis of Some Foods and Drugs*. Bentham Science Publishers, Sharjah, UAE
3. Jesse P. Battershall. 2019. *Food adulteration and its detection*. Good Press. Glasgow, UK.
4. J. T. Pratt. 2018. *Food Adulteration: or, what we eat, and we should eat*. Forgotten Books, UK
5. Siva Kiran, R.R. 2012. Manual for Detection of Common Food Adulterants, First Edition, Japan.

Web Resources:

1. https://indianlegalsolution.com/laws-on-food-adulteration/
2. https://fssai.gov.in/dart
3. https://byjus.com/free-ias-prep/fssai-food-safety-and-standards-authority-of-india/
4. https://cleartax.in/glossary/agmark/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	3	2	3	2	3	3	3	3
CO2	3	3	3	3	3	2	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	2	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	2	2
Total	**15**	**15**	**14**	**15**	**15**	**13**	**15**	**14**	**15**	**15**	**13**	**14**
Average	**3**	**3**	**2.8**	**3**	**3**	**2.6**	**3**	**2.8**	**3**	**3**	**2.6**	**2.8**

3 – Strong, 2 – Medium, 1 - Low

SEMESTER III

SPECIFIC VALUE-ADDED COURSE: BASIC MICROBIAL TECHNIQUES

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU233V03	1	-	1	-	1	2	30	25	75	100

Prerequisite:

Basic knowledge of microbiology and laboratory techniques is recommended

Learning Objectives

1. To introduce students to fundamental concepts and techniques in microbiology.
2. To introduce students to fundamental concepts and techniques in microbiology.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	define the principles microbial culture.	K1
2	identify common bacterial species based on morphological and biochemical characteristics.	K2
3	practice aseptic techniques and safety precautions when working with microorganisms.	K3
4	interpret microbial growth patterns, and draw conclusions from observations.	K4
5	perform basic laboratory techniques for culturing, staining, and observing microorganisms	K5

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** – Evaluate

Units	Contents	No. of Hours
I	**Introduction to Microbiology:** Definition of microbiology and its significance, Historical development and key discoveries in the field. Basic microbial morphology, structure, and classification**.**	6
II	**Microbial Growth and Culturing Techniques:** Principles of microbial growth. Sterilization methods and aseptic techniques for handling microorganisms**. C**ulture media preparation, inoculation, and incubation methods	6
III	**Microbial Staining Techniques**: Simple and differential staining techniques, Gram staining method, Acid-fast staining method for identifying acid-fast bacteria.	6
IV	**Microscopic Observation of Microorganisms:** Use and care of the compound light microscope. Preparation, observation and identification of bacterial and fungal species under the microscope.	6
V	**Biochemical Tests for Microbial Identification:** Introduction to biochemical tests, Interpretation and identification of common bacterial species. Hands-on practice with biochemical test kits and diagnostic panels	6
	Total	30

Self-study	Microbiological techniques

Textbooks:

1. Ankitha Joshi, Chaukan, R.S. 2022. *Immunological Techniques: Interpretations, Validation and Safety Measures,* IP Innovative Publications, New Delhi.
2. Arora, D.R. 2023. *Practical Microbiology*, 3rd Ed., CBS Publishers, New Delhi.

Reference Books:

1. Arti Kapil. 2013. *Anandanarayan and Paniker's textbook of Microbiology*, Hyderabad: Universal Press.
2. Vijaya Ramesh, K. 2004. *Environmental Microbiology*. Chennai: MJP Publishers.
3. Powar, C.B. and Daginawala, H.F. 2008. *General Microbiology*, Vol. 2, Chennai:
4. Himalaya Publishing House.
5. Singh, R.P. 2007. *General Microbiology*, New Delhi: Kalyani Publishers.
6. Johri R.M., Snehlatha, Sandhya Sharma. 2010. *A Textbook of Algae*, New Delhi: Wisdom Press.

Web Resources:

1.https://dspmuranchi.ac.in/pdf/Blog/General_MicrobiologyCSP_Proof012417.PDF
2. https://microbenotes.com/category/environmental-microbiology/
3. https://microbenotes.com/category/food-microbiology/
4. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SMB1101.pdf
5. https://www.drngpasc.ac.in/pdf/syllabus/2020-21/fobs/M.Sc.Microbiology.pdf

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	3	3	2	3	3	3	3	3	2
CO2	3	3	2	3	3	2	3	3	3	2	3	2
CO3	2	2	3	3	3	3	3	2	3	3	3	3
CO4	2	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3	3	3
Total	**13**	**13**	**13**	**15**	**15**	**13**	**15**	**14**	**14**	**14**	**15**	**14**
Average	**2.6**	**2.6**	**2.6**	**3**	**3**	**2.6**	**3**	**2.8**	**2.8**	**2.8**	**3**	**2.8**

3 – Strong, 2 – Medium, 1 - Low

SEMESTER III/V

SELF-LEARNING COURSE: PUBLIC HEALTH AND HYGIENE

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU233SL1/ZU235SL1	-	-	-	-	1	-	-	25	75	100

Prerequisite:

Knowledge on epidemiology, environmental health, healthcare systems

Learning Objectives

1. To enable the students to identify the national and global public health problems.
2. To make aware about the issues of food and water safety, vaccination, exercise and obesity.

Course Outcome

On the successful completion of the course, student will be able to:		
1	grasp of public health principles, and epidemiological concepts.	**K1**
2	identify strategies to address public health challenges.	**K2**
3	apply evidence-based approaches to promote health and prevent disease in diverse populations	**K3**
4	explore the socio-economic determinants of health and their influence on health	**K4**
5	assess the importance of hygiene practices in preventing the spread of infectious diseases	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** – Evaluate

Units	Contents
I	**Introduction to public health and hygiene**: Determinants and factors. Pollution and health hazards; water and air borne diseases. Radiation hazards: Mobile Cell tower and electronic gadgets (recommended levels, effects and precaution). Personal hygiene, oral hygiene, and sex hygiene.
II	**Nutrient deficiency diseases:** Classification of food into micro and macro nutrients. Balanced diet, dietary plan for an infant, normal adult, pregnant woman, and old person. Importance of dietary fibres. Significance of breast feeding. Malnutrition anomalies – Anaemia (Iron and B12 deficiency), Kwashiorkor, Marasmus, Rickets, Goiter (cause, symptoms, precaution and cure). Substitution of diet with required nutrients to prevent malnutrition disorders.
III	**Communicable diseases**: Infectious agents responsible for diseases in humans. Communicable viral diseases- measles, chicken pox, dengue, chikungunya, rabies, and hepatitis. Communicable bacterial diseases- tuberculosis, typhoid, tetanus, plague, diphtheria, leprosy. sexually transmitted diseases
IV	**Contagious diseases**: AIDS, syphilis and gonorrhoea. Health education and preventive measures for communicable diseases. Non-communicable diseases and cure non-communicable diseases such as hypertension, stroke, coronary heart disease, myocardial infarction. Osteoporosis, osteoarthritis and rheumatoid arthritis-cause, symptom, precautions.
V	Diabetes- types and their effect on human health. Gastrointestinal disorders-acidity, peptic ulcer, constipation, piles (cause, symptoms, precaution and remedy) etc. Obesity (Definition and consequences). Mental illness (depression and anxiety). Oral and lung cancer and their preventive measures.

Textbooks

1. Sanjay Kumar & Jugal Kishore. 2020. *Public Healthcare in India*. Century Publications, India
2. Dass, K. 2021. *Public Health and Hygiene.* Notion Press, Parel, Mumbai.

Reference Books

1. Mary Jane Schneider. 2011. *Introduction to Public Health.* Jones & Bartlett Learning; fourth edition, India.
2. Diatha Krishna Sundar, Isha Garg, Shashank Garg. 2015**.** Public Health in India technology, governance, and service delivery. 1st edition, Routledge India.
3. Michael J. Gibney, Barrie M. Margetts, John M. Kearney, Lenore Arab. 2013. Public Health Nutrition. Wiley, Somerset
4. Wong, K.V. 2017. *Nutrition, Health and Disease*. Momentum Press, India.

Web Resources

1. https://download.e-bookshelf.de/download/0000/7531/70/L-G-0000753170-0002366262.pdf
2. https://jgu.edu.in/blog/2023/12/29/what-is-public-health/
3. https://www.britannica.com/topic/public-health
4. https://www.youtube.com/watch?v=IBH63uXsy8U
5. https://www.youtube.com/watch?v=LZV5Ihjn4iI

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	3	3	3	3	3	3	3	2
CO2	3	3	3	3	3	3	3	2	3	3	3	3
CO3	3	3	3	2	3	3	3	2	2	3	3	3
CO4	2	3	2	2	3	3	2	2	3	3	3	3
CO5	3	2	3	3	3	3	2	3	3	3	3	3
Total	**14**	**14**	**13**	**13**	**15**	**15**	**13**	**12**	**14**	**15**	**15**	**14**
Average	**2.8**	**2.8**	**2.6**	**2.6**	**3**	**3**	**3**	**2.4**	**2.8**	**3**	**3**	**2.8**

3 – Strong, 2 – Medium, 1 - Low

SEMESTER IV
CORE COURSE IV: ANIMAL PHYSIOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU234CC1	4	1	-	-	5	5	75	25	75	100

Pre-requisite:

Students should have the basic knowledge of structure and function of different organ system

Learning Objectives:

1. To enable the students to comprehend the functional significance of various organs and organ systems.
2. To train future researchers in the field of physiology both academically and intellectually as well as the ability to assess and report experiments and observations in physiology

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall the basic anatomy of digestive, respiratory, excretory, homeostatic, neuromuscular, endocrine and reproductive system	**K1**
2.	describe the important physiological systems and internal regulation.	**K2**
3.	compare various organ systems and adaptations exhibited by animals.	**K3**
4.	infer the integration of activities of different organ and organ system.	**K4**
5.	interrelate different organ systems to diseases for a holistic approach to human health.	**K5**

K1 - Remember; **K2 -** Understand; **K3** – Apply; **K4 -** Analyse; **K5 -** Evaluate

Units	Contents	No. of Hours
I	**Nutrition and Digestion:** Nutrition-types of food and feeding mechanisms, composition of food**.** Balanced diet. Basal Metabolic Rate (BMR) and Body Mass Index (BMI), Digestive enzymes and their role in digestion, absorption and assimilation of carbohydrate, protein and fat.	**15**
II	**Respiration:** Respiratory organs, Respiratory pigments and functions. Transport of gases [Co2 and O2) - Chloride Shift, Haldane and Bohr's effect. **Circulation:** Types of heart, Structure and function of heart, Double circulation - origin and conduction, pace maker, cardiac cycle and ECG, blood pressure. Heart diseases - atherosclerosis, acute coronary occlusion, myocardial infarction.	**15**
III	**Excretion-** patterns of excretion, excretory organs in vertebrates, structure of kidney in man, nephron, counter current mechanism of urine formation. Nephritis and dialysis. **Osmoregulation -** Osmo conformers and osmoregulatory, osmoregulation in crustaceans, fishes and mammals. **Thermoregulation-** poikilotherms and homeotherms, thermoregulatory mechanisms.	**15**
IV	**Muscle physiology:** types of muscles, ultrastructure and properties of skeletal muscle, mechanism of muscle contraction and Rigormortis. **Neurophysiology -** structure and types of neurons, conduction of nerve impulse through non-myelinated, myelinated nerve and synapse.	**15**
V	**Endocrine system:** Endocrine organs- hypothalamus and endocrine glands– pituitary, thyroid, parathyroid, adrenal, islets of Langerhans. Biological clock and rhythms. **Receptors:** Photoreceptor – Structure of a mammalian eye, physiology of vision. Phonoreceptor – Structure of mammalian ear, Physiology of hearing, equilibrium.	**15**
	Total	**75**

Self-study	Balanced diet. Basal Metabolic Rate (BMR) and Body Mass Index (BMI), Respiratory pigments, patterns of excretion, Types of neurons

Textbooks:

1. Arora, M. P. 2007. *Animal Physiology* (6th ed.). Mumbai: Himalayan Publishing House.
2. Agarwal R.A., Srivastava, A.K. and Kaushal Kumar. 2015. *Animal Physiology and Biochemistry* (5th ed.). New Delhi: S. Chand and Company Ltd.

Reference Books:

1. Rastogi, S.C. 2019. *Essentials of Animal Physiology.* (4th edn,), New Age International; New Delhi.
2. Goel, K. A. and K.V. Sastry. 2016. *A Text Book of Animal Physiology* (7th ed.). Meerut: Rastogi Publications.
3. Singh, H. R. Shoban Lal Nagin. 2017. *Animal Physiology and Related Biochemistry.* New Delhi: S. Chand and Co.
4. William S. Hoar. 1999. *General and Comparative Physiology.* (3rd ed.). New Delhi: Prentice Hall of India Publications.
5. Nagabhushan, R. Kodarkar, M.S. and Sarojini, R. 1982. *Text book of Animal Physiology* (2nd ed.). New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.

Web Resources

1. https://courses.lumenlearning.com/suny-home-health-aide/chapter/food-nutrition-and-meal-preparation/
2. https://www.news-medical.net/health/Structure-and-Function-of-the-Heart.aspx
3. https://byjus.com/biology/countercurrent-mechanism-urine-formation/
4. https://egyankosh.ac.in/bitstream/123456789/68246/1/Unit-4.pdf
5. https://byjus.com/biology/endocrine-glands-and-hormones/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	2	3	3	3	3	3	3	3	3	3
CO2	2	3	3	2	3	3	2	3	2	3	2	3
CO3	2	2	2	3	2	2	2	3	3	2	3	2
CO4	2	2	2	2	2	2	2	2	3	3	2	2
CO5	1	3	2	2	1	2	3	3	3	2	3	2
TOTAL	**9**	**13**	**11**	**12**	**11**	**12**	**12**	**14**	**14**	**13**	**13**	**12**
AVERAGE	**1.8**	**2.6**	**2.2**	**2.4**	**2.2**	**2.4**	**2.4**	**2.8**	**2.8**	**2.6**	**2.6**	**2.4**

3 – Strong, 2- Medium, 1- Low

SEMESTER IV

CORE LAB COURSE IV: LAB ON ANIMAL PHYSIOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU234CP1	-	-	2	-	2	2	30	25	75	100

Pre-requisite:

Students should have knowledge relevant to genetics, evolution and physiology.

Learning Objectives:

1. To equip the students to analyse the physiological, genetical and evolutionary processes.
2. To develop the skills of writing the report and presentation.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	choose appropriate methods to analyse physiological functions and food adulterants.	**K1**
2.	describe the principles of analytical methods and instruments and its uses in physiology.	**K2**
3.	prepare balanced diet for different age group, calculate BMI, identify food adulterants.	**K3**
4.	analyse the effect of physical factors on the rate of activity physiological process.	**K4**
5.	estimate the variation in rate of physiological activity, BMI, blood cells, oxygen consumption and excretory products under varying environmental condition.	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** - Evaluate

Units	Contents	No. of Hours
1	Activity of salivary amylase in relation to pH.	**30**
2	Activity of salivary amylase in relation to temperature.	
3	Oxygen consumption of fresh water fish with reference to body weight	
4	Detection of nitrogenous waste products (Ammonia, urea and uric acid).	
5	Preparation of a balance diet for different age groups using standard diet chart	
6	Estimation of carbohydrate, protein and lipid	
7	Experiment on BMI calculation	
8	Analysis of common food adulterants by simple methods	
9	Estimation of Haemoglobin.	
10	Measurement of Blood pressure	
Charts/ Slides/ Models/ Bookplates/ Instruments		
Haemoglobin , ECG, Cardiac muscle, Skeletal muscle , Smooth muscle, Simple muscle curve , Kymograph, Model - mammalian eye and ear, Thyroid gland.		

Textbooks:

1. Mali,R. P. and Afsar, S.K.. 2015. *Practical manual on innovative animal physiology*. Oxford Book Company, Jaipur.
2. Ghai, C. L. 2012. *A textbook of practical physiology*. 8th Edn, Jaypee. New Delhi.

Reference Books:

1. Don W. Bailey. 1983. *Laboratory manual for animal physiology.* Tichenor Pub; 2nd edition, USA.
2. Ottam G.S., Mittal P.K., Gupta B., Jindal S.K., Bilochi D.R. 2020. *Practical veterinary physiology.* Satish Serial Publishing House, Azadpur, New Delhi.
3. Bhabesh Mili. 2024. *Practical manual veterinary physiology.* NIPA, New Delhi.
4. Archana Jain, Jyotsana Shakkarpude, Aamrapali Bhimte, Ranjit Aich, Shweta Rajoriya 2023. *Veterinary physiology a practical manual paper* 2. SSPH, Azadpur, Delhi.
5. Thomas Colville & Joanna M Bassert, 2019. *Laboratory manual for clinical anatomy and physiology for veterinary technicians*. Elsevier.

Web Resources:

1. https://www.betterhealth.vic.gov.au/health/healthyliving/bottle-feeding-nutrition-and-safety
2. https://elibrary.mjfveterinarycollege.org/public/images/manuals/1637142454.VETERINARY%20PHYSIOLOGY%20VOLUME%201st.pdf
3. https://students.aiu.edu/submissions/profiles/resources/onlineBook/d5X2x8_practical-physiology-nutrition.pdf
4. http://repo.jfn.ac.lk/med/bitstream/701/830/1/Manual%20for%20Medical%20Phys%20Pract%202014.pdf
5. https://www.news-medical.net/health/Structure-and-Function-of-the-Heart.aspx

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	3	3	3	3	3	3	3	3
CO2	3	1	2	2	3	3	3	2	3	3	3	3
CO3	3	2	2	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3
TOTAL	**15**	**11**	**13**	**13**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**
AVERAGE	**3**	**2.2**	**2.6**	**2.6**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

3 – Strong, 2- Medium, 1- Low

SEMESTER IV
ELECTIVE COURSE IV: ECONOMIC ZOOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU234EC1	3	-	1	-	3	4	60	25	75	100

Pre-requisite:

Students should have fundamentals of culture practices of economically important animals.

Learning Objectives:

1. To empower the students with the culture practices of economically important animals.
2. To enable the students to become an entrepreneur.

