

Holy Cross College (Autonomous), Nagercoil
Kanyakumari District, Tamil Nadu.
Accredited with A⁺ by NAAC - IV Cycle – CGPA 3.35

Affiliated to
Manonmaniam Sundaranar University, Tirunelveli



Semester I – IV

UG Guidelines & Syllabus

DEPARTMENT OF ZOOLOGY



2023-2026

(With effect from the academic year 2024-2025)

Issued from

THE DEANS' OFFICE

ZU 1

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 Aquaculture, Sericulture, Apiculture, Poultry, Vermi	PO1, PO4, PO6

	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	8 x 100	800
	Core Research Project	1 x 100	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**Distribution of Hours and Credits****Curricular Courses**

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	6 (6)	6 (6)	6 (6)	6 (6)	5 (4) + 5 (4)	6 (5) + 6 (5)	70	62
Core Lab Course	2 (2)	2 (2)	2 (2)	2 (2)	5 (4)	6 (4)		
Core Research Project					5 (4)			
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
Value Education					2 (2)			2
Internship					(2)		2	2
Professional Competency Skill						2 (2)	2	2
Total	30 (23)	30 (23)	30 (23)	30 (24)	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		(1)		(1)			2
Student Training Activity: Clubs & Committees / NSS				(1)			1
Community Engagement Activity: RUN				(1)			1
Human Rights Education					(1)		1
Gender Equity Studies						(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	Language: Tamil French	3	6
	FU231FL1			
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	Language: Tamil French	3	6
	FU232FL1			
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	Language: Tamil French	3	6
	FU233FL1			
Part II	EU233EL1	English	3	6
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	Language: Tamil French	3	6
	FU234FL1			
Part II	EU234EL1	English	3	6
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: Evolutionary Biology	4	5
	ZU235CC2	Core Course VI: Developmental Biology	4	5
	ZU235CP1	Core Lab Course V: Lab on Evolutionary Biology & Developmental Biology	4	5
	ZU235RP1	Core Research Project	4	5
	ZU235DE1	Discipline Specific Elective I: a) Food, nutrition, and health b) Biofertilizers c) Aquatic Biology	3	4
	ZU235DE2			
	ZU235DE3			
	ZU235DE4	Discipline Specific Elective II: a) Sericulture b) Nanobiology c) Vector Biology	3	4
	ZU235DE5			
	ZU235DE6			
Part IV	ZU235VE1	Value Education	2	2
	ZU235IS1	Internship	2	-

		Total	26	30
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SEMESTER VI

Course	Course Code	Title of the Course	Credits	Hours/Week
Part III	ZU236CC1	Core Course VIII: Animal Biotechnology	5	6
	ZU236CC2	Core Course IX: Immunology & Microbiology	5	6
	ZU236CP1	Core Lab Course X: Immunology & Microbiology	4	6
	ZU236DE1	Discipline Specific Elective III: a) Toxicology	3	5
	ZU236DE2	Discipline Specific Elective III: b) Preventive medicine		
	ZU236DE3	Discipline Specific Elective III: c) Bioeconomics		
	ZU236DE4	Discipline Specific Elective IV: a) Agricultural entomology	3	5
	ZU236DE5	Discipline Specific Elective IV: b) Medical Laboratory Technology		
	ZU236DE6	Discipline Specific Elective IV: c) Ecotourism		
	ZU236PS1	Professional Competency Skill	2	2
		Total	22	30
TOTAL			140	180

Co-curricular Courses

Part	Semester	Code	Title of the Course	Credit
Part V	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
	II & IV	-	MOOC	1+1
	III & IV	UG234LC1	Life Skill Training II: Catechism	1
		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 Education	1
	VI	UG236GS1	Gender Equity Studies	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, Value Education, Professional Competency Skill**

Ratio of Internal and External = 25: 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 One 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)	25
Part B: Open choice – 5 out of 8 questions (5 x 10)	50

Total	75
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iii. Environmental Studies**Internal Components**

Component	Marks
Project Report	15
Viva voce	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 One out of Three)	9	Part C 5 x 9 (Open choice any Five out of Eight)	45
Total	25	Total	75

iii. Internship

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

Co-Curricular Courses:**i. Life Skill Training: Catechism & Moral, Human Rights Education & 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 One 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	K1	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			
		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:**