Course Outcomes

On the successful completion of the course, students will be able to:		
1	recall the principles of api-, seri-, and aquaculture, poultry and dairy farming.	**K1**
2	explain the tools and techniques used in rearing practices.	**K2**
3	practice the fundamental concepts of applied zoology in research and animal farms.	**K3**
4	inspect the quality of honey, silk, egg, milk and fish.	**K4**
5	evaluate the profitability of animal farms.	**K5**

K1 - Remember; **K2 -** Understand; **K3** – Apply; **K4 -** Analyse; **K5** – Evaluate

Units	Contents	No. of Hours
I	**Aquaculture:** Aquaculture in India – Important cultivable organisms and their qualities – culture of Indian major carps, Marine prawn culture, Pearl culture. Integrated fish culture (Paddy cum fish culture).	**12**
II	**Apiculture:** classification and kinds of bees, bees and their society - caste distinction and their functions. Methods of bee keeping (primitive and modern). Honey bee products: honey, bee wax, bee venom.	**12**
III	**Sericulture:** Moriculture – methods of propagation – Common species of Silkworm – Life cycle of mulberry silkworm (egg, larva, pupa and adult). Rearing of silkworm – mounting – spinning- harvesting of cocoons – silk reeling and marketing.	**12**
IV	**Poultry Farming:** Poultry housing - types of poultry houses – management of chick, growers, layers and broilers. Sexing in chicks, Nutritive value of egg. Diseases of poultry – Ranikhet, Fowl pox, Coryza, Coccidiosis, Polyneuritis.	**12**
V	**Dairy Farming:** Breeds of Dairy animals – Establishment of a typical Dairy farm – Management of cow (Newborn, calf, Heifer, milking cow) – Diseases (Mastitis, Rinder Pest, Foot and Mouth Disease). Dairy products (Standard milk, skimmed milk, toned milk and fermented milk - curd, ghee, cheese) Pasteurization.	**12**
	Total	**60**

Self-study	Pearl culture, honey, spinning, Fowl pox

Textbooks:

1. Arumugam, N., Murugan, T., Johnson Rajeshwar, J. and Ram Prabhu, R. 2011. *Applied Zoology*.: Saras Publications Nagercoil.
2. Shukla, G.S.& Upadhyay, V.B.2017. Economic Zoology, Rastogi Publications, India.

Reference Books:

1. Johnson, J. and Jeya Chandra, I. 2005. *Apiculture.* Olympic Grafix. Marthandam.
2. Ganga, G. and Sulochana Chetty 1997. *An Introduction to Sericulture.* Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi
3. Gnanamani, M.R. (2005). *Profitable Poultry Farming*. J. Hitone Publications, Madurai.
4. Santhanakumar, G. and Selvaraj, A.M. (2002). *Concepts of Aquaculture.* Meenam Publications. Nagercoil
5. Uma Shankar Singh (2008). *Dairy Farming.* Anmol Publishers. New Delhi

Web Resources:

1. https://ariesagro.com/rise-of-aqua-culture-in-india/
2. https://fisheries.bihar.gov.in/Docs/prawnculture.pdf
3. https://en.wikipedia.org/wiki/Beekeeping
4. https://kvk.icar.gov.in/API/Content/PPupload/k0160_11.pdf
5. https://byjus.com/chemistry/sericulture/#:~:text=Sericulture%20is%20the%20process%20of,used%20silkworm%20species%20in%20sericulture

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	2	3	3	3	3	3	3	3	3	3
CO2	2	3	3	2	3	3	2	3	2	3	2	3
CO3	2	2	2	3	2	2	2	3	3	2	3	2
CO4	2	2	2	2	2	2	2	2	3	3	2	2
CO5	1	3	2	2	1	2	3	3	3	2	3	2
TOTAL	**9**	**13**	**11**	**12**	**11**	**12**	**12**	**14**	**14**	**13**	**13**	**12**
AVERAGE	**1.8**	**2.6**	**2.2**	**2.4**	**2.2**	**2.4**	**2.4**	**2.8**	**2.8**	**2.6**	**2.6**	**2.4**

3 – Strong, 2- Medium, 1- Low

SEMESTER IV

ELECTIVE LAB COURSE II: LAB ON ECONOMIC ZOOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU234EP1	**-**	**-**	**2**	**-**	**2**	**2**	**30**	**25**	**75**	**100**

Pre-requisite:

Students with basic knowledge on economically important animals.

Learning Objectives:

1. To develop practical skills in basic concepts of biology.
2. To make students to acquire more practical knowledge through industrial visits to agro- based farms.

Course Outcomes

On the successful completion of the course, students will be able to:		
1	identify and classify invertebrates and chordates.	**K1**
2	estimate the salinity and oxygen content of water samples.	**K2**
3	identify aquatic culturable organisms and their diseases.	**K3**
4	develop skill in dissection and microscopy.	**K4**
5	gain knowledge through field visit.	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** – Evaluate

Units	Contents	No. of Hours
1.	Dissection of silk gland of *Bombyx mori*.	**30**
2.	Testing of purity of Honey in three different samples	
3.	Identification of cells in the honey bee comb	
4.	Qualitative analysis of milk - Methylene reductase test	
5.	Estimation of protein in hen's egg.	
6.	Estimation of oxygen in water samples.	
7.	Estimation of salinity in water samples.	
8.	Visit to places having importance related to theory.	
9.	**Spotters / Models / Charts / Bookplates**	
Honey bee (worker, queen and drone), Newton's bee-hive, silkworm (egg, larva, pupa and adult), Chandrika, Rearing stand, Poultry feeders, Fowl pox, Coccidiosis, *Catla catla*, *Rohu*, *Mrigala*.		

Textbooks:

1. Aminul Islam, 2016. *Textbook of Economic Zoology*. I K International Publishing House Pvt. Ltd, India.
2. Supriti Sarkar, 2014. *Introduction to Economic Zoology*. New Central Book Agency; New edition, India.

Reference Books:

1. Monika Panchani, 2021. *Lab manual applied Zoology*. Panchami Publishing, White Falcon Publishing, India.
2. Rastogi V.B. 1999. *Lower non-chordate* & *Economic Zoology*, Rastogi publications, Meerut, Uttar Pradesh.
3. Plummer D.T., 1988, *An introduction Practical Biochemistry*. 3rd edition, Tata M.C Graw-Hill publishing, New York.
4. Raghuramu, Nair and Kalyanasundaram, 1983. *A Manual of Laboratory, Techniques*, Hyderabad, India.

5. Adate et al., 2023. *A Hand book of practical Zoology*. Bhumi Publishing, Kolhapur, Maharashtra.

Web Pages:

1. https://www.youtube.com/watch?v=agdFb9qPYQs
2. https://www.youtube.com/watch?v=frtln5ZoeNQ
3. https://www.youtube.com/watch?v=R4TdJGeeA30
4. https://www.youtube.com/watch?v=5-5gIRl9uCg
5. https://www.youtube.com/watch?v=cLsRxySgqvo

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	2	3	3	3	3	3	3	3	3	3
CO2	2	3	3	2	3	3	2	3	2	3	2	3
CO3	2	2	2	3	2	2	2	3	3	2	3	2
CO4	2	3	2	2	2	2	2	2	3	3	2	2
CO5	1	3	2	1	3	2	3	3	3	1	3	2
TOTAL	**9**	**14**	**11**	**11**	**13**	**12**	**12**	**14**	**14**	**12**	**13**	**12**
AVERAGE	**1.8**	**2.8**	**2.2**	**2.2**	**2.6**	**2.4**	**2.4**	**2.8**	**2.8**	**2.4**	**2.6**	**2.4**

3 – Strong, 2- Medium, 1- Low

SEMESTER III / IV

SKILL ENHANCEMENT COURSE SEC – IV: DIGITAL FLUENCY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG23CSE2	2	-	-	-	2	2	30	50	50	100

Pre-requisite: Basic computer knowledge

Learning Objectives:

1. To provide a comprehensive suite of productivity tools that enhance efficiency
2. To build essential soft skills that are needed for professional success.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	work with text, themes and styles	**K1**
2.	produce a mail merge	**K2**
3.	secure information in an Excel workbook	**K2**
4.	perform documentation and presentation skills	**K2, K3**
5.	add special effects to slide transitions	**K3**

K1 - Remember; **K2** - Understand; **K3** – Apply

Units	Contents	No. of Hours
I	**Microsoft Word 2010:** Starting Word 2010 - Understanding the Word Program Screen - Giving Commands in Word - Using Command Shortcuts – Document: Creating - Opening - Previewing - Printing and Saving. Getting Started with Documents: Entering and Deleting Text - Navigating through a Document - Viewing a Document. Working with and Editing Text: Spell Check and Grammar Check- Finding and Replacing Text - Inserting Symbols and Special Characters – Copying, Moving, and Pasting Text.	**6**
II	**Formatting Characters and Paragraphs**: Changing Font Type, Font Size, Font Color, Font Styles and Effects, Text Case, Creating Lists, Paragraph Alignment, Paragraph Borders and Shadings, Spacing between Paragraphs and Lines. Formatting the Page: Adjusting Margins, Page Orientation and Size, Columns and Ordering, Headers and Footers, Page Numbering. Working with Shapes, Pictures and SmartArt: Inserting Clip Art, Pictures and Graphics File, Resize Graphics, Removing Picture's Background, Text Boxes, Smart Art, Applying Special Effects. Working with Tables: Create Table, Add and delete Row or Column, Apply Table Style - Working with Mailings.	**6**
III	**Microsoft Excel 2010:** Creating Workbooks and Entering Data: Creating and Saving a New Workbook - Navigating the Excel Interface, Worksheets, and Workbooks - Entering Data in Worksheets - Inserting, Deleting, and Rearranging Worksheets. Formatting Worksheets: Inserting and Deleting Rows, Columns and Cells - Formatting Cells and Ranges - Printing your Excel Worksheets and Workbooks. Crunching Numbers with Formulas and Functions: Difference between Formulae and Functions - Applying Functions. Creating Powerful and Persuasive Charts: Creating, Laying Out, and Formatting a Chart.	**6**
IV	**Microsoft PowerPoint 2010:** Creating a Presentation - Changing the Slide Size and Orientation - Navigating the PowerPoint Window - Add content to a Slide - Adding, Deleting, and Rearranging Slides - Using views to work on Presentation. Creating Clear and Compelling Slides: Planning the Slides in Presentation - Choosing Slide Layouts to Suit the Contents - Adding Tables, SmartArt, Charts, Pictures, Movies, Sounds, Transitions and Animations - Slideshow.	**6**

V	**Digital Platforms:** Graphic Design Platform: Canva - Logo Making, Invitation Designing. E-learning Platform: Virtual Meet – Technical Requirements, Scheduling Meetings, Sharing Presentations, Recording the Meetings. Online Forms: Creating Questionnaire, Publishing Questionnaire, Analyzing the Responses, Downloading the Response to Spreadsheet.	**6**
	Total	**30**

Self-study	Parts of a computer and their functions

Textbook:

1. Anto Hepzie Bai J. & Divya Merry Malar J.,2024, Digital Fluency, Nanjil Publications, Nagercoil.

Reference Books:

1. Steve Schwartz, 2017, *Microsoft Office 2010 for Windows*, Peach pit Press.
2. Ramesh Bangia, 2015, Learning Microsoft Office 2010, Khanna Book Publishing Company.
3. Bittu Kumar, 2018, *Mastering MS Office*, V & S Publishers.
4. James Bernstein, 2020, *Google Meet Made Easy*, e-book, Amazon.
5. Zeldman, Jeffrey, 2005, *Web Standards Design Guide*, Charles River Media.

Web Resources:

1. https://www.youtube.com/watch?v=oocieLn6umo
2. https://www.youtube.com/watch?v=pPSwbK4_GdY
3. https://www.youtube.com/watch?v=DKAiSDhU4To
4. https://www.youtube.com/watch?v=sbeyPahs-ng
5. https://www.youtube.com/watch?v=fACEzzmXelY

SEMESTER IV
ENVIRONMENTAL STUDIES

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG234EV1	2	-	-	-	2	2	30	25	75	100

Pre-requisite: Interest to learn about nature and surrounding.

Learning Objectives

1.To know the different types of pollutions, causes and effects

2.To understand the importance of ecosystem, resources and waste management

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	know the different kinds of resources, pollution and ecosystems	**K1**
2.	understand the biodiversity and its constituents	**K2**
3.	use the methods to control pollution and, to conserve the resources and ecosystem	**K3**
4.	analyse the factors behind pollution, global warming and health effects for sustainable development	**K4**
5.	evaluate various water, disaster and waste management systems	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** – Evaluate

Units	Contents	No. of Hours
I	**Nature of Environmental Studies** Multidisciplinary nature of environmental studies- scope of environmental studies - environmental ethics-importance- types- natural resources - renewable and non-renewable resources – forest, land, water and energy resources.	**6**
II	**Biodiversity and its Conservation** Definition: genetic, species of biodiversity - biodiversity hot-spots in India - endangered and endemic species of India – Red Data Book - In-situ and Ex-situ conservation of biodiversity. Ecosystem- types - structure and function - food chain - food web- ecological pyramids- forest and pond ecosystems.	**6**
III	**Environmental Pollution** Pollution - causes, types and control measures of air, water, soil and noise pollution. Role of an individual in prevention of pollution. Solid waste management: Causes, effects and control measures of urban and industrial wastes. Disaster management– cyclone, flood, drought and earthquake.	**6**
IV	**Environmental Management and Sustainable Development** From unsustainable to sustainable development -Environmental Law and Policy – Objectives; The Water and Air Acts-The Environment Protection Act - Environmental Auditing-Environmental Impact Assessment-Life Cycle Assessment- Human Health Risk Assessment, Water conservation, rain water harvesting, watershed management.	**6**
V	**Social Issues and the Environment** Population explosion-impact of population growth on environment and social environment. Women and Child Welfare, Role of information technology in environment and human health. Consumerism and waste products. Climate change - global warming, acid rain and ozone layer depletion. **Field work:** Address environmental concerns in the campus (or) Document environmental assets- river / forest / grassland / hill / mountain in the locality	**6**

	(or) Study a local polluted site-urban / rural / industrial / agricultural area.	
	Total	**30**

Self-study	Pollutants, Ecosystems and Resources

Textbook

1. Punitha A and Gladis Latha R, 2024. Fundamentals of Environmental Science.

Reference Books

1. Agarwal, K.C., 2001. *Environmental Biology*, Nidi Publishers. Ltd. Bikaner.
2. Brunner R.C., 1989, *Hazardous Waste Incineration*, McGraw Hill Ltd.
3. Gorhani, E & Hepworth, M.T. 2001. *Environmental Encyclopedia*, Jaico Publ. House, Mumbai.
4. De A.K.,2018. *Environmental Chemistry*, Wiley Eastern Ltd.
5. Gleick, H.P. 1993. *Water in crisis*, Pacific Institute for Studies Oxford Univ. Press.

Web Resources

1.https://www.sciencenews.org/topic/environment
2.https://news.mongabay.com/2024/05/
3. https://www.sciencedaily.com/news/earth_climate/environmental_issues/
4.https://wildlife.org/rising-oryx-numbers-may-distress-new-mexico-ecosystem/
5. https://phys.org/news/2024-02-global-wild-megafauna-ecosystem-properties.html

SEMESTER III & IV

LIFE SKILL TRAINING II: CATECHISM

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG234LC1	1	-	-	-	1	1	15	-	50	100

Learning Objectives:

1. To develop human values through value education
2. To understand the importance of personal development to lead a moral life

Course Outcomes

On the successful completion of the course, students will be able to:		
1	know and understand the aim and importance of value education	K1,K2
2	get rid of inferiority complex and act confidently in the society	K3
3	live lovingly by facing loneliness and make decisions on their own	K3
4	develop human dignity and able to stand bravely in adversity	K6
5	learn unity in diversity and grow in a life of grace	K6

K1 - Remember **K2**-Understand; **K3**-Apply; **K6**- Create

Units	Contents	No. of Hours
I	**Face Loneliness:** Loneliness – Causes for Loneliness – Loneliness in Jesus Christ Life – Ways to Overcome Loneliness – Need and Importance Bible Reference: Matthew: 6:5-6	3
II	**Inferiority Complex:** Inferiority Complex - Types – Ways to Get Rid of Inferiority Complex – Words of Eric Menthol – Balanced Emotion – Jesus and his Disciples. Bible Reference: Luke 8:43-48	3
III	**Decision Making:** Importance of Decision Making – Different Steps – Search – Think – Pray – Decide- Jesus and his Decisions Bible Reference: Mathew 7:7-8 **Independent:** Freedom from Control – Different Types of Freedom - Jesus the Liberator Bible Reference: Mark 10:46-52	3
IV	**Human Dignity:** Basic Needs – Factors that Degrade Human Dignity – How to Develop Human Dignity. Bible Reference: Luke 6:20-26 **Stand Bravely in Adversity:** Views of Abraham Maslow – Jesus and his Adversity. Bible Reference: Luke 22:43	3
V	**Unity in Diversity:** Need for Unity – The Second Vatican Council on the Mission of Christian Unity. Bible Reference: I Corinthians 1:10 **To Grow in a Life of Grace:** Graceful Life – View of Holy Bible – Moses – Amos – Paul – Graceful Life of Jesus Bible Reference: Amos 5:4	3
TOTAL		15

Textbooks

1. *Valvukku Valikattuvom*, Christian Life Committee, Kottar Diocese
2. *The Holy Bible*

SEMESTER III & IV

LIFE SKILL TRAINING II: MORAL

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG234LM1	1	-	-	-	1	1	15	50	50	100

Learning Objectives:

1. To cultivate human values through value education
2. To comprehend the importance of humane and morals to lead ethical and moral life.

Course Outcome

On the successful completion of the course, students will be able to:		
1	know the significance of life	K1
2	understand the importance of self-care	K2
3	realise the duty of youngsters in the society and live up to it	K3
4	analyse how to achieve success in profession	K4
5	develop mystical values by inculcating good thoughts	K5

K1 - Remember; K2 - Understand; K3 – Apply; K4 - Analyse; K5 – Evaluate

Unit	Contents	No. of Hours
I	**Edu Care:** Introduction- -Personal Care-Temple of Mind-Emotional stability-Inner views- Internal and external Beauty- Life is a Celebration	3
II	**Self-care:** Self- discipline- Selfishness in doing good things- Adolescence stage-What am I? - Self-esteem- Self-Confidence- Respect for womanhood	3
III	**Profession based Values:** Time Management-Continuous effort- What next? –Present moment is yours, Hard work and Smart Work-Broad view- destruct your failures	3
IV	**Mystical Values:** Thoughts- Positive and negative thoughts- Origin of negative thoughts-Moralisation of needs- Elimination of obstacles	3
V	**Society and you:** Knowing Humanity-Thankfulness- love and happiness- Honesty-Heroism -Youth is gift of God-Youngsters in politics and social media utilization.	3
TOTAL		15

Textbook

1. "Munaetrathin Mugavari", G. Chandran, Vaigarai Publisher.

SEMESTER IV/VI

SELF-LEARNING COURSE: DAIRY PRODUCTION TECHNOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU234SL1/ ZU236SL1	-	-	-	-	1	-	-	25	75	100

Prerequisite:

Basic knowledge on animal husbandry and principles.

Learning Objectives:

1. The students understand the basics of dairy animal management, including feeding, housing, and health care.
2. Learn the fundamentals of dairy genetics and breeding for improved milk production and quality,

Course Outcomes

On the successful completion of the course, students will be able to:		
1	outline the historical evolution and future prospects of the dairy industry.	K1
2	identify various dairy products and their nutritive values	K2
3	address common disorders in dairy cattle and implement measures to prevent disease transmission	K3
4	ensure milk quality through proper milking management, hygiene practices, etc.	K4
5	explore various milk products and their production processes, including cheese, yogurt, and gluten.	K5

K1 - Remember; **K2 -** Understand; **K3** – Apply; **K4 -** Analyse; **K5** – Evaluate

Units	Contents
I	**Planning and maintaining desired cattle breeds:** History of Dairy Industry. Distribution map of mdairy farming areas/ major milk producing regions in India. Dairy farm planning Management. Challenges in setting up a dairy farm. Animals Dairy herd health and production.
II	**Managing Dairy Cattle**: Breed selection: Breeds of cattle and buffalo, Native cow varieties, Indian exotic breeds their popularity and performance; Forage Production and Pasture Management. Nutritional requirements, Sources of feed: Temperate and tropical grasses. Feed composition– nutrients for milk production,
III	**Housing and maternity management:** Housing of Dairy Cattle. Dairy and shed design. Cleaning Management. Dairy herd Management and growth; Cow health and reproductive performance. Breeding Dairy Cattle. Artificial insemination and conception; Maternity management, The Lactation Cycle. management, Calf diseases; Common management procedures. Vaccination, dehorning, weaning etc.
IV	**Milk products management:** Dairy Products and their nutritive value - Milk, cheese, yoghurt, gluten etc;. Milking Management. Gathering cow for milking; Milking machines for smallholders; cleaning and sanitizing dairy equipment; Milking procedure. Dry cow therapy; Milk filtration Management. Milking Hygiene; Post-harvest milk quality.
V	**Business prospects, Biosecurity** Dairy business profit strategies. Common disorders in Dairy Cattle; Managing Dairy Facilities for sick and lame cows. Mastitis, metabolic disorders, hypermagnesemia, ketosis and fatty liver, Ruminal acidosis, metritis; Hoof management. Manure handling. Biosecurity; Farm level economics affecting productivity and profitability.

Textbooks:

1. De Sukumar, 2001. *Outlines of dairy technology*. Oxford, USA.
2. Niir Board, 2013. *Modern technology of milk processing & dairy products*.

NIIR project consultancy services; 4th Edition, Kamla Nagar, Delhi.

Reference Books

1. Eiri Board, 2018. *Hand book of milk processing dairy products and packaging technology.* Jain Board Deposits, New Delhi.
2. Mahindru, S. 2014. Milk and Milk products. Jain Board Deposits, New Delhi.
3. Unifem, 1996. Dairy Processing: Food Cycle Technology. Practical Action Publishing Ltd., New Delhi.
4. Edgar Spreer, 1998. *Milk and Dairy Product Technology*. CRC Press, 1st edition, USA.
5. Klaus, A. J. 2015. *Dairy Farming: The Beautiful Way*. Create space Independent Pub., USA.

Web Resources:

1. https://www.fao.org/4/i0588e/I0588E05.htm
2. http://www.agritech.tnau.ac.in/expert_system/cattlebuffalo/Breeds%20of%20cattle%20&%20baffalo.html
3. https://kvk.icar.gov.in/API/Content/PPupload/k0221_11.pdf
4. https://www.youtube.com/watch?v=Soqm-8zhhuo
5. https://www.youtube.com/watch?v=0J2FHVm0k7U

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	3	2	3	3	2	3	3	2
CO2	3	3	2	3	3	3	3	3	2	2	3	3
CO3	3	3	3	2	3	3	3	3	3	3	3	3
CO4	2	3	3	3	3	3	3	2	2	3	3	3
CO5	2	3	3	3	3	3	3	3	3	3	3	3
Total	**12**	**14**	**14**	**13**	**15**	**14**	**15**	**14**	**12**	**14**	**15**	**14**
Average	**2.4**	**2.8**	**2.8**	**2.6**	**3**	**2.8**	**3**	**2.8**	**2.4**	**2.8**	**3**	**2.8**

3 – Strong, 2 – Medium, 1 - Low

SEMESTER V

CORE COURSE V: GENETICS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU235CC1	4	1	-	-	4	5	75	25	75	100

Pre-requisite: Fundamental understanding of chromosomes and the principles of inheritance.

Learning Objectives:

1. To enable the students to understand the basic principles of hereditary mechanisms.
2. To equip students with skills in genetic inheritance, genetic disorders and genetic counseling.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	define fundamental concepts of Mendelian genetics, inheritance patterns, linkage, and crossing over.	**K1**
2.	explain the mechanisms of gene interactions, chromosomal variations, mutation processes, and their role in genetic inheritance.	**K2**
3.	demonstrate the application of genetic principles in solving inheritance problems, predicting genetic disorders.	**K3**
4.	analyze inheritance patterns, genetic variations, mutations, linkage, and gene regulation.	**K4**
5.	assess the genetic mechanisms, mutations, and regulatory processes in inheritance and gene expression.	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** - Evaluate

Units	Contents	No. of Hours
I	**Mendelian Genetics and Inheritance** Mendelian genetics: Mendelian experiments, laws of Mendel, monohybrid, dihybrid, back and test cross; Interaction of genes: incomplete dominance, codominance, complementary genes, supplementary genes, inhibiting genes, lethal genes and atavism. Inheritance: Polygenic inheritance- skin colour; multiple alleles- ABO blood groups; extra chromosomal inheritance, kappa particles; sex linked inheritance – colour blindness and hemophilia in man.	**15**
II	**Linkage and Crossing Over** Linkage: Linked genes, complete and incomplete linkage. Crossing over: molecular mechanisms of crossing over, kinds of crossing over, models of recombination. Chromosome mapping: interference and coincidence, haploid mapping, somatic cell hybridization.	**15**
III	**Cytogenetic** Variation in chromosome number and structure: position effect, chromosomal mutation. Gene mutation: types, molecular basis of mutation, mutational hot spots, reversion; radiation and chemical agents as mutagens; Detection of mutation - ClB method.	**15**
IV	**Microbial and Human Genetics** Bacterial genetics: Conjugation, transformation, transduction. Human genetics: Karyotype and idiogram; sex determination - Barr body technique, drumstick method; chromosomal abnormalities in humans, Pedigree analysis; diagnosis of genetic abnormalities; Eugenics, Euphenics, and Euthenics. Population genetics: gene pool, gene frequency and genotype frequency; Hardy- Weinberg law of equilibrium.	**15**

V	**Gene expression and gene regulations** Insertion elements, transposable elements, retroelements; integrons and antibiotic resistance cassettes; the lactose system and operon model, tryptophan operon, role and relative positions of promoters and operators.	**15**
Total		**75**

Self-study	Karyotype and ideogram

Text Books:

1. Meyyan R.P. 2022. *Genetics*, (8th Edition), Saras Publication, Nagercoil, India.
2. Verma P.S., Agarwal V.K., 2018. *Genetics*, S. Chand & Company (P) Ltd., New Delhi.

Reference Books:

1. Veer Bala Rastogi, 2019. *Text Book of Genetics*, (4th Edition), Medtech, New Delhi.
2. Ajoy Paul. 2018. *Text Book of Genetics* (2nd Edition), Books and Allied Pvt., Kolkata.
3. Verma P.S, Agarwal V.K. 2009. *Genetics*, (9th Edition), Chand and Company Ltd.
4. Griffiths A.J.F., Wessler S.R., Lewontin R.C., Carroll S.B., 2015. *Introduction to Genetic Analysis*, (11th Edition), W.H. Freeman and Company, New York.
5. Hartl D.L., Jones E.W., 2018. *Genetics*: *Analysis of Genes and Genomes*, (9th Edition), Jones & Bartlett Learning, Burlington.

Web Resources:

1. https://en.wikipedia.org/wiki/Mendelian_inheritance
2. https://en.wikipedia.org/wiki/Genetic_linkage
3. https://en.wikipedia.org/wiki/Chromosome_abnormality
4. https://en.wikipedia.org/wiki/Human_genetics
5. https://en.wikipedia.org/wiki/Operon

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	3	3	2	3	3	3	2	3	3
CO2	3	2	3	3	3	3	3	2	3	3	3	3
CO3	3	3	3	3	3	3	3	2	3	3	3	3
CO4	2	3	3	3	3	3	3	3	3	3	3	3
CO5	3	2	3	2	3	3	3	3	2	3	2	3
TOTAL	**14**	**13**	**15**	**14**	**15**	**14**	**15**	**13**	**14**	**14**	**14**	**15**
AVERAGE	**2.8**	**2.6**	**3**	**2.8**	**3**	**2.8**	**3**	**2.6**	**2.8**	**2.8**	**2.8**	**3**

3 – Strong, 2- Medium, 1- Low

SEMESTER V

CORE COURSE VI: DEVELOPMENTAL BIOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU235CC2	5	-	-	-	4	5	75	25	75	100

Pre-requisite: Basic understanding of principles of development.

Learning Objectives:

1. To impart knowledge on the sequential changes during the embryonic development of animals and human reproductive health.
2. To develop skills on observation of developmental stages, regeneration, and nuclear transplantation.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	define the concepts of reproduction, embryonic development, nucleo-cytoplasmic interaction and birth control.	**K1**
2.	outline the patterns of cleavage, morphogenetic movements, fate map, the reproductive disorders and treatment.	**K2**
3.	relate the embryological process in animals.	**K3**
4.	analyse the embryonic development, clinical implications of the development and gender based reproductive disorders.	**K4**
5.	evaluate the significance of applied embryology, including regeneration, embryonic stem cells, and culture techniques.	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** – Evaluate

Units	Contents	No. of Hours
I	**Gametogenesis and Fertilization** Basic concepts of developmental biology. Structure and types of Spermatozoa, Mammalian egg - Egg membranes. types of egg - Spermatogenesis – Oogenesis. Fertilization – mechanism, theories and significance – Parthenogenesis.	**15**
II	**Blastulation and Gastrulation** Cleavage - Planes and Patterns, Factors controlling cleavage - Fate map and its construction. Blastulation - types of blastula. Morphogenetic movements - Gastrulation of frog and chick.	**15**
III	**Organogenesis** Development of eye, heart and gut in frog. Development of brain in chick. Foetal membranes in chick. Development of Pro, Meso, Metanephric kidneys. Placentation in Mammals - types and functions.	**15**
IV	**Applied Embryology** Organizer concept – Structure – mechanism of induction and competence. Gradient theory. Nuclear transplantation – *Acetabularia*. Teratogenesis. Regeneration: types - events and factors. Embryonic stem cells and significance. Methods to culture embryo.	**15**
V	**Human embryology** Reproductive organs, Menstrual cycle and menopause - Pregnancy – trimesters – development. Erythroblastosis foetalis - Twins – types. Infertility – causes. Test tube baby and Assisted Reproductive Technology – IUI, IVF, ICSI – Embryo transfer – Amniocentesis.	**15**
Total		**75**
Self-study	Regeneration: types - events and factors.	

Text Books:

1. Subramoniam, T. 2003. *Developmental Biology*, Narosa Publishing House, New Delhi, India.
2. Verma, P.S., Agarwal, V. K.2010. *Chordate Embryology: Developmental Biology*, S. Chand & Company, New Delhi., India.

Reference Books:

1. Lewis Wolpert, 2007. *Principles of Developmen*t, 3rd edition, Oxford University Press, New Delhi, India
2. Gilbert S.F. 2010. *Developmental Biology*, Sinauer Associates, Massachusetts, USA.
3. Balinsky, B.I. 1970. *Introduction to Embryology*, Philadelphia & London, UK.
4. Berril, N.J. 1971. *Developmental Biology*, McGraw Hill, New York, USA.
5. Russ Hodge 2010. *Developmental Biology*, Facts on File, Inc., New York, USA.

Web Resources:

1. https://www.ncbi.nlm.nih.gov/books/NBK10052/
2. https://www.cdc.gov/ncbddd/developmentaldisabilities/facts.html
3. https://anatomypubs.onlinelibrary.wiley.com/doi/full/10.1002/dvdy.20468
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5293490/
5. https://pmc.ncbi.nlm.nih.gov/articles/PMC2973558/#:~:text=Embryonic%20stem%20cells%20(ESC)%20are, and%20establishment%20of%20organ%20structures

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO 3	PSO4	PSO5
CO1	3	2	3	3	2	2	3	3	2	2	3	2
CO2	3	2	3	3	2	2	2	3	2	2	3	2
CO3	3	2	3	3	2	2	2	3	2	2	3	2
CO4	3	2	3	3	2	2	2	3	2	2	3	2
CO5	3	2	3	3	2	2	2	3	2	2	3	2
TOTAL	**15**	**10**	**15**	**15**	**10**	**10**	**10**	**15**	**10**	**10**	**15**	**10**
AVERAGE	**3**	**2**	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**3**	**2**

3 – Strong, 2- Medium, 1- Low

SEMESTER V

CORE LAB COURSE V: GENETICS AND DEVELOPMENTAL BIOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU235CP1	-	-	5	-	4	5	75	25	75	100

Pre-requisite: Students should have the basic knowledge on genetics and embryonic development.

Learning Objectives:

1. To develop skills on experimental Genetics and interpret the results.
2. To observe the key stages of embryonic development through experimental techniques.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall fundamental genetic and developmental biology concepts, such as Mendelian traits, pedigree construction, and embryonic stages.	**K1**
2.	explain inheritance patterns, polygenic traits, and the effects of hormones on amphibian metamorphosis.	**K2**
3.	perform genetic experiments like blood group identification, Drosophila mutant analysis, and temporary mounting of embryonic structures.	**K3**
4.	compare monohybrid and dihybrid crosses, assess genetic disorders like color blindness, and interpret pedigree charts.	**K4**
5.	critically assess experimental outcomes, such as sperm motility, ovulation induction, and regeneration in organisms, to understand biological principles.	**K5**

K1 - Remember**; K2 -** Understand**; K3 –** Apply**; K4 -** Analyse**; K5 -** Evaluate

Units	Contents	No. of Hours
	GENETICS	**75**
1	Observation of simple Mendelian traits in man.	
2	Demonstration of monohybrid cross using beads.	
3	Demonstration of dihybrid cross using beads.	
4	Identification of mutant forms of *Drosophila*.	
5	Observation of polygenic inheritance - Length of leaves.	
6	Identification of Blood group in man.	
7	Construction and analysis of Pedigree.	
8	Observation of Barr body in squamous epithelial cells.	
9	Observation of inactive chromosomes in neutrophils.	
10	Detection of colour blindness - Ishihara Test.	
Charts/ Slides/ Models/ Bookplates: Colour Blindness, Haemophilia, Somatic Cell Hybridization, Idiogram, Klinefelter's syndrome, Turner's syndrome, Down syndrome, Transduction, Transposable elements, Operon Model.		
	DEVELOPMENTAL BIOLOGY	
1	Temporary mounting of Frog egg and sperm. (Virtual Demonstration)	
2	Temporary mounting and observation of Chick embryo.	
3	Demonstration of induced ovulation in frog (virtual demonstration).	
4	Effect of thyroxine on Amphibian metamorphosis (Virtual Demonstration).	
5	Observation of developmental stages in an insect - *Drosophila*	

6	Observation of frog's sperm motility. (Virtual Demonstration)	
7	Observation of regeneration in earthworm (Demonstration)..	
8	Submission of report on chick embryo development.	
9	Identification of types of egg based on shell and yolk.	
10	Embryonic development of egg of Zebrafish.	
Charts/ Slides/ Models/ Bookplates/ Instruments: Sperm and egg of Human, Cleavage (2, 4, 8 and 16 cell stage), blastula and gastrula of frog, Placenta – Diffuse, Discoidal, Zonary and Cotyledonary, Condoms, copper T, *Invitro* fertilization, budding in hydra.		

Textbooks:

1. Rajeev Shrivastava, Prabha and Mayuri Sahu., 2013. *Practical Manual on Principles of Genetic*s, College of Agriculture, IGKV, Raipur (C.G.).
2. Jain, P.C., 2013. *Elements of Developmental Biology* (7th Edition.). Jalandhar: Vishal Publishing Co.

Reference Books:

1. Dinesh S Phad. 2020. *Practical Manual of Fundamental Genetics*. LAP Lambert Academic Publishing.
2. Sastry, K.V. and Shukla, V., 2003. *Developmental Biology*. Meerut: Rastogi Publications.
3. Gilbert S. F., 2010. *Developmental Biology*. IX Edition, Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts, USA.
4. Gardner E. J., Simmons M. J., Snustad D. P., 2005. *Principles of Genetics*, Volume 1, (8th Edition), John Wiley & Sons, New York.
5. Russell P. J., 2010. *Genetics: A Molecular Approach*, Volume 1, (3rd Edition), Pearson Education, San Francisco.

Web Resources:

1. https://www.ncbi.nlm.nih.gov/books/NBK10052/
2. https://www.cdc.gov/ncbddd/developmentaldisabilities/facts.html
3. https://anatomypubs.onlinelibrary.wiley.com/doi/full/10.1002/dvdy.20468
4. https://www.sciencedirect.com/science/article/abs/pii/S0065266024000105
5. https://www.labster.com/simulations/medical-genetics

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	2	3	3	3	3	3	3	3	3	3
CO2	2	3	3	2	3	3	2	3	2	3	2	3
CO3	2	2	2	3	2	2	2	3	3	2	3	2
CO4	2	2	2	2	2	2	2	2	3	3	2	2
CO5	1	3	2	2	1	1	3	3	3	2	3	2
TOTAL	**9**	**13**	**1**	**12**	**11**	**12**	**12**	**14**	**14**	**13**	**13**	**12**
AVERAGE	**1.8**	**2.6**	**2.2**	**2.4**	**2.2**	**2.4**	**2.4**	**2.8**	**2.8**	**2.6**	**2.6**	**2.4**

3 – Strong, 2- Medium, 1- Low

SEMESTER V

CORE RESEARCH PROJECT

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU235RP1	-	-	5	-	4	5	75	25	75	100

Pre-requisite: Basic knowledge of Zoology and simple research skills.