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

For the entire programme:

Cumulative Grade Point Average (CGPA) $\frac{\sum_n \sum_i C_{ni} G_{ni}}{\sum_n \sum_i C_{ni}}$

$$\text{CGPA} = \frac{\text{Sum of the multiplication of grade points by the credits of the entire programme}}{\text{Sum of the credits of the courses of the entire programme}}$$

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:

- To distinguish the characteristic features and function, evolutionary position, economic importance, and interaction with the environment of invertebrates.
- 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: <i>Paramecium</i> (Morphology and Reproduction) and <i>Plasmodium</i> (Lifecycle) - Parasitic protozoans (<i>Entamoeba</i> , <i>Trypanosoma</i> & <i>Leishmania</i>) - Economic importance Nutrition in protozoa - Host-parasitic interactions in <i>Entamoeba</i> and <i>Plasmodium</i> - 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: <i>Obelia</i> (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: <i>Fasciola hepatica</i> (Morphology and lifecycle)-. Parasitic adaptations. Host-parasitic interactions of Helminthine parasites	18
III	Aschelminthes : General characters and classification of up to classes - Type study: <i>Ascaris lumbricoides</i> (Morphology and lifecycle), Nematode Parasites and diseases - <i>Wuchereria bancrofti</i> , <i>Enterobius vermicularis</i> , <i>Ancylostoma duodenale</i> . Parasitic adaptations. Annelida: General characters and classification up to Classes. Type study: <i>Nereis</i> (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: <i>Penaeus indicus</i> (Morphology	18

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

Self-study	Nutrition in Protozoa; Corals and coral reefs; Nereis; <i>Penaeus indicus</i> – Morphology; Economic importance- Cephalopods
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Textbooks

1. Ekambaranatha Ayyar, and T. N. Ananthkrishnan, 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. Mifflin and ELBS, London.
2. Bhamrah, H.S. and Kavitha Juneja, 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: <i>Amoeba</i> , <i>Paramecium</i> , <i>Paramecium</i> Binary fission and Conjugation, <i>Entamoeba histolytica</i> , <i>Plasmodium vivax</i> (ii). Porifera: Sycon, Gemmule (iii). Coelenterata: Obelia – Colony & Medusa, Aurelia, Physalia, Gorgonia, (iv). Platyhelminthes: Planaria, <i>Fasciola hepatica</i> , Fasciola larval forms – Miracidium, Redia, Cercaria, <i>Taenia solium</i> , (v). Nematelminthes: 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.

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

References Books

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

Web Resources

- <https://www.nationalgeographic.com/animals/invertebrates/>
- <https://bit.ly/3kABzKa>
- <https://www.nio.org/>
- <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

- To acquire a basic knowledge of diversity and organization of Protozoa, Coelenterates, Helminthes, Annelida, Arthropoda, Mollusca and Echinodermata.
- 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

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

Reference Books

- Ekambaranatha Iyer M. and Anantakrishnan T. N. 1990. *A manual of Zoology*. Vol. I. Invertebrata (Part 1 &2). S. Vishwanathan Pvt. Ltd.
- Ekambaranatha Iyer M. and Anantakrishnan T. N. 1990. *A manual of Zoology*. Vol. II. Chordata S. Vishwanathan Pvt. Ltd.
- 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 : <i>Paramecium, Plasmodium, Scypha, Leucosolenia, Corals. Taenia solium</i> – entire, <i>Ascaris</i> 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: Invertebrates*, 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 Jersey, 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
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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

- To provide the knowledge of fundamental principles in zoology that will be a foundation for their later advanced courses in more specific biological subjects.
- 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 and nomenclature, Systematics: Kingdom Protista- Salient features, examples; Kingdom 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.
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Textbooks

- 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, Invertebrates* 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	13	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:

- To provide the basic principles of nutrition, including the classification of nutrients into food groups.
- 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
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Textbooks