Learning Objectives

1. To develop skills to identify subject related problems applying appropriate tools and techniques.
2. To enable the students to synthesize technical knowledge to identify, formulate and solve problems of professional interest and importance.

Course Outcomes

On the successful completion of the course, students will be able to:		
1	identify a research problem relevant to the subject or society.	**K1**
2	conduct an experiment to interpret the data.	**K2**
3	write research reports and present results in the scientific community.	**K3**
4	critically analyse and interpret the results.	**K4**
5	evaluate the data to find its significance.	**K5**
6	design experiments to solve environmental and societal problems	**K6**

K1 - Remember**; K2 -** Understand**; K3 –** Apply**; K4 -** Analyse**; K5 –** Evaluate; **K6 -** Create

Guidelines

- Submission of Project report is mandatory.
- Project is subject-based and in group (5-6 students per group).
- Students can be permitted to do projects in industries, hospitals or other academic institutions (15 – 30 hrs)
- Group Viva.

I Framework of Project report

- Font - Times New Roman
- Heading - Font size 14 (Bold) - Uppercase
- Sub-headings - Font size 12 (Bold) – Lowercase; should be numbered. (E.g.: Introduction 1; Subheading 1.1; 1.2 ….)
- Text– Font size -12 (Normal).
- Citation - Any works of other researchers, if used either directly or indirectly should be indicated at appropriate places in the text.

  The citation may assume any one of the following forms:

  i) A paper, a monograph or a book with single author may be designated by the name of the first author followed by the year of publication, placed inside brackets at the appropriate places in the text.

  ii) A paper, a monograph or a book with two authors may be designated by the name of the first and second author followed by the year of publication, placed inside brackets at the appropriate places in the text.

  iii) A paper, a monograph or a book with more than two authors may be designated by the name of the first author followed by et al, and the year of publication, placed inside brackets at the appropriate places in the text.
- Line space - 1.5
- Margin - 2” on the left and 1” on the right, Gutter -0.5.
- Page Numbering – Bottom middle alignment; excluding initial pages and references.

- Total number of pages - Minimum 20 - Maximum 30 (excluding initial pages and reference).
- The Tables and Figures should be included subsequently after referring them in the text.
- The content should be printed on single side.

II. Project report must be completed within the stipulated time.

III. Submission

One hard copy (Soft binding) of the project report duly signed and endorsed by the Supervisor and the Head of the Department, should be submitted in the Department.

The report contains three main parts:

A. Initial Pages - in the following sequence

i. Title Page
ii. Certificate from the Supervisor
iii. Declaration by the candidate endorsed by the Supervisor and HoD.
iv. Acknowledgement (within one page - signed by the candidate).
v. Table of Contents

B. Main body of the report

i) Introduction with Literature review and Objectives
ii) Materials and methods
iii) Results
iv) Discussion
v) Summary
vi) References (DOI number of the journals can be included)

C. The guidelines for References (minimum 20 maximum 30)

1. Journal Article: with Single Author

Waldron, S 2008, 'Generalized Welch bound equality sequences are tight frames', IEEE Transactions on Information Theory, vol. 49, no. 9, pp. 2307-2309.

2. Journal Article: with Two Authors

Conley, TG and Galeson, DW 1998, 'Nativity and wealth in mid-nineteenth Centurycities', Journal of Economic History, vol. 58, no. 2, pp. 468-493.

3. Journal Article: with more than two Authors

Alishahi, K, Marvasti, F, Aref, VA & Pad, P 2009, 'Bounds on the sum capacity Of synchronous binary CDMA channels', Journal of Chemical Education, vol. 55, no. 8, 3577-3593.

4. Books

Holt, DH 1997, Management Principles and Practices, Prentice-Hall, Sydney.

5. E-book

Aghion, P and Durlauf, S (eds.) 2005, Handbook of Economic Growth, Elsevier, Amsterdam. Available from: Elsevier books. [4 November 2004].

6. Conference Proceeding Paper with editors

Riley, D 1992, 'Industrial relations in Australian education', in Contemporary Australasian industrial relations: proceedings of the sixth AIRAANZ conference, ed. D. Blackmur, AIRAANZ, Sydney, pp. 124-140.

7. Conference Proceeding Paper without editors

Fan, W, Gordon, MD &Pathak, R 2000, 'Personalization of search engine services for effective retrieval and knowledge management', Proceedings of the twenty-first international conference on information systems, pp. 20-34.

8. Website

Australian Securities Exchange 2009, Market Information. Available from: <http://www.asx.com.au/professionals/market_information/index.htm>.

9. Patent

Cookson, AH 1985, Particle trap for compressed gas insulated transmission systems, US Patent 4554399.

10. Thesis: Unpublished

Hos, JP 2005, Mechano chemically synthesized nanomaterials for intermediate temperature solid oxide fuel cell membranes. Ph.D. thesis, University of Western Australia.

11. Newspaper: Print

Ionesco, J 2001, 'Federal election: new Chip in politics', The Advertiser 23 October

Reference List Order

Arrange entries in alphabetical order by the surname of the first author followed by the initials of the author's given name(s).

III. Appendices (if any – the primary data, article published during the tenure of this programme**)**

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	2	2	2	3	3	2	3	3	3	2	2	2
CO2	3	3	2	3	3	2	3	3	3	2	3	2
CO3	2	2	3	2	2	3	3	2	3	3	2	3
CO4	3	3	2	3	3	2	2	3	2	3	2	3
CO5	3	3	3	3	3	3	2	3	3	2	3	2
CO6	2	2	3	3	3	3	3	3	2	3	3	3
TOTAL	**15**	**15**	**15**	**17**	**17**	**15**	**16**	**17**	**16**	**15**	**15**	**15**
AVERAGE	**2.5**	**2.5**	**2.5**	**2.8**	**2.8**	**2.5**	**2.6**	**2.8**	**2.6**	**2.5**	**2.5**	**2.5**

3 – Strong, 2- Medium, 1- Low

SEMESTER V

DISCIPLINE SPECIFIC ELECTIVE I: a) EVOLUTIONARY BIOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU235DE1	3	-	1	-	3	4	60	25	75	100

Pre-requisite:

A fundamental knowledge on the evolution of animals, fossils and to analyse the evolutionary relationship of animals.

Learning Objectives:

1. To impart knowledge on the evolutionary significance of animals and origin of species.
2. To provide skills for tracing fossil records, interpreting animal evolution and analyzing phylogenetic trees.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall the concepts of evolution, origin of life, geological time scale, natural selection, speciation and evidences of evolution.	**K1**
2.	discuss on the theories and forces of evolution, isolation, variation, speciation, fossils and phylogram.	**K2**
3.	apply the principles of evolution to identify evidences in support of evolution, genetic equilibrium, speciation, and rate of evolution.	**K3**
4.	analyse the major transitions in evolution and phylogeny of animals.	**K4**
5.	report the evidences in support of evolution through real world experience and phylogenetic analysis	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** – Evaluate

Units	Contents	
I	**Origin and theories of evolution** Inorganic and organic evolution - primordial earth and primeval atmosphere, Chemical origin of life: Synthesis of organic molecules, Urey-Miller experiment, Origin of prokaryotes and eukaryotes. Lamarckism - Neo Lamarckism - Darwinism - Neo Darwinism, Mutation theory of de Vries and modern synthetic theory.	**12**
II	**Isolating mechanisms, Speciation and Elemental forces of evolution** Isolating mechanisms - Modes of speciation - Hardy-Weinberg law and elemental forces of evolution – mutation, recombination, hybridization, variation, isolation, natural selection, Founder's principle and genetic drift. Genetic load and genetic death. Identification of mutant forms in *Drosophila*, analyze the variations in *Umbonium* shells and the processes of genetic drift using beads.	**12**
III	**Modes of Evolution, Mimicry and Colouration and Adaptive radiation** Modes of evolution. Coevolution. Molecular evolution. Heterochrony-Paedomorphosis and Peramorphosis. Rate of evolution. Human Evolution – organic, cultural and future evolution. Mimicry and colouration. Law of Adaptive Radiation - Adaptive radiation in reptiles, Darwin's finches and mammals – Convergence, divergence and parallelism. Field observation of animals exhibiting mimicry. Prepare models to understand adaptive radiation.	**12**
IV	**Evidences in Support of Evolution and Genome Evolution** Morphological, physiological, and biochemical evidences – Embryological, taxonomical, and geographical evidences – Palaeontological evidences – Fossil records of humans. Geological Time Scale – Nature of fossils – Dating of fossils – Identification of fossil types. Genome Evolution –	**12**

	Evolutionary genomics – Mobile genetic elements – Gene duplication. Comparative evolutionary studies – Observation of serial homology in prawns – Analogy in the wings of animals.	
V	**Phylogenetic analysis** Phylogenetic trees – structure and types. Tools for sequence alignment – BLAST, FASTA. Methods of phylogenetic tree analysis - phenetic and cladistic, methods for determining evolutionary trees – maximum parsimony, distance and maximum likelihood. Sequence alignment by BLAST and construction of cladogram. Mutations as data source for evolutionary analysis.	**12**
Total		**60**

Self-study	Cultural and future evolution of man, Mimicry and colouration

Text Books:

1. Sanjib Chattopadhyay 2012. *LIFE: Evolution, Adaptation and Ethology.* Kolkata: Books and Allied (P) Ltd.
2. Brian K Hall and Benedikt Hallgrimsson. 2008. Strickbergers's Evolution. 4th Edition. Jones and Bartkett Publishers, Massachusetts.

Reference Books:

1. Arora, M.P. 2003. *Evolutionary Biology.* Chennai: Himalaya Publishing House.
3. Arumugam, N. 2022. *Organic Evolution.*: (11th Edition) Saras Publications. Nagercoil.
4. Lull, R.S. 2010. *Organic evolution*, The Macmillan, New York.
2. Verma, P.S. and V.K. Agarwal 1998. *Concept of Evolution.* S. Chand and Company Ltd., New Delhi
3. Verma, P.S. and V.K. Agarwal 1982. *Principles of General Biology (Evolution).* S. Chand and company Ltd., New Delhi
4. Gladis Helen Hepsyba, S. and Hemalatha, C.R. 2009. *Basic Bioinformatics.* MJP Publishers, Chennai.
5. John Britto, A. 2011. *Bioinformatics.* St. Xavier' College, Palayamkottai

Web Resources:

1. https://bit.ly/3nPD09m
2. https://bit.ly/3CHOdgL
3. https://bit.ly/2XvcCXl
4. https://bit.ly/2XAL1Vh
5. https://bit.ly/3zoU9Jl

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	-	3	2	1	3	3	2	2	3	1
CO2	3	2	-	3	2	1	3	3	2	2	3	1
CO3	3	2	-	3	2	1	3	3	3	3	3	2
CO4	3	3	3	3	2	1	3	3	3	3	3	3
CO5	3	3	1	3	2	1	3	3	3	3	3	3
TOTAL	**15**	**11**	**4**	**15**	**10**	**5**	**15**	**15**	**13**	**13**	**15**	**10**
AVERAGE	**3**	**2.5**	**0.2**	**3**	**2**	**1**	**3**	**3**	**2.6**	**2.6**	**3**	**2**

3 – Strong, 2- Medium, 1- Low

SEMESTER V

DISCIPLINE SPECIFIC ELECTIVE I: b) VECTORS, DISEASES AND MANAGEMENT

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU235DE2	3	1		-	3	4	60	25	75	100

Pre-requisite: Basic understanding of insect taxonomy, human physiology, and ecology.

Learning Objectives:

1. To impart knowledge on vector types, biology, disease transmission, and control methods.
2. To inculcate skills in identifying vectors, monitoring their presence, and using effective control methods.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	describe the classification, morphology, and vectorial capacity of various vectors.	K1
2.	explain the disease transmission mechanisms and epidemiology of vector-borne diseases.	K2
3.	apply the knowledge of vector surveillance and control strategies.	K3
4.	analyze the effectiveness of vector bionomics and vector control measures.	K4
5.	assess the role of environmental and human factors in disease outbreaks.	K5

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** – Evaluate

Units	Contents	No. of Hours
I	**Introduction to Vectors and Vector Biology** Definition, classification, and significance of vectors. Morphology of major vectors - mosquitoes, flies, fleas, lice, bugs, ticks, and mites. Host-vector interaction and vectorial capacity. Vector incrimination and its role in disease transmission. Evolution of vector bionomics and human practices influencing vector prevalence. Identification of vectors.	**12**
II	**Vector-Borne Diseases and Epidemiology** Disease transmission by major vector groups - Diptera, Siphonaptera, Siphunculata, Hemiptera, Arachnida. Role of vectors in transmission of diseases - Malaria, Dengue, Chikungunya, Filariasis, Plague, Typhus, Chagas disease, Myiasis, Lyme disease.	**12**
III	**Vector Surveillance and Control Methods** Physical control - screening, fly traps, electrocution, poison baits, residual sprays. Chemical control - insecticides, synthetic pyrethroids, residual sprays, treated bed nets, fumigation. Biological control - role of predators - larvivorous fishes, parasites, fungi, bacteria, viruses, nematodes. Sterile insect technique and genetic approaches. Pheromonal and behavioral control.	**12**
IV	**Integrated Vector Management (IVM)** Concept and principles of IVM. Methods of sampling and monitoring. Risk assessment and damage threshold estimation - Integrated Pest Management (IPM) approaches in vector control - Legislation, policies, and ethical considerations in vector control.	**12**
V	**Emerging Trends in Vector Management** Impact of climate change on vector distribution and disease emergence. Utilisation of molecular techniques and GIS mapping for rapid vector identification. Innovative approaches - gene editing, transgenic vectors, and novel biocontrol methods.	**12**
Total		**60**

Self-study	Human impact on disease outbreaks and epidemiological patterns.

Text Books:

1. Tyagi, B. K. 2019. *Vector-borne diseases: epidemiology and control*. Scientific Publishers. 1st Edn. New Delhi.
2. Joel Jaison and Jayalakshmi Krishnan. 2024. *Mosquitoes control strategies to reduce the impact of vector-borne diseases.* Bentham Science Publishers Pte. Ltd. Singapore.

Reference Books:

1. Imms, A.D. 1977. *A General Text Book of Entomology*. Chapman & Hall, UK.
2. Tyagi, B. K. Dhanasekaran, D. 2018. *Microbial control of vector-borne disease*. CRC Press. Taylor and Francis Group, Florida.
3. Chapman, R.F. 1998. *The Insects: Structure and Functionoid.* Edition, Cambridge University Press, UK.
4. Mathews, G. 2011. *Integrated Vector Management: Controlling Vectors of Malaria and other Insect Vector borne Diseases*. Wiley-Blackwell, UK.
5. Belding, D.L. 1942. *Textbook of Clinical Parasitology*. Appleton-Century Co., Inc., New York.

Web Resources:

1. https://ec.europa.eu/echo/files/evaluation/watsan2005/annex_files/WEDC/evc/evc-02.pdf
2. https://www.who.int/news-room/fact-sheets/detail/vector-borne-diseases
3. https://ncvbdc.mohfw.gov.in/Doc/IVM-Manual-Draft-2015.pdf
4. https://www.slideshare.net/slideshow/vector-control-measures/250984665
5. ttps://www.health.gov.za/wp-content/uploads/2024/07/National-Vector-Control-Strategy-2023-2027-signed.pdf

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	3	3	2	3	3	3	2	2	2
CO2	3	3	2	3	3	2	3	3	3	2	3	3
CO3	2	2	3	2	2	3	3	2	3	3	2	3
CO4	3	3	2	3	3	2	2	3	3	3	2	3
CO5	3	3	3	3	3	3	2	3	3	2	3	2
TOTAL	**13**	**13**	**12**	**14**	**14**	**13**	**13**	**14**	**15**	**12**	**12**	**13**
AVERAGE	**2.6**	**2.6**	**2.4**	**2.8**	**2.8**	**2.6**	**2.6**	**2.8**	**3**	**2.2**	**2.2**	**2.4**

3 – Strong, 2- Medium, 1- Low

SEMESTER V

DISCIPLINE SPECIFIC ELECTIVE I: c) NANOBIOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU235DE3	3	1	-	-	3	4	60	25	75	100

Pre-requisite: Fundamental understanding of Biology and Chemistry.

Learning Objectives:

1. To inculcate the basic concepts and various techniques pertaining to nanobiology.
2. To provide the skills to develop nanomaterials.

Course outcomes

Upon completion of this course the students will be able to:		
1.	recall the fundamental concepts of Nano-science and Nano-biology.	**K1**
2.	explain principle, structure, properties and characterization of nanomaterials.	**K2**
3.	demonstrate the use of different techniques for the synthesis of nanomaterials.	**K3**
4.	analyse the composition and functional properties of nanostructures.	**K4**
5.	evaluate the suitability and effectiveness of nanoparticles in the biological systems.	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** – Analyse; **K5 – Evaluate**

Units	Contents	No. of Hours
I	Nanobiology: Definition - concepts and scope. History of nanotechnology and nanoscience. Structure and properties of nanomaterials - size, surface charge, conductivity, optical properties and biocompatibility.	**12**
II	Synthesis and characterization of nanomaterials: Fabrication of nanostructures, metallic nanoparticles, semiconductor, biopolymeric nano-structures and nanoparticles.	**12**
III	Composition and functional properties of nanostructures: Protein and peptide-based nanostructures, carbohydrate and nucleic acid-based nanomaterials; Use of gold, silver and other metallic nanoparticles.	**12**
IV	Strategies to design biologically active nanostructure-based biomaterials. Interaction of nanoparticles with biomolecules to study their conformational and functional properties.	**12**
V	Biological Applications of Nanomaterials and nanoparticles – therapeutics – biomaterials - immobilized enzymes - drug delivery systems – biosensors - cellular imaging tools and diagnostics.	**12**
Total		**60**

Self-study	Structure and Properties of nanomaterials, Protein and peptide-based nanostructures, Immobilized enzymes.

Text Books:

1. Madhuri Sharon, Maheshwar Sharon, Sunil Pandey and Goldie Oza, 2012. *Bio Nanotechnology: Concepts and Applications.* Ane Books Pvt. Ltd., New Delhi
2. Parthasarathy, B.K, 2007. *Nanotechnology in Life Science.* Isha Books, New Delhi

Reference Books:

1. Vinod, L, Abhasetwar and Diandra. L. Leslie-Pelecky, 2007. *Biomedical applications of Nanotechnology.* Wiley Publications, New Jersey.
2. Jo Anne Shatkins, 2008. *Nanotechnology: Health and Environmental Risks.* CRC Press, New York.
3. Raghavan, Y.S., 2010. *Nanostructures and Nanomaterials: Synthesis properties and applications.* Arise Publishers and distributors, New Delhi.
4. Rakesh, K. Yada, 2009. *Investing in Nanotechnology*. Mangalam Publications, New Delhi.
5. Pradeep, T. 2017. *The Essentials: Understanding Nanoscience and Nanotechnology:* McGraw-Hill Education, New York.

Web Resources:

1. https://en.wikipedia.org/wiki/History_of_nanotechnology
2. https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular- biology/nanobiotechnology
3. https://en.wikipedia.org/wiki/Nanoparticle
4. https://en.wikipedia.org/wiki/Carbon_nanotube
5. https://www.nature.com/subjects/nanomaterials

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	3	3	3	3	2	3	3	3	2	3
CO2	2	3	3	3	3	3	2	3	2	3	3	3
CO3	3	3	2	3	3	3	2	3	2	3	3	3
CO4	2	2	2	3	3	2	2	3	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3	3	2
TOTAL	**12**	**14**	**13**	**15**	**14**	**14**	**11**	**15**	**12**	**15**	**13**	**13**
AVERAGE	**2.4**	**2.8**	**2.6**	**3**	**2.8**	**2.8**	**2.2**	**3**	**2.4**	**3**	**2.6**	**2.6**

3 – Strong, 2- Medium, 1- Low

SEMESTER V

DISCIPLINE SPECIFIC ELECTIVE II: a) ECONOMIC ZOOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU235DE4	3		1	-	3	4	60	25	75	100

Pre-requisite: Fundamental knowledge of the culture practices of economically important animals.

Learning Objectives:

1. To impart knowledge on animal farming methods, breeding, and disease control.
2. To develop the skill on culturing techniques and production methods of different farm animals.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	identify the breeds and varieties of bees, fish, poultry and cattle and explain the basic aspects of farming.	**K1**
2.	summarise the available tools and techniques to increase the productivity in farms.	**K2**
3.	practice the fundamental concepts of applied zoology in research and animal farms.	**K3**
4.	examine the quality of honey, silk, egg, milk and fish.	**K4**
5.	evaluate the profitability of animal farms.	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** – Evaluate

Units	Contents	No. of Hours
I	**Apiculture** Species of honey bees – Social organisation of honey bee – Newton's bee hive – products of beekeeping – enemies and diseases of honey bees. Sericulture: Species of silkworm – life history of mulberry silkworm – Rearing of silkworm – pests and diseases of silkworm.	**12**
II	**Vermiculture** Introduction - Types of earthworms - Physical, chemical and biological changes caused by earthworms in the soil. Vermicomposting - vermicomposting methods – factors affecting vermicomposting – Vermiculture unit - advantages of vermicompost. Vermiwash and its applications.	**12**
III	**Aquaculture** Freshwater aquaculture - Carp culture – types of ponds – preparation – maintenance – harvesting and management. Prawn culture. Marine aquaculture - edible fin fishes - Indian Pompano, pearl oyster culture. Ornamental fish culture - aquarium fish - aquarium maintenance at home.	**12**
IV	**Poultry Farming** Poultry housing - types of poultry houses – management of chick, growers, layers and broilers. Nutritive value of egg and meat - Broiler management - Housing and equipment, Brooding - brooder, grower and layer management; Sexing and debeaking in chicks. Women in backyard poultry farming.	**12**

V	**Dairy Farming** Advantages of dairying – classification of breeds of cattle – Indigenous and exotic breeds. Dairy cattle management – housing – water supply – cattle nutrition and feeding standards. Milk - composition of milk – milk spoilage – pasteurization. Role of milk and milk products in human nutrition. Dairying as a source of additional income and employment.	**12**
Total		**60**

Textbooks:

1. Arumugam, N., Murugan, T., Johnson Rajeshwar, J. and Ram Prabhu, R. 2011. *Applied Zoology.* Saras Publications, Nagercoil.
2. Shukla, G.S.& Upadhyay, V.B. 2017. *Economic Zoology*, Rastogi Publications, India.

Reference Books:

1. Awasthi, V.B., 2012. *Introduction to General and Applied Entomology,* third edition, Scientific publishers, India.
2. Vasanthraj David, B and Ramamurthy, VV., 2012. *Elements of Economic Entomology,* Seventh edition, Namrutha publications, Chennai.
3. Shukla &Upadhyay, 2014. *Economic Zoology*, 5th edn. Rastogi Publication, Meerut New Delhi.
4. Gupta, S.M., 2010. Text book of fishery, Ann Backer, Mumbai.
5. Shailendra Ghosh, 2009. *Fisheries and aquaculture management*, Adhyayan, New Delhi

Web Resources

1. https://bit.ly/3tXHjk8
2. https://bit.ly/3tUTHBu
3. https://bit.ly/3hVv96q
4. https://bit.ly/39nztH1
5. https://bit.ly/3CzasVO

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	2	3	3	3	3	3	3	3	3	3
CO2	2	3	3	2	3	3	2	3	2	3	2	3
CO3	2	2	2	3	2	2	2	3	3	2	3	2
CO4	2	2	2	2	2	2	2	2	3	3	2	2
CO5	1	3	2	2	1	2	3	3	3	2	3	2
TOTAL	**9**	**13**	**11**	**12**	**11**	**12**	**12**	**14**	**14**	**13**	**13**	**12**
AVERAGE	**1.8**	**2.6**	**2.2**	**2.4**	**2.2**	**2.4**	**2.4**	**2.8**	**2.8**	**2.6**	**2.6**	**2.4**

3 – Strong, 2- Medium, 1- Low

SEMESTER V

DISCIPLINE SPECIFIC ELECTIVE II: b) FOOD, NUTRITION AND HEALTH

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU235DE5	4	-	-	-	3	4	60	25	75	100

Pre-requisite: Basic knowledge of biology and chemistry with an interest in health and wellness.

Learning Objectives:

1. To understand the basic concepts of a balanced diet for people of different age groups.
2. To learn about the consequences of malnutrition, deficiency diseases, and diseases caused by poor hygiene.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall the basic concepts of food, balanced diet, and nutrient requirements for different age groups and physiological conditions.	**K1**
2.	explain the role of macro and micronutrients, their dietary sources, biological functions, and the importance of maintaining a balanced diet.	**K2**
3.	identify the causes, symptoms, and prevention methods for nutritional deficiency diseases, lifestyle-related diseases, and social health problems.	**K3**
4.	analyze the causes, transmission, and prevention of food and water-borne diseases, and understand the importance of food hygiene and sanitation.	**K4**
5.	assess the dietary requirements of different age and physiological groups.	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** – Analyse; **K5** - Evaluate

Units	Contents	No. of Hours
I	**Nutrition and dietary nutrients** Basic concepts of Food - Components and nutrients. Concept of balanced diet, nutrient requirements and dietary pattern for different groups viz., adults, pregnant and nursing mothers, infants, school children, adolescents and elderly people.	**12**
II	**Macro nutrients and micronutrients** Macronutrients - Carbohydrates, Lipids, Proteins- Definition, classification, their dietary source and role. Micronutrients - Vitamins - Water-soluble and Fat-soluble vitamins- their sources and importance. Important minerals *viz*., Iron, Calcium, Phosphorus, Iodine, Selenium and Zinc - their biological functions.	**12**
III	**Malnutrition and nutrient deficiency diseases** Definition and concept of health. Common nutritional deficiency diseases - protein malnutrition (e.g., Kwashiorkor and Marasmus), vitamin A deficiency, iron deficiency and iodine deficiency disorders - their symptoms, treatment, prevention and government initiatives.	**12**
IV	**Lifestyle dependent diseases** Hypertension, diabetes mellitus, and obesity - their causes and prevention. Social health problems - smoking, alcoholism, narcotics. Acquired Immuno Deficiency Syndrome (AIDS) - causes, treatment and prevention.	**12**

V	**Diseases Caused by Microorganisms** Food hygiene and potable water - Sources and domestic-level purification methods. Food and water-borne infections. Bacterial diseases - cholera, typhoid fever. Viral diseases - Hepatitis, poliomyelitis. Protozoan diseases - Amoebiasis, giardiasis. Parasitic diseases - Taeniasis, ascariasis. Their transmission, causative agents, sources of infection, symptoms, and prevention. Causes of food spoilage and its prevention.	**12**
Total		**60**

Self-study	Vitamins- Water-soluble and Fat-soluble vitamins- their sources and importance.

Text Books:

1. Mudambi, S.R. and Rajagopal, M.V. 2007. *Fundamentals of Foods, Nutrition and Diet Therapy*; Fifth Ed. New Age International Publishers, New Delhi.
2. Srilakshmi, B. 2007. *Food Science*; Fourth Ed; New Age International (P) Ltd, New Delhi.

Reference Books:

1. Swaminathan, M. 1986. *Handbook of Foods and Nutrition*; Fifth Ed; BAPPCO, Bokaro.
2. Goyal Shashi and Gupta Pooja, 2012. Food Nutrition and Health. S. Chand & Company, India.
3. Bamji, M.S. Rao, N.P. and Reddy, V. 2009. *Text Book of Human Nutrition*; Oxford & IBH Publishing Co. Pvt Ltd., New Dlhi.
4. Lakra, P. and Singh M.D. 2008. *Textbook of Nutrition and Health*; First Ed; Academic Excellence, New Delhi.
5. Gibney, M.J. et al. 2004. *Public Health Nutrition*; Blackwell Publishing, USA.

Web Resources:

1. https://www.dietaryguidelines.gov
2. https://en.wikipedia.org/wiki/Nutrient
3. https://en.wikipedia.org/wiki/Malnutrition
4. https://www.cdc.gov/tobacco/index.htm
5. https://ncdc.mohfw.gov.in/wp-content/uploads/2024/04/Food-Borne-Diseases.pdf

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	3	2	3	3	1	3	2	2
CO2	2	3	3	2	2	3	2	2	3	2	3	3
CO3	3	3	2	2	3	3	3	3	3	2	3	3
CO4	2	3	3	2	2	3	2	2	2	3	3	3
CO5	2	3	1	2	3	3	2	2	2	3	3	3
TOTAL	**12**	**14**	**12**	**10**	**13**	**14**	**12**	**12**	**11**	**13**	**14**	**14**
AVERAGE	**2.4**	**2.8**	**2.4**	**2**	**2.6**	**2.8**	**2.4**	**2.4**	**2.2**	**2.6**	**2.8**	**2.8**

3 – Strong, 2- Medium, 1- Low

SEMESTER V

DISCIPLINE SPECIFIC ELECTIVE II: c) BIOINSTRUMENTATION

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU235DE6	2	1	1	-	3	4	60	25	75	100

Pre-requisite: Knowledge on the fundamental methods used in experimental biology.

Learning Objectives:

1. To induce interest in the use of various biological instruments.
2. To design experiments with the underlying principles of bioinstrumentation.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall the usage of various biological instruments.	**K1**
2.	explain the principles and working mechanism of bioinstruments.	**K2**
3.	relate the applications of biological techniques.	**K3**
4.	analyse the experimental samples using different techniques.	**K4**
5.	appraise the use of instruments for specific biological experiments.	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** – Evaluate

Units	Contents	No. of Hours
I	Laboratory Practices – Guidelines, symbols, safety and ethical issues in laboratory setting, Cleaning and sterilization of lab ware, handling and care of laboratory animals. Autoclave – principle and applications.	**12**
II	Concepts of molecular weight, atomic weight, preparation of molar solutions. pH - Sorenson's pH scale, Buffers, pH meter. Microscopy – compound microscope, phase contrast microscope, electron microscope.	**12**
III	Centrifugation - principle and types. Colorimetry and spectrophotometry. Chromatography – principle, types and applications, paper chromatography.	**12**
IV	Electrophoresis - principles and applications of agarose and SDS - PAGE. Polymerase chain reaction (PCR) - principle and application. ELISA; Immunofluorescence. Southern and Western blotting.	**12**
V	Biomedical Instrumentation - ESR, haemoglobin measurement, blood pressure, ECG, EEG, CT scan, X- ray imaging, NMR and Ultrasound imaging. Biosensors - glucose biosensor, alcohol biosensor, environmental biosensors.	**12**
Total		**60**

Self-study	Concepts of molecular weight, atomic weight, preparation of solutions of a particular molarity and percentage.

Text Books:

1. Veerakumari L. 2019. *Bioinstrumentation*. MJP Publishers. Chennai.
2. Gurumani N. 2021. *Research Methodology for Biological Sciences*. MJP Publishers. Chennai

Reference Books:

1. Fulekar M.H., Bhawana Pandey 2019. *Bioinstrumentation*, Dreamtech Press, New Delhi.
2. Pranav Kumar 2018. *Fundamentals and Techniques of Biophysics and Molecular Biology*, Pathfinder publication, India.

3. Prakash Singh Bisen, Anjana Sharma, 2012. *Introduction to Instrumentation in Life Sciences*, CRC Press, Taylor & Francis Group, New York, USA.
4. Gupta P.C. 2010. *Biological Instrumentation and Methodology* (*Tools & Techniques*), S. Chand & Company Limited, New Delhi, India.
5.Arumugam N. 2024. *Bioinstrumentation*, Saras publications, Nagercoil.

Web Resources:

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5206469/
2. https://www.nature.com/subjects/biological-techniques
3. https://www.vedantu.com/physics/spectroscopy
4. https://en.wikipedia.org/wiki/Blot_(biology)
5. https://en.wikipedia.org/wiki/List_of_research_methods_in_biology

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	2	2	2	2	3	3	3	3	2
CO2	3	2	1	2	2	2	3	3	3	3	3	2
CO3	3	3	1	2	2	2	2	3	3	3	3	2
CO4	3	2	1	2	2	2	3	3	3	3	3	2
CO5	3	3	1	2	2	2	2	3	3	3	3	2
TOTAL	**15**	**13**	**5**	**10**	**10**	**10**	**12**	**15**	**15**	**15**	**15**	**10**
AVERAGE	**3**	**2.6**	**1**	**2**	**2**	**2**	**2.4**	**3**	**3**	**3**	**3**	**2**

3 – Strong, 2- Medium, 1- Low

SEMESTER V

PROFESSIONAL COMPETENCY SKILL I- CAREER SKILLS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG235PS1	1	1	-	-	2	2	30	25	75	100

Pre-requisite: A foundational understanding of the basic communication skills and computer literacy.

Learning Objectives

1. To develop effective communication and interpersonal skills to enhance workplace interactions and teamwork
2. To build job readiness skills such as resume writing, interview techniques, and professional ethics

Course Outcomes

On the successful completion of the course, students will be able to:		
1	outline key career skills such as communication, teamwork, and problem-solving	**K1**
2	explain the importance of professional ethics, workplace etiquette, and time management	**K2**
3	demonstrate effective resume writing, interview techniques, and job application strategies	**K3**
4	assess different workplace scenarios to determine appropriate communication and conflict resolution strategies	**K4**
5	develop a personal career plan with clear goals, skills assessment, and strategies for professional growth	**K5**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**- Analyse; **K5**- Evaluate

Units	Contents	No. of Hours
I	**Linguistic Skills** Vocabulary, Resume Writing, Report Writing, Technical Writing, Agenda Preparation, Preparing Minutes, E-mail.	**6**
II	**Employability Skills** Social Etiquette, Telephone Etiquette, Interview Skills, Types of Interviews, Mock Interview, Group Discussion.	**6**
III	**Digital Capabilities** Digital Learning, Digital Participation, ICT Proficiency, Creative Production, Digital Identity, Digital well-being	**6**
IV	**Body Language** Defining Body Language, Scope and Relevance, Proxemics, Oculesics, Haptics, Kinesics, Paralanguage, Chronemics, Chromatics and Olfactics	**6**
V	**Coping Mechanisms** Goal Setting, Emotional Intelligence, Team Management, Stress Management, Time Management, Leadership Skills, Problem solving Skills, Decision Making.	**6**
	Total	**30**

Self-study	Basic language skills and communication skills

Textbook

Virgin Nithya Veena. V & Jemi A.R. 2025. *New Age Career Skills*.

Reference Books

1. Herta A. Murphy and Herbert W. Hildebrandt. 1997. *Effective Business Communication*. 7th edition. McGraw- Hill.

2. Jeff Butterfield. 2020. *Soft Skills for Everyone*. Cengage India Pvt. Ltd.
3. Jayaprakash N Satpathy. 2024. *Soft Skills for Career*. Urania Publishing House.
4. S. Xavier Alphonse S. J. 2008. *Change or Be Changed*. ICRDCE. Sri Venkateswara Printers. Chennai.
5. AK. Xavier. 2025. *Employability Skills*. JKP Publications. Madurai.

Web Resources

1. https://exchange.nottingham.ac.uk/content/uploads/Professional-Competencies-Handbook-Sept-2018.pdf
2. https://vpge.stanford.edu/professional-development/competencies-grad-grow
3. https://vpge.stanford.edu/professional-development/competencies-grad-grow
4. https://www.indeed.com/career-advice/resumes-cover-letters/core-competencies-and-skills-valued-by-employers
5. https://resources.hrsg.ca/blog/what-s-the-difference-between-skills-and-competencies

SEMESTER V
INTERNSHIP

Course Code	L	T	P	S	Credits	Inst. Hours	Marks
CU235IS1	-	-	-	-	2	-	100

FRAMEWORK FOR INTERNSHIP

- Preparatory Inputs
- Industrial Visit
- Internship
- Periodic reviews by industry supervisor and faculty guide
- Report Writing
- Viva-voce

Note: Industries allowed – Govt./NGO/MSME/Rural Internship/Innovation / Entrepreneurship / Private Industry.

S.No.	Components	Marks
1	Industry Contribution	50
2	Report & Viva-voce	50

GUIDELINES FOR PREPARING INTERNSHIP REPORT

The training report should be presented in the following format only:

a) The report should be printed in A4 sheets.
b) Text Format in the report:
   - Times New Roman 12 Font size, with 1.5 line spacing.
   - Margins 1.5" left and 1" all other sides of the report.
c) Page numbers should be placed at the bottom middle position.
d) Chapters should be numbered as I, II, III and IV.
e) The tables and charts should be in the format of 1.1, 1.2, etc.
f) The training report should have a minimum of 25 pages and should not exceed 50 pages.
g) Students should submit 2 hard copies of report (department copy + student copy) duly signed by the faculty guide and the HOD.
h) The hard copy should be in bound format with soft binding as the cover page.
i) Students are eligible for training evaluation only if she has completed 25 days of training.

FORMAT FOR INTERNSHIP REPORT

The report should be bound with pages in the following sequence:

1) Cover page - Outer cover of the report.
2) Front page - The format of cover page and front page should be one and the same.

3) Certificate
4) Company Certificate
5) Declaration
6) Acknowledgement
7) Contents
8) List of Tables if any
9) List of Figures/Charts if any
10) List of Abbreviations, if any
11) Chapter I, II, III and IV
12) Appendices
13) Bibliography

GUIDELINES FOR WRITING ACKNOWLEDGEMENT

The summer training report should contain acknowledgements in the following order:

- Principal & Secretary, College Management
- The Head of the Department
- Faculty guide and Industry supervisor
- Management of the organization in which training was taken up.

GUIDELINES FOR WRITING CHAPTERWISE REPORT

- **Chapter I** of the report should be titled as "**INTRODUCTION**". The Introduction chapter should include Introduction, Importance, Objectives, Scope and Period of the training.
- **Chapter II** of the report should be titled as "**COMPANY PROFILE**".
- **Chapter III** of the report should be titled as "**ACTIVITIES DONE."** The third chapter should cover the objectives of the different departments and its functioning and also the learning outcome. Tables and figures in a chapter should be placed in the immediate vicinity of the reference where they are cited.
- **Chapter IV should be titled as "CONCLUSION".** The Conclusion part should include the observations made by the trainee in each department and the extent of fulfillment of training objectives and also reflections.

SEMESTER V

HUMAN RIGHTS, JUSTICE AND ETHICS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG235HR1	1	-	-	-	1	1	15	50	50	100

Learning Objectives

1. To identify issues, problems, and violations of human rights.
2. To promote awareness of social justice, equality and human dignity.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	explain human rights principles and the role of the UN, with a focus on human rights issues in India.	**K1, K2**
2.	apply ethical principles in social, national, and professional contexts.	**K3**
3.	analyse social justice issues like untouchability, casteism, and discrimination.	**K4**
4.	examine legal frameworks for women's and child rights in India.	**K4**
5.	assess media's influence on values, digital rights, and consumerism.	**K5**

K1-Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** - Evaluate

Units	Contents	No. of Hours
I	**Social Justice:** Concept and need for social justice-Parameters of social justice - Issues: untouchability, casteism, and discrimination	**3**
II	**Foundations of Human Rights:** Concept and principles of human rights- United Nations and Human Rights- Human rights concerns in India	**3**
III	**Women's Rights and Child Rights:** UN and women's rights – major issues -Constitutional and legal provisions for women in India - Child rights in India – Major Issues -legal framework and enforcement	**3**
IV	**Values and social media:** Media Power- Socio, cultural and political consequences of mass mediated culture - New media prospects and challenges - Role of media in value building -Digital Rights and Privacy- Consumerist culture	**3**
V	**Ethics:** Meaning and Importance- Social ethics: Tolerance, equity, justice for all -Nationalism: love for nation, pride for nature- Professional ethics: Dedication to work and duty**.**	**3**
	Total	**15**

Self-study	Mass Media: Effects and Influence on youth and children

1. Baxi, Upendra. 2008 *The Future of Human Rights*. Oxford University Press,.
2. Donnelly, Jack. 2013. *Universal Human Rights in Theory and Practice*. Cornell University Press.
3. Agnes, Flavia. *Law and Gender Inequality: The Politics of Women's Rights in India*. Oxford University Press, 2001.
4. *State of the World's Children 2021*. UNICEF
5. McLuhan, Marshall. *Understanding Media: The Extensions of Man*. MIT Press, 1994.
6. Zuboff, Shoshana. *The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power*. PublicAffairs, 2019.
7. Singer, Peter. *Practical Ethics*. Cambridge University Press, 2011.

Web Recourses

1. http://www.oxfordreference.com/views/BOOK_SEARCH.html?book=t286
2. http://globetrotter.berkeley.edu/humanrights/bibliographies/
3. https://libguides.princeton.edu/history/humanrights

SEMESTER VI

CORE COURSE VII: ANIMAL BIOTECHNOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU236CC1	4	1	1	-	5	6	90	25	75	100

Pre-requisite: Basic knowledge of cells and types, genetics and DNA.

Learning Objectives:

1. To inculcate the basic concepts and various techniques pertaining to biotechnology.
2. To provide interdisciplinary skills for research and employability in biotech industries.

Course outcomes

Upon completion of this course the students will be able to:		
1.	explain the basic concepts of biotechnology.	**K1**
2.	recite rDNA, hybridoma technology, tissue engineering and applications of nanotechnology.	**K2**
3.	apply appropriate tools and techniques in biotechnological manipulation and problems ethically.	**K3**
4.	examine the transgenic animals, microbial and biotechnological products.	**K4**
5.	priorities biotechnological techniques for the welfare of environment and society.	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** – Evaluate

Units	Contents	No. of Hours
I	**Animal cell culture and rDNA technology** Animal cell culture - Basic requirements and techniques of cell culture, natural and synthetic culture media, primary culture and cell lines. Stem cells: types, culture and applications. rDNA technology - Enzymes; Vectors – pBR322, Phage lambda, Cosmid, YAC. Gene cloning - steps in cloning, selection of clones.	**18**
II	**Genetic Engineering** Isolation and purification - DNA and mRNA. Blotting techniques - Southern and Western blotting; DNA sequencing - Sanger method, DNA chips, microarray. PCR - principle, types and application. Gene library - screening with probes. Gene transfer in animal cells - transfection, liposomal, viral mediated, electroporation, biolistic, direct DNA injection.	**18**
III	**Transgenic Animal Technology** Transgenesis - Concept, transgenes, transgenic animal models - knockout mice, sheep - applications of transgenesis - molecular farming, transgenic fishes, transgenic live stocks, and animals as bioreactors.	**18**
IV	**Medical biotechnology** Monoclonal antibodies, DNA diagnostic systems - tuberculosis, AIDS, genetic diseases. Gene therapy - *Ex vivo* and *in vivo*, role in cancer treatment; CRISPR gene editing. Molecular markers - RFLP, RAPD, DNA fingerprinting and application. Human genome project - Mapping of human genome and applications, Recent trends in animal biotechnology. Socio ethical problems and ethical implications.	**18**
V	**Industrial Biotechnology** Bioreactors - basic concepts of fermentation, bioreactor design, production of ethanol and streptomycin, recombinant vaccines, hepatitis B, hormones and insulin.	**18**

Total	90

Self-study	Vectors – pBR322, Phage lambda, Transgenic fishes, bioreactor design.

Text Books:

1. Singh B. D, 2015. *Biotechnology*: Expanding horizon, Kalyani publishers.
2. Sathyanarayran U, 2008. *Biotechnology*, Books and Allied, Kolkata.

Reference Books:

1. Veer Bala Rastogi, 2016. *Principles of Molecular biology*, Medtech, Maine, USA.
2. Primrose S. B, 2001. *Molecular Biotechnology*, Panima Publishing Corporation, New Delhi, India.
3. Ramawat, K.G and Shailey Goyal, 2009. *Comprehensive biotechnology*, S. Chand company, New Delhi, India.
4. Peters, P, 2009. *Biotechnology* – A guide to genetic engineering, WMC brown publisher, UK.
5. Michael Crichton, 2014. *Essentials of Biotechnology*, Medtech, Maine, USA.

Web Resources:

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3612824/
2. https://www.isaaa.org/resources/publications/pocketk/40/default.asp
3. https://www.ncbi.nlm.nih.gov/books/NBK207574/
4. https://iopscience.iop.org/article/10.1088/1755-1315/492/1/012035/pdf
5. https://go.nature.com/3zAZmO9

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2	3	2	3	3	2	2	3
CO2	2	3	3	3	3	3	2	3	2	3	3	3
CO3	3	3	3	2	3	3	2	2	3	3	3	3
CO4	2	2	2	3	3	2	2	3	3	3	3	2
CO5	3	3	3	2	2	3	3	2	2	2	3	2
TOTAL	**13**	**14**	**14**	**13**	**13**	**14**	**11**	**13**	**13**	**13**	**14**	**13**
AVERAGE	**2.6**	**2.8**	**2.8**	**2.6**	**2.6**	**2.8**	**2.2**	**2.6**	**2.6**	**2.6**	**2.8**	**2.6**

3 – Strong, 2- Medium, 1- Low

SEMESTER VI

CORE COURSE VIII: IMMUNOLOGY AND MICROBIOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU236CC2	4	2	-	-	5	6	90	25	75	100

Pre-requisite: Basic knowledge of cell biology, microbiology, biochemistry, and immunology is required.

Learning Objectives:

1. To enable the students to know about the immune system and the microbes around us.
2. To develop the analytical skill on invading microbes and immune response.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	define the components of the immune system, mechanisms of immune response, microbial diversity, infectious diseases and microbial application.	**K1**
2.	discuss the types of immune cells, immune response, taxonomic classification of microbes and their role in industries.	**K2**
3.	apply the concepts of Immunology and Microbiology for interdisciplinary research and life-long learning.	**K3**
4.	analyze the role of microbes in food, air, water, soil and immune response to infection.	**K4**
5.	evaluate the food safety by the simple microbiological techniques.	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** – Evaluate

Units	Contents	No. of Hours
I	**Immune system in invertebrates and vertebrates** Immunity - Innate and acquired. Types - Lymphoid organs and immune cells. Antigens Types of antigens, haptens, adjuvants. Immunoglobulins – structure and functions. Antibody reactions –Precipitation precipitin curve. Agglutination reaction – hemagglutination.	**18**
II	**Immune Response and Cytokines** Immune Response - Humoral and Cell-mediated. Immunological memory (Anamnesis). Clonal selection, immunization schedule. Immune effector mechanisms: Cytokines and their functions. Complement system – classical and alternative pathways, biological functions	**18**
III	**Immune system in health and diseases** MHC – structure and functions. Hypersensitivity – Types, factors causing hypersensitivity. Immunodeficiency - Autoimmune diseases - characteristics, causes, classification.	**18**
IV	**Introduction to microbiology** Scope, systematic position: 5 kingdom classification of Whittaker. Culture media – Types, culture techniques - pure culture isolation, streak plate, and pour plate techniques. Sterilization – types.	**18**
V	**Applied microbiology** Food poisoning, food spoilage and preservation, Rheumatoid arthritis, Gravis. Industrial: Wine and Vinegar production. Medical: Bacterial diseases (Tuberculosis, Streptococcal dermal infection), viral diseases (AIDS, Rabies), fungal diseases (Mycotoxicosis and Aspergillosis).	**18**
Total		**90**

Self-study	Immunization schedule – Human

Textbooks:

1. Kuby, Jeni Punt, Sharon Stranford, Patricia Jones, Judith Owen, (2018) *Immunology* (8th edn.), W. H. Freeman & Co., New York.
2. Jeffrey K. Actor, 2011. Elsevier's Integrated Review *Immunology and Microbiology* E-Book: Online Access 2nd Edition, Kindle Edition.

Reference Books:

1. Rao, C.V. 2008. *Immunology* (2th ed.). Narosa Publishing House, Chennai.
2. Prescott (2023) (12th ed.) *Prescott's Microbiology* MX Grawhill Exclusive (35), ISBN: 13-978-1265123031.
3. Deves, P., Martin, S., Burton, D. and Roitt I.M., 2017. *Roitt's Essential Immunology.* (13thed.). Wiley-Blackwell Scientific Publication, Oxford.
4. Arti Kapil. 2013. *Anandanarayan and Paniker's textbook of Microbiology*, Hyderabad: Universal Press
5. Singh, R.P 2007. *General Microbiology*, New Delhi: Kalyani Publishers

Web Resources:

1. https://immunologylink.com/#
2. https://en.wikipedia.org/wiki/Outline_of_immunology
3. http://www.elsevier.com/inca/publications/store/3/0/5/2/1/
4. http://www.immunity.com/
5. https://dspmuranchi.ac.in/pdf/Blog/General_MicrobiologyCSP_Proof012417.PDF

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	2	2	3	3	3	3	3	2	2
CO2	3	2	2	2	3	3	2	3	3	2	2	3
CO3	2	2	3	3	3	3	3	3	3	2	3	2
CO4	3	2	3	3	3	2	2	3	3	3	3	3
CO5	3	3	3	2	2	3	3	2	2	3	3	3
TOTAL	**14**	**12**	**14**	**12**	**13**	**14**	**13**	**14**	**14**	**13**	**13**	**13**
AVERAGE	**2.8**	**2.4**	**2.8**	**2.4**	**2.6**	**2.8**	**2.6**	**2.8**	**2.8**	**2.6**	**2.6**	**2.6**

3 – Strong, 2- Medium, 1- Low

SEMESTER VI

CORE LAB COURSE VI: ANIMAL BIOTECHNOLOGY, IMMUNOLOGY AND MICROBIOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU236CP1	-	-	6	-	4	6	90	25	75	100

Pre-requisite:

Basic knowledge on animal Biotechnology, Immunology and Microbiology.

Learning Objectives:

1. To demonstrate competency in routine biotechnological, Immunological and microbiological techniques.
2. To develop skills in cell culture and analytical techniques for procuring employability in research laboratories.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall Biotechnology, Immunological and Microbiological experiment protocols.	**K1**
2.	identify tools and techniques relevant to Biotechnology, Immunology and Microbiology.	**K2**
3.	perform experiments pertaining to the welfare of the environment and society.	**K3**
4.	analyse the impact of genetically modified organisms.	**K4**
5.	explore the role of agglutination in serological testing and blood typing.	**K5**

K1 - Remember**; K2 -** Understand**; K3 –** Apply**; K4 -** Analyse**; K5 -** Evaluate

Units	Contents	No. of Hours
	ANIMAL BIOTECHNOLOGY	
1	Isolation of genomic DNA from *E. coli.*	**90**
2	Estimation of DNA by Diphenylamine (DPA) Method	
3	DNA – Agarose Gel Electrophoresis (Demonstration)	
4	Estimation of BOD in Sewage.	
5	Estimation of COD in sewage.	
6	Preparation of wine	
7	Immobilization of enzyme (Amylase/ Invertase/ Protease) using sodium alginate.	
8	Polymerase Chain Reaction – Demonstration.	
9	Production of Hybridoma and Monoclonal antibodies – Flow chart	
10	Animal cell culture media preparation (Demonstration).	
Charts/ Slides/ Models/ Bookplates/ Instruments: Plasmid DNA isolation, Insulin production by rDNA Technology, Hybridoma production, Superbug, Fermenter, Dolly.		
	IMMUNOLOGY AND MICROBIOLOGY	
1	Identification of lymphoid organ in rat (Virtual)	
2	Simple immunodiffusion	
3	Identification of lymphocytes in human blood smear	
4	Qualitative analysis of antigen-antibody using human blood group system	

5	Determination of hemagglutination titre	
6	Preparation of culture media for bacteria. (Agar/broth/slant)	
7	Isolation of bacteria from soil (Streak plate method)	
8	Observation o f bacterial motility by Hanging Drop method	
9	Staining types: Simple, differential (Gram staining), spore staining and negative staining of bacteria	
10	Methylene blue reduction test to assess the quality of milk	
Charts/ Slides/ Models/ Bookplates/ Instruments: Autoclave, Agglutination, Precipitation, Immune response curve, *E. coli*, *Aspergillus*, Corona virus		

Textbooks:

1. Dubey, R.C. 2014. *A Text book of Biotechnology* (6th ed.). New Delhi: S. Chand and Co. Ltd.
2. Talwar, G.P., Gupta, S.K. 2017. *A Handbook of Practical and Clinical Immunology*, Vol. 1, 2nd Ed, CBS Publishers, New Delhi.

Reference Books:

1. Satyanarayana, V. (2005). *Biotechnology*. Kolkata: Books and Allied (P) Ltd.
2. Rema L.P. (2006). *Applied Biotechnology*. Chennai: MJP Publishers.
3. Prakash S. Lohar (2005). *Biotechnology*. Chennai: Kalyani Publishers.
4. Ankitha Joshi, Chaukan, R.S.2022. *Immunological Techniques: Interpretations, Validation and Safety Measures*, IP Innovative Publications, New Delhi.
5. Arora, D.R. 2023. *Practical Microbiology*, 3rd Ed., CBS Publishers, New Delhi.

Web Resources:

1. https://www.urmc.rochester.edu/MediaLibraries/URMCMedia/labs/frelinger-lab/documents/Immunology-Lab-Manual.pdf
2. https://www.researchgate.net/publication/275045725_Practical_Immunology-_A_Laboratory_Manual
3. https://www.youtube.com/watch?v=JUp4n_r5s2w
4. https://www.youtube.com/watch?v=Et1v8EQP10U
5. https://www.youtube.com/watch?v=o6vF2yPTsh8

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	2	2	3	3	3	3	3	2	2
CO2	3	2	2	2	3	3	2	3	3	2	2	3
CO3	2	2	3	3	3	3	3	3	3	2	3	2
CO4	3	2	3	3	3	2	2	3	3	3	3	3
CO5	3	3	3	2	2	3	3	2	2	3	3	3
TOTAL	**14**	**12**	**14**	**12**	**13**	**14**	**13**	**14**	**14**	**13**	**13**	**13**
AVERAGE	**2.8**	**2.4**	**2.8**	**2.4**	**2.6**	**2.8**	**2.6**	**2.8**	**2.8**	**2.6**	**2.6**	**2.6**

3 – Strong, 2- Medium, 1- Low

SEMESTER VI

DISCIPLINE SPECIFIC ELECTIVE III: a) ECOLOGY AND TOXICOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU236DE1	4	-	1	-	3	5	75	25	75	100

Pre-requisite: Basic understanding of ecological concepts, toxicology, and environmental management.

Learning Objectives:

1. To impart a deep understanding on the interaction between the environment and the living organisms.
2. To develop skills to assess the toxicants and its impacts, environmental standards.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall the concepts of ecosystem, population dynamics, toxicology and waste management.	**K1**
2.	explain the principles of the environment and its interaction with the community.	**K2**
3.	apply the knowledge of ecosystem dynamics, population regulation, and toxicological parameters to real-world environmental scenarios.	**K3**
4.	analyze the relationship between biotic and abiotic factors, ecological succession, and pollution impacts on the environment.	**K4**
5.	evaluate the effectiveness of pollution control methods, toxicant impact assessments and sustainable environmental management strategies.	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** - Evaluate

Units	Contents	No. of Hours
I	**Introduction to Ecology** Scope-Branches of ecology. Autecology and synecology. Environment – atmosphere, lithosphere, hydrosphere and biosphere. Biological effects of temperature and light. Interspecific relationship - mutualism, commensalism, antagonism - antibiosis, parasitism, predation and competition. Habitat ecology- adaptations of deep sea and desert living animals.	**15**
II	**Ecosystem and Population Ecology** Ecosystem –Structure, abiotic and biotic factors. Function- Detritus and grazing food chains, food web, trophic levels, ecological pyramids. Terrestrial and Aquatic Ecosystem. Population ecology - density, natality, mortality, age distribution, population growth, population equilibrium, population fluctuations, biotic potential, population dispersal and dispersion, regulation of population	**15**
III	**Community Ecology** Concept of community, Community- structure, composition and stratification. Ecological niche, Ecotone and Edge effect, Ecotype, Ecological indicators. Ecological succession - types, general process, Concepts of climax- theories of climax, patterns of succession. Animal distribution – continuous and discontinuous. Remote sensing and its applications in agriculture, fisheries, forest management and food management.	**15**
IV	**Toxicology** Scope and sub-divisions of toxicology. Toxicants – classification, toxicity - lethal, sublethal, LC_{50}, and LD_{50}. Toxic agents and their mode of action	**15**

	– toxicokinetics – toxicodynamics. Pollution - pollutants, xenobiotics, greenhouse effect, ozone depletion, acid rain, photochemical, smog, Bhopal episode, Chernobyl disaster, BOD, Eutrophication, Red tide, Minamata disease, bioaccumulation, biomagnifications, biotransformation, biomonitoring. Waste water treatment and solid waste management.	
V	**Ecotoxicology and Environmental analysis** Estimation of ammonia, soil alkalinity, determination of hardness of water. Determination of pH of soil. Environmental determinants: Estimation of BOD/COD. Physicochemical properties of water. Use of LC_{50} values – sub lethal effects of critical pollutants on fish. Determination of phosphate levels in clean and polluted waters.	**15**
Total		**75**

Self-study	Terrestrial and Aquatic Ecosystem.

Text books:

1. P.S. Verma and Dr. V.K. Agarwal 2020. *Environmental Biology.* S. Chand Publications, UP.
2. Sharma P.D. 2014. *Environmental Biology and Toxicology*. Rastogi Publications, Uttar Pradesh.

Reference Books:

1. Ashutosh Kumar. 2023. *Environmental Toxicology and Ecosystem*. CRC Press, USA.
2. Kishore R. Pawar and Ashok E Desai. 2017. *Environmental Biology and Toxicology*. Nirali Prakashan Publications, Pune.
3. Bhattacharya, S. 2011. *Environmental Toxicology*. Kolkata: Books and Allied (P) Ltd., Kolkatta
4. Subramanian, M.A. 2004. *Toxicology: Principles and methods.* M. J. P. Publishers, Chennai.
5. Prasantkumar Joshi and Puhyamitra Joshi. 2000. *Textbook of Animal Ecology, Toxicology and Environmental Pollution*. Shashwat Publishers, Bilaspur.

Web Resources:

1. https://en.wikipedia.org/wiki/Ecology
2. https://en.wikipedia.org/wiki/Outline_of_ecology
3. https://bio.libretexts.org/Bookshelves/Ecology/Environmental_Science_(Ha_and_Schleiger)/04%3A_Humans_and_the_Environment/4.04%3A_Environmental_Health/4.4.04%3A_Environment al_ Toxicology
4. https://en.wikipedia.org/wiki/Ecosystem_ecology
5. https://byjus.com/chemistry/environmental-toxicology/#:~:text=Ecotoxicology%3A%20It%20is%20the%20study,environmental%20chemicals %20on%20human%20health.

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	3	1	3	3	2	3	3	1
CO2	3	2	3	3	3	2	2	3	3	1	2	3
CO3	3	3	3	3	1	3	3	2	3	3	3	3
CO4	3	1	3	2	3	3	2	3	3	1	2	3
CO5	2	3	3	1	3	3	3	3	2	3	3	3
TOTAL	**14**	**12**	**14**	**12**	**13**	**12**	**13**	**14**	**13**	**13**	**13**	**13**
AVERAGE	**2.8**	**2.4**	**2.8**	**2.4**	**2.6**	**2.4**	**2.6**	**2.8**	**2.6**	**2.6**	**2.6**	**2.6**

3 – Strong, 2- Medium, 1- Low

SEMESTER VI

DISCIPLINE SPECIFIC ELECTIVE III: b) HISTORY OF INDIAN SCIENCE

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU236DE2	2	3	-	-	3	5	75	25	75	100

Pre-requisite: Understanding of different time periods of ancient, medieval, colonial, and modern India.

Learning Objectives:

1. To understand the historical and modern advancements in Indian science.
2. To explore the role of Indian scientists and research institutions in shaping scientific progress.

Course Outcomes

On the successful completion of the course, students will be able to:		
1	recall the major scientific contributions of Indian scholars from ancient to modern times in science.	**K1**
2	explain the influence of various civilizations, including Islamic and European, on the development of science and technology in India.	**K2**
3	apply knowledge of scientific advancements to analyze the role of premier Indian research institutions	**K3**
4	analyze the impact of major agricultural and scientific revolutions in India, including Green, White, and Pink Revolutions.	**K4**
5	evaluate the contributions of Indian scientists and technological innovations in shaping global scientific progress.	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** - Evaluate.

Units	Contents	No. of Hours
I	**Science in Ancient and Medieval India** Development in astronomy, mathematics, engineering, and medicine in Ancient India. Use of copper, bronze, and iron in Ancient India. Geography in ancient Indian literature. Influence of the Islamic world and Europe on mathematics, chemistry, astronomy, and medicine. Innovations in agriculture: New crops, irrigation techniques.	**15**
II	**Science in Colonial and Pre-Independence India** Contributions of early surveyors, zoologists, and doctors in Colonial India. Indian perception and adoption of modern scientific knowledge. Establishment of premier research organizations: CSIR, DRDO, ICAR, ICMR, IITs. Formation of the Atomic Energy Commission. Milestones in space research: ISRO and its accomplishments. Zoological Survey of India.	**15**
III	**Prominent Ancient Indian and Modern Indian Scientists** Eminent mathematicians and astronomers - Baudhayana, Aryabhatta, Brahmagupta, Bhaskaracharya, Varahamihira, Nagarjuna. Contributions to Ayurveda and Yoga Medical Science - Susruta, Charak. Scientists of Modern India - Srinivasa Ramanujan, C.V. Raman, Jagdish Chandra Bose, Homi J. Bhabha, Vikram Sarabhai.	**15**
IV	**Advances in Animal Sciences in India** History of animal tissue culture in India. Green, White, and Pink Revolutions: Causes, details, and outcomes. Pioneers in agricultural and livestock research. First gene cloning and genome sequencing in India. GM organisms and their impact.	**15**

V	**Contemporary Scientific Research and Innovations** Premier research institutes in modern India. Current eminent Indian scientists and their	**15**
	contributions. Emerging trends in biotechnology, space research, and medicine. India's role in global scientific advancements.	
Total		**75**

Self-study	Milestones in space research: ISRO and its accomplishments.

Text Books:

1. Kuppuram, G. 1990. *History of Science and Technology in India*, South Asia Books.
2. Handa, O.C. 2014. *Reflections on the history of Indian Science and Technology*, Pentagon Press.

Reference Books:

1. Basu, A. 2006. *Chemical Science in Colonial India: The Science in Social History*, K.P. Bagchi & Co., New Delhi.
2. Habib, I. 2016. *A people's history of India 20: Technology in Medieval India*, 5th Edition, Tulika Books, Chennai.
3. Rahman, A. 1982. *Science and Technology in Medieval India – A Bibliography of Source Materials in Sanskrit, Arabic and Persian*. Indian National Science Academy, New Delhi.
4. Subbarayappa, B.V. and Sarma, K.V. 1985. *Indian Astronomy - A Source Book*, Bombay.
5. Srinivasan, S., Ranganathan, S. 2013. *Minerals and Metals heritage of India*, National Institute of Advanced Studies.

Web Resources:

1. https://indiamap.com/stories/ancient-indian-sciences-and-mathematics
2. https://egyankosh.ac.in/bitstream/123456789/12201/1/Unit-7.pdf
3. https://www.nios.ac.in/media/documents/SecICHCour/English/CH.15.pdf
4. https://www.researchgate.net/publication/309010697_Advances_in_Animal_Sciences_and_Biomedicine_in_21st_Century
5. https://indiavidya.com/top-20-scientific-research-institutes-in-india/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO7**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	2.5	2	2	2	2	2	2.5	2.5	3	3	3	2.5
CO2	2.5	2	2	2	2	2	3	3	3	3	3	2.5
CO3	3	2	1	2	2	2	2.5	3	3	3	3	2.5
CO4	2.5	3	1	2	2	2	3	2.5	3	3	3	2.5
CO5	2.5	2	1	2	2	2	2.5	3	3	3	3	2.5
TOTAL	**13**	**11**	**7**	**10**	**10**	**10**	**13.5**	**15**	**15**	**15**	**15**	**12.5**
AVERAGE	**2.6**	**2.2**	**1.4**	**2**	**2**	**2**	**2.7**	**3**	**3**	**3**	**3**	**2.5**

3 – Strong, 2- Medium, 1- Low

SEMESTER VI

DISCIPLINE SPECIFIC ELECTIVE III: c) AGRICULTURAL ENTOMOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU236DE3	3	1	1		3	5	75	25	75	100

Pre-requisite: Fundamental knowledge of the culture practices of economically important insects.

Learning Objectives:

1. To understand entomology concepts, insect morphology and biodiversity.
2. To analyse pest status, economic importance, and integrated pest management.

Course Outcomes

Upon completion of this course the students will be able to:		
1.	recall the features of various insect orders and describe the life history, social organization, and management practices of insects.	**K1**
2.	understand the biology of insects associated with medical, household, and veterinary/public health importance.	**K2**
3.	apply their knowledge of pest biology to assess damage and beneficial insect life cycles to practical rearing.	**K3**
4.	analyze the causes of pest outbreaks and the economic threshold levels.	**K4**
5.	propose effective control measures for vectors associated with medical, household, and veterinary/public health importance.	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** – Evaluate

Units	Contents	No. of Hours
I	**Overview of insects and insect taxonomy** **S**alient features of Class Insecta and orders - Orthoptera, Isoptera, Hemiptera, Diptera, Coleoptera, Lepidoptera, Dermaptera, Odonata, Neuroptera and Hymenoptera. - Causes for insect assuming pest status - Methods of collection, mounting and preservation of insect pests.	**15**
II	**Destructive insects** Insect pests - definition - Categories of pests - Types of damage to plants by insects - Causes of pest outbreak - Economic threshold level - Biology of the insect pests - Pests of paddy, cotton, vegetables and coconut.	**15**
III	**Beneficial Insects** Honey bees, types, hive, apiary, selection of bees for apiary, Newton's bee hive, enemies and diseases of honey bees. Silkworms: Types, silkworm races, life history of mulberry silk worm, features of sericulture industry, pests and diseases of silkworm. Lac insects - life history, lac cultivation; Pollinators, predators, parasitoids, scavengers, weed killers, soil-builders.	**15**
IV	**Pest management strategies** Methods and principles of pest control - Natural control, artificial control, physical, mechanical, chemical and biological control methods, merits and demerits or limitations of these methods in pest control. Development and uses of pest resistant plant varieties - Integrated Pest Management.	**15**

V	**Vector biology** Stable fly and cattle fly. Insects associated with medical importance and management - head louse *Pediculus humanuscapitis*, mosquitoes - Anopheles, Culex. Insects associated with household – cockroaches and termites. Vectors of veterinary and public health importance	**15**
Total		**75**

Self-study	Types of honey bees, Pest of Paddy, Natural control of pest.

Textbooks:

1. Ayyar, L.V. R, 1936. Hand book of economic entomology for South India. Narendra Publishing House. New Delhi.
2. Vasantharaj David, B. and V.V. Ramamurthy, 2016. Elements of economic entomology, eighth edn, Brillion Publishing, New York.

Reference Books:

1. Chapman, R.F., S.J. Simpson and A.E. Douglas, 2012. The Insects: Structure and Function, Fifth Edition, Cambridge University Press, Lodo.
2. Daly, H.V., J.T. Doyen and P.R. Ehrlich, 1978. Introduction to Insect Biology and Diversity. Mc Graw- Hill Kogakusha Ltd., Tokyo.
3. Hill, D.S, 1974. Agricultural Insect Pests of the Tropics and Their Control. Cambridge University Press, New York.
4. Krishnaswami. S, 1973. Sericulture Manual, Vol. I & II, Silkworm rearing, FAO Agricultural Science Bulletin, Rome.
5. Mani, M.S, 1982. General Entomology. Oxford & IBH Publishing Co., India.

Web Resources:

1. https://egyankosh.ac.in/bitstream/123456789/85342/1/Unit-4.pdf
2. https://www.rlbcau.ac.in/pdf/PGCourse/Entomology/Insect%20Taxonomy%20(APE%20 503).pdf
3. https://egov.uok.edu.in/elearning/tutorials/1011020512BR15103CR15Apiculture%20Lac20culture%20and%20%20sericultureapiculture%20lac%20culture%20and%20%20seri culture%20upload.pdf
4. https://agritech.tnau.ac.in/farm_enterprises/fe_api_pestanddiseases.html 5. https://cpacollege.ac.in/assets/uploads/1645091697APPLIED_ZOOLOGY_SEM_NOTE _pdf.pdf

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	2	3	1	3	3	3	3	3	3	3
CO2	2	2	2	2	3	3	2	3	2	3	2	3
CO3	2	3	2	3	2	2	2	3	3	2	3	2
CO4	2	2	2	2	2	2	2	2	3	3	2	2
CO5	3	3	2	2	3	2	3	3	3	2	3	2
TOTAL	**11**	**13**	**11**	**12**	**11**	**12**	**12**	**14**	**14**	**13**	**13**	**12**
AVERAGE	**2.2**	**2.6**	**2.2**	**2.4**	**2.2**	**2.4**	**2.4**	**2.8**	**2.8**	**2.6**	**2.6**	**2.4**

3 – Strong, 2- Medium, 1- Low

SEMESTER VI

DISCIPLINE SPECIFIC ELECTIVE IV: a) BIOCHEMISTRY, BIOPHYSICS AND BIOSTATISTICS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU236DE4	3	-	2	-	3	5	75	25	75	100

Pre-requisite: Basic knowledge of biomolecules, biophysics and statistical analysis.

Learning Objectives

1. To impart knowledge on the structure, chemical and physical properties of biomolecules and statistical methods.
2. To develop practical skills on analysis of biomolecules, data presentation and interpretation.

Course outcomes

Upon completion of this course the students will be able to:		
1.	recall the structure of biomolecules, the basic biophysical concepts, statistical data and formulas.	**K1**
2.	explain the chemical, physical properties of biomolecules and statistical methods.	**K2**
3.	select the analytical techniques and statistical methods for the biological experiments.	**K3**
4.	assess experimental results by analytical and statistical approach.	**K4**
5.	integrate the bioanalytical techniques and statistical methods to interpret the research investigations.	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** - Evaluate

Units	Contents	No. of Hours
I	**Bonds and Buffer** Atoms – Chemical bonds – Isotopes – Hydrogen ion concentration – pH. Measurement of pH – Acids and bases. Buffers – Mechanism of buffer action – Biological buffer systems and significance. Proteins: Amino acids – classification, structure and properties. Proteins – classification, structure (primary, secondary, tertiary and quaternary). Enzymes: Classification of enzymes, nomenclature and properties, mechanism of enzyme action.	**15**
II	**Carbohydrates** Classification, Monosaccharides (glucose and fructose), Disaccharides (sucrose and lactose), Polysaccharides (glycogen and hyaluronic acid), biological functions of carbohydrates. Lipids: Classification, simple lipids (triglycerides and waxes), compound lipids (lecithin), derived lipids (cholesterol), biological functions of lipids.	**15**
III	**Thermodynamics and Light** Laws of thermodynamics, enthalpy, entropy and free energy, redox reactions and redox potential, ATP bioenergetics. Membrane conductivity: Diffusion, osmosis and active transport. Light: Nature and properties – electromagnetic spectrum – absorption and emission spectrum, fluorescence and phosphorescence.	**15**
IV	**Collection and Classification of Data** Introduction to Biostatistics: Definition – characteristics, importance and applications of biostatistics. Collection of Data: Primary – secondary data. Types of Classification: Qualitative – quantitative. Variables: Discrete – continuous. Diagrammatic and Graphical Representations of Data: Bar diagrams (simple, multiple, and percentage), pie diagram, frequency distributions. Frequency Diagram: Histograms – frequency polygon – frequency curve – line graphs	**15**

V	**Descriptive & Inferential Statistics** Measure of Central Tendency: Arithmetic mean – median – mode. Measures of Dispersion: Standard deviation – standard error – coefficient of variance. Test of Significance: Chi-square test for goodness of fit – Student 't' test.	**15**
Total		**75**

Self-study	Atoms; Classification of enzymes, biological significance of membrane conductivity, graphical representations of data.

Textbooks

1. Jain J.L., Sunjay Jain and Nitin Jain 2007. *Fundamentals of Biochemistry* (6th ed.). New Delhi: S. Chand and Company Ltd.
2. Subramanian, M.A., 2016. *Biophysics – Principles and Techniques*, MJP, Chennai.

Reference Books

1. Betty Karasek, 2015. *Advanced concepts of biophysics*, Callisto Reference, 198pp.
2. Daniel, W.W., 2000. *Biostatistics: A foundation for analysis in the health sciences*, 7thEd.JohnWiley&SonsLtd.NewYork. 328pp.
3. Yadav, B.S.,2020. *Text book of biophysics*, Arjun Publishing House, New Delhi.
4. EdwardK.Yeargers,2018. *Basic Biophysics for Biology*, CRCPress, USA.195pp
5. Gurumani, N., 2005. *An introduction to Biostatistics*, MJP, Chennai, 250pp.

Web Resources:

1. https://byjus.com/chemistry/protein-structure-and-levels-of-protein/
2. https://www.princeton.edu/~wbialek/PHY562/WB_biophysics110918.pdf
3. https://www.pharmaguideline.com/2021/12/relationship-between-free-energy-enthalpy-and-entropy.html
4. https://bio.libretexts.org/Bookshelves/Human_Biology/Human_Biology_(Wakim_and_Grewal)/05%3A_Cells/5.07%3A_Cell_Transport
5. http://www.biostathandbook.com/analysissteps.html
6. https://onlinecourses.nptel.ac.in/noc19_bt19

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	2	2	2	2	3	2	2	2
CO2	3	3	2	2	3	2	2	2	3	2	3	2
CO3	2	3	2	3	3	2	2	2	3	2	2	2
CO4	2	2	2	3	3	3	2	2	3	2	2	2
CO5	3	2	2	3	2	2	3	2	2	3	3	3
TOTAL	**13**	**12**	**11**	**13**	**13**	**11**	**11**	**10**	**14**	**11**	**12**	**11**
Average	**3**	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**2**

3 – Strong, 2- Medium, 1- Low

SEMESTER VI

DISCIPLINE SPECIFIC ELECTIVE IV: b) INTELLECTUAL PROPERTY RIGHTS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU236DE5	4		1	-	3	5	75	25	75	100

Pre-requisite: Basic understanding of technical aspects of intellectual property rights (IPR) and cyber laws.

Learning Objectives:

1. To provide a comprehensive understanding of Intellectual Property Rights (IPR).
2. To analyze the impact of emerging issues such as cybercrimes, biotechnological inventions, and digital piracy on intellectual property.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	define key concepts of patents, copyrights, trademarks, and their significance in India and globally.	**K1**
2.	explain the procedures, rights, and legal aspects of patents, copyrights, and trademarks in protecting innovation and creativity.	**K2**
3.	apply the legal framework and procedures for obtaining patents, copyrights, and trademarks in industrial and technological contexts.	**K3**
4.	analyze the ethical, legal, and socio-economic impacts of IP laws, biotech inventions, cyber-crimes, and digital piracy.	**K4**
5.	evaluate the effectiveness of IP and cyber laws in addressing digital rights, industrial designs, and traditional knowledge protection.	**K5**

K1 - Remember; K2 - Understand; K3 – Apply; K4 - Analyse; K5 - Evaluate

Units	Contents	No. of Hours
I	**Fundamentals of Intellectual Property Right (IPR)** Copyright Act and IPR. IPR in India and other countries - WTO, TRIPS, WIPO. Patents - objectives, rights, Patent treaty, 1970 and its amendments. Patent Search and Analysis using Indian Patent Office Database.	15
II	**Patents, Copyrights and Trademarks** Protocol of obtaining patents, industrial application - non-patentable subject matter - registration procedure, rights and duties of Patentee, License - Infringement of patents. Copyrights - type of work protected under copyright laws, rights, transfer of copyright, Infringement and penalties. Trademarks - objectives, rights of holder, infringement, remedies and penalties.	15
III	**Protection of Traditional Knowledge, Industrial Designs** Concept of Traditional Knowledge, Holders, Traditional knowledge on the International Arena, at WTO, at National level, international enforcement of intellectual property rights. Bioprospecting and Bio-piracy, Commercial piracy, Transnational lawsuits. Geographical Indications Germplasm protection in India. National gene bank, Benefit sharing. Protection of Plant Varieties and Farmers' Rights Act, 2001. Germplasm Protection and Farmers' Rights Survey.	15
IV	**Other examples of IPR and ethical issues** Biotechnological Inventions - objective, applications, concept of novelty, concept originality or creativity requirements. Patenting with microorganisms. Ethical issues in patenting biotechnological inventions. Computer Software and intellectual property, Database and data protection, protection of semiconductor chips etc.	15

V	**Cyber Crimes and Intellectual Property Rights** Types of cybercrimes (e.g., hacking, online piracy, data theft). Effect of cybercrimes on copyrights, trademarks, patents, and trade secrets. Digital piracy, unauthorized reproduction, and distribution of digital content. Key provisions of the Information Technology Act and related cybercrime laws in India.	**15**
Total		**75**

Self-study	Protocol of obtaining patents.

Textbooks:

1. Gopalakrishnan, N.S. and Agitha, T.G., 2014. *Principles of Intellectual Property right*, (2nd Edition), Eastern Book Company, Lucknow.
2. Nithyananda, K V, 2019. *Intellectual Property Rights: Protection and Management*, Cengage Learning India Private Limited, Noida Uttar Pradesh, India.

Reference Books:

1. Reddy, G.B., 2020. *Intellectual Property Rights and the Law*, (12th Edition), Gogia Law Agency, Hyderabad, India.
2. Narayanan, P., 2017. *Law of Copyright and Industrial Designs*, (5th Edition), Eastern Law House, Delhi, India.
3. Rajeev, B. 2022. *Intellectual Property Rights in India*. Bloomsberry, India.
4. Parulekar, A., D'Souza, S., 2006. *Indian Patents Law – Legal & Business Implications*, (2nd Edition), Macmillan India Ltd., New Delhi, India.
5. Wadehra, B.L., 2016. *Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications*, (5th Edition), Universal Law Publishing Pvt. Ltd., New Delhi, India.

Web Resources:

1. http://cipam.gov.in
2. https://www.wipo.int/about-ip/en/
3. http://www.ipindia.nic.in
4. https://www.annauniv.edu/ipr/files/downloadable/Overview%20of%20IPR.pdf
5. https://www.rgmcet.edu.in/assets/img/departments/CIVIL/materials/R15/3-2/PESS/unit-6.pdf

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	2	3	3	3	3	2	3	3	2	3
CO2	3	3	3	3	2	3	3	3	2	3	3	3
CO3	3	2	3	3	3	3	2	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	2	3	3	3
CO5	3	2	3	3	3	3	3	3	3	2	3	3
TOTAL	**14**	**13**	**14**	**15**	**14**	**15**	**14**	**14**	**13**	**14**	**14**	**15**
AVERAGE	**2.8**	**2.6**	**2.8**	**3**	**2.8**	**3**	**2.8**	**2.8**	**2.6**	**2.8**	**2.8**	**3**

3 – Strong, 2- Medium, 1- Low

SEMESTER VI

DISCIPLINE SPECIFIC ELECTIVE IV: c) BIOECONOMICS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU236DE6	4	1	-	-	3	5	75	25	75	100

Pre-requisite: Basic knowledge of biodiversity, natural resource management and conservation principles.

Learning Objectives:

1. To comprehend the fundamental principles of the bioeconomy, sustainability, resource management and sustainable development.
2. To develop bio-based solutions for environmental and economic challenges

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall the interdisciplinary relationships between the bioeconomy, sustainability, ecological conservation, and sustainable development.	**K1**
2.	explain the basic concepts of bioeconomy, principles of sustainability, economic valuation techniques and resource management strategies.	**K2**
3.	utilize resource management, sustainability measures, and evaluate the financial and ecological effects	**K3**
4.	analyse the relationship between economic growth, environmental valuation and policy implications.	**K4**
5.	assess the role of bioeconomy in addressing global sustainability and entrepreneurial ventures.	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** – Evaluate

Units	Contents	No. of Hours
I	**Introduction to Bioeconomy** Concept and scope of bioeconomy. History and key drivers of bioeconomy. Multidisciplinary approaches for sustainable development. Biological resources: Biomass, bio-based materials, and bioproducts. Biodiversity conservation and resource management. Sustainable Development Goals (SDGs).	**15**
II	**Integrating Ecology, Economics, and Sustainability** Multi-isciplinary approaches - ecological, economic and social dimensions for sustainable development. Economics versus ecology, economic growth versus sustainable development; Natural resources - sustainable or renewable resources.	**15**
III	**Bioproducts, Biorefineries, and Ecosystem Services** Environmental economic valuation methods. Standard market prices, benefit-cost ratio, net present value, present value ratio, value ecosystem services that are not traded in the market place. Millennium Ecosystem Assessment. Sustainability indicators; Eco-labelling.	**15**
IV	**Economic Valuation and Sustainability Metrics** Spatial scale – Sustainability and the green footprint, measuring ecosystem health. Temporal scale: Equity and discounting the future, opportunity cost, Resource use incentives and property rights, Private, common, and public property rights and limitations, defendable rights to resources.	**15**
V	**Bioeconomy and Entrepreneurship** Bioeconomy – challenges, opportunities and benefits for modern economy and society. Bioproducts and their categories. Entrepreneurship, elements of running a small company. Funding sources for raising R&D company in the biotech sector.	**15**
Total		**75**

Self-study	Sustainable Development Goals, Natural resources- sustainable or renewable resources

Text Books:

1. Nicole Gaudet, Jan Lask, Jan Maier, Boris Tchouga, Ricardo Vargas-Carpintero, 2018. *Bioeconomy Shaping the Transition to a Sustainable*, Biobased Economy Iris Lewandowski.
2. Mayumi, K., Martinez, J. 2012. *The Origins of Ecological Economics*: The Bioeconomics of Georgescu-Roegen. 1 edition Routledge, London.

Reference Books:

1. Ram Prasad , Shachi Shah and V. Venkatramanan 2021, *Sustainable Bioeconomy*: *Pathways to Sustainable Development Goals Paperback*, 1st ed. Springer Verlag, Singapore.
2. Daly, H. and Farley, J. 2011. *Ecological Economics*: *Principles and Applications* (2nd Ed). Island Press, Washington D.C.
3. William, J. G. 2005. *Investing in Nature: Case studies of land conservation in collaboration with business.* Island Press, Washington, D.C.
4. Daily, G. C. and Ellison, K. 2002. *The New Economy of Nature: The quest to make conservation profitable.*
5. Assessment, M.E. 2005. *Ecosystems and Human Well-being:* Synthesis and Biodiversity Synthesis. DC: WRI, Washington.

Web Resources:

1. https://www.researchgate.net/publication/351169677_Role_of_Bioeconomy_in_the_Achievement_of_Sustainable_Development_Goals
2. https://www.ieabioenergy.com/wp-content/uploads/2021/10/IEA-Bioenergy-SDG-Case-Study-Report-FINAL-1.pdf
3. https://www.isa.org.jm/wp-content/uploads/2023/11/Guidance-on-economic-valuation-Part-II-of-the-report.pdf
4. https://www.sciencedirect.com/science/article/pii/S2667041024000065
5. http://www.unep-iemp.org/file/2024/04/24/1713940443921.pdf

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	2	3	2	2	3	3	3	3	3
CO2	3	2	3	2	2	2	2	3	2	2	2	2
CO3	2	2	3	2	3	2	3	2	2	3	2	3
CO4	2	2	3	2	2	2	3	3	3	3	2	3
CO5	3	3	3	3		3	3	3	3	3	3	3
TOTAL	**13**	**12**	**15**	**11**	**10**	**11**	**13**	**14**	**13**	**14**	**12**	**14**
AVERAGE	**3**	**2**	**3**	**2**	**2**	**2**	**3**	**3**	**3**	**3**	**2**	**3**

3 – Strong, 2- Medium, 1- Low

SEMESTER VI

PROFESSIONAL COMPETENCY SKILL II: COMPETENCY IN ZOOLOGY AND APTITUDE SKILLS FOR COMPETITIVE EXAMS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU236PS1	1	1	-	-	2	2	30	25	75	100

Pre-requisite: Basic understanding of Zoology and Logical Reasoning.

Learning Objectives:

1. To enhance Zoology-based knowledge relevant to competitive examination.
2. To develop logical thinking, analytical reasoning and problem-solving skills.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall the fundamental concepts of zoology in general knowledge, logical reasoning, quantitative aptitude and career skills	**K1**
2.	demonstrate scientific concepts, and quantitative aptitude for competitive exams.	**K2**
3.	apply effective resume writing, interview techniques and job application strategies	**K3**
4.	analyze competitive exam questions, interpret data, and evaluate solutions critically.	**K4, K5**
5.	create strategies for exam preparation, career development and time management for competitive exams	**K6**

K1 – Remember; **K2 -** Understand; **K3** – Apply; **K4** – Analyse; **K5** – Evaluate; **K6 -** Create

Units	Contents	No. of Hours
I	**General Knowledge** Indian and World Geography - Biodiversity hotspots, wildlife sanctuaries, and conservation areas. Wildlife Protection Act, Environmental Laws, and Animal Welfare. Environmental Issues and Biodiversity Conservation - Endangered species, conservation strategies, climate change. Current Affairs in Science - Breakthroughs in Zoology, Nobel Prizes in Biology, emerging infectious diseases.	**6**
II	**Logical Reasoning and Critical Thinking** Number Series and Alphabet Series. Blood Relations and Coding-Decoding - Pedigree analysis in genetics, DNA coding concepts. Syllogisms and Simple Puzzles - Logical reasoning applied to biological classification and food chains.	**6**
III	**General Science and Reasoning** Logical reasoning - Human physiology and health science. Animal diversity and classification - Ecology and wildlife conservation, Fisheries and aquaculture basics.	**6**
IV	**Quantitative Aptitude and Data Interpretation** Percentage, ratio and proportion - animal population estimation, breeding ratios. Profit and loss, simple and compound interest. Time, speed & distance. Pie charts and bar graphs.	**6**

V	**Exam Preparation and Career Guidance** Overview of UPSC (IFS), TNPSC, ICAR, ICMR, SSC - Biology/Zoology-related sections. Research. Mock test discussions and time management strategies Previous year questions in Zoology-based exams. Career pathways in Government & Private Sectors.	**6**
Total		**30**
Self-study	Previous year questions in Zoology-based exams	

Textbooks

1. Praveen Gupta, Pranav Prasoon, Kumar Abhiram Jha, 2024. *Guide book of life sciences (for CSIR-NET, DBT-JRF, GATE-BT & GATE-LS exams).* Ramesh Publishing House, India.
2. Kailash Choudhary, R.P. Saran, Ramesh Raliya, 2017. *Objective Life Science 3rd Ed.: MCQS for Life Science Examination (CSIR, DBT, ICAR, ICMR, ASRB, IARI, SET & NET).* Competition Tutor, Jodhpur.

Reference Books:

1. Pranav Kumar and Satyendra Singh, 2018. *MCQs Life Sciences Biotechnology.* Pathfinder, India.
2. Aggarwal, R.S., 2022. *A modern approach to verbal and nonverbal reasoning*. S. Chandh Competition books, Haryana.
3. Ram Mohan Pandey, 2017. *Test & Evaluation: Life Sciences / Biotechnology & General Aptitude Theory and Practice*.
4. Prabhanshu Kumar and. Preeti T. Kumar, 2024. *GKP GATE 2025: Life science – Solved Papers 2000-2024.* GK publishers, India.
5. Disha Experts, 2024. *General Science Encyclopaedia for Competitive Exams.* Disha Publications, India.

Web Resources

1. https://www.sanfoundry.com/1000-life-sciences-questions-answers/#google_vignette
2. https://ifasonline.com/?srsltid=AfmBOorOMQFLnjWVQdMExj5lbzTRftVSN 2kYu15WPs OU0tO1WV_zkwtt
3. https://triyambak.org/free-resources
4. https://easybiologyclass.com/zoology-free-lecture-notes-online-tutorials-lecture-notes-ppts- mcqs/
5. https://edurev.in/courses/92371_GATE-Life-Sciences-CYM-Marker-3-Mock-Test-Series

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	3	2	3	2	2	3	1	2	3	2
CO2	2	1	2	3	3	3	2	3	1	2	3	1
CO3	3	2	3	2	2	2	3	2	3	3	2	2
CO4	2	3	2	2	3	3	2	3	2	2	2	2
CO5	3	3	3	3	3	3	2	3	3	3	3	2
TOTAL	**12**	**9**	**13**	**12**	**14**	**13**	**11**	**14**	**14**	**10**	**10**	**10**
AVERAGE	**2**	**2.2**	**2.2**	**2**	**2.4**	**2**	**2.2**	**2.8**	**2.8**	**2**	**2**	**2**

3 – Strong, 2- Medium, 1- Low

SEMESTER VI

GENDER EQUITY AND INCLUSIVITY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG236GE1	1	-	-	-	1	1	15	50	50	100

Learning Objectives

1. To understand the challenges faced by women in the society.
2. To analyze the legitimate rights and laws that aid women to march towards emancipation and empowerment.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	interpret the life struggles of women and to promote equality	K1
2	identify the socio-cultural and religious practices that subjugate women	K2
3	probe deep into the root cause of marginalization of women and to promote an inclusive nature	K3
4	investigate the challenges faced by women in practical life	K4
5	evaluate exploitation of women as commercial commodities in advertisements and media	K5

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

Unit	Contents	No. of Hours
I	**Life Struggle of a Woman:** Challenges faced by girl students, education and religion, woman and society, working environment.	3
II	**Cultural Traits:** Myths and religious texts, opposition and rebuttal, contemporary literature, cultural decay, opportunities provided by social media.	3
III	**Women's Rights:** Democratic women's association, Laws for women's rights, essential legal rights of girl child in India, gender justice, millennium development goals, Political parties.	3
IV	**Women's Liberation:** Struggle for social rebirth, role of government and NGO's- self-help group for women, Indian political of legal profession and gender representation. the supreme courts efforts, challenging patriarchal narratives, global responsibility, women in sustainable development.	3
V	**Inclusivity:** Equal opportunities for women and men, equal access and opportunities for disabled people, indigenous populations, refugees and migrants - Importance of challenging and redefining gender roles - value and respect towards all gender identities.	3
	TOTAL	15

Reference Books

1. Hosoda, M. 2021. Promoting Gender Diversity and Inclusion at Workplace: A Case Study of Japanese Retail and Financial Service Company. Rikkyo University
2. Palo, S., Jha, K. K. 2020. Introduction to Gender. Tata Institute of Social Sciences.
3. Debois, E. and L. Dumenil. 2005. Through Women's Eyes: An American History With Documents. St. Martin Press.
4. Carter, Sarah. Mansell, 1990. Women's Studies: A Guide to Information Sources
5. .Datchana Moorthy Ramu.2020. Gender Equality and Sustainable development Goals,Notion Press.

Web Resources

1. https://en.wikipedia.org/wiki/Women%27s_studies
2. https://libguides.berry.edu/wgs/reference
3. https://www.albany.edu/~dlafonde/women/wssresguide9602
4. https://openbooks.library.umass.edu/introwgss/chapter/references-feminist-movements/
5. https://libguides.niu.edu/womensandgenderstudies/ReferenceSources