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

Reference Books

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

Ltd., Chennai

2. Srilakshmi, B. (2014). *Dietetics* (7thed). New Delhi: New Age International (P) Ltd.
3. Sumati Mudambi, R. (2012). *Fundamentals of Foods and Nutrition* (6thed.), 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
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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 (<i>Balanoglossus</i>), Urochordata (<i>Ascidia</i>), Cephalochordata (<i>Amphioxus</i>).	18
II	Agnatha: Characteristics of subphylum vertebrata. General characters and classification up to class level, Agnatha (<i>Petromyzon</i>), - Pisces (<i>Scoliodon sorrakowah</i>), 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 – <i>Rana hexadactyla</i> - 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 – (<i>Calotes versicolor</i> - Morphology, endoskeleton of <i>Varanus</i>). Extinct reptiles. Snakes of South India: Poisonous snakes - <i>Naja naja</i> , King cobra and Viper, Non-poisonous snakes - Python, Rat snake (<i>Ptyas mucosa</i>) and Wolf snake (<i>Lycodon aulicus</i>). 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 - <i>Columba livia</i> - 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
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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

- To identify the structures and distinct features of phylum Chordata
- 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, 5 th Cranial nerve, 9 th and 10 th 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: <i>Torpedo</i> , <i>Channa</i> , <i>Hippocampus</i> , <i>Exocoetus</i> , <i>Echieneis</i> , <i>Catla</i> , <i>Clarius</i> . Scales: placoid, cycloid, ctenoid Amphibia: <i>Ichthyophis</i> , <i>Bufo</i> , Axolotl larva Reptilia : <i>Draco</i> , <i>Chamaeleon</i> , <i>Gecko</i> , <i>Uromastix</i> , <i>Vipera russelli</i> , <i>Naja</i> , <i>Enhydrina</i> , <i>Typhlops Trionyx</i> , <i>Crocodylus</i> , Aves: <i>Psittacula</i> , <i>Bubo</i> , <i>Corvus</i> , <i>Pavo</i> ; Collection and study of different types of feathers: Quill, Contour, Filoplume, Down Mammalia: <i>Ornithorhynchus</i> , <i>Tachyglossus</i> , <i>Pteropus</i> , <i>Funambulus</i> , <i>Loris</i> , Hedgehog	
V	Embryology: Life cycle of Frog - Placenta in mammals.	

Textbooks

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

Reference Books

- Robert William Hegner, 2015. *Practical Zoology*, Biblio Life. Macmillan London.
- Young, J, Z., 1972. *The life of Vertebrates*. Oxford University. London.
- 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
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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 <i>Bombyx mori</i> .	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, <i>Catla catla</i> , <i>Rohu</i> , <i>Mrigala</i> .		

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 Resources:

1. <https://www.youtube.com/watch?v=agdFb9qPYQs>
2. <https://www.youtube.com/watch?v=ftrlN5ZoeNQ>
3. <https://www.youtube.com/watch?v=R4TdJGeeA30>
4. <https://www.youtube.com/watch?v=5-5gIR19uCg>

**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.
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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 – <i>Apis cerana indica</i> , <i>Apis mellifera</i> ; 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	Pests 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.)
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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/attendance/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 - <i>Lac</i> 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
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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.

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

Web Resources

- <https://byjus.com/biology/cellsignalling/#:~:text=%E2%80%9CCell%20signalling%20is%20the%20process,signalling%20to%20regulate%20different%20functions.>
- <https://www.genome.gov/geneticsglossary/Organelle#:~:text=An%20organelle%20is%20a%20subcellular,and%20ribosomes%2C%20which%20assemble%20proteins.>
- <https://www.khanacademy.org/test-prep/mcat/cells/eukaryotic-cells/a/organelles-article>
- <https://www.genome.gov/genetics-glossary/Cellcycle>
- <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 <i>Chironomus</i> 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
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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		
<i>Paramecium, Plasmodium, Scypha, Leucosolenia, Corals. Taenia solium – entire, Ascaris male and female. Earthworm, Prawn, Scorpion, Pila, Starfish Amphioxus, Shark, Frog, Calotes, Pigeon feather, Bat</i>		

Textbooks

1. Lal, S.S, 2016. *Practical Zoology Invertebrate*, Rastogi Publications. Meerut, Uttar Pradesh
2. Verma, P. S. 2010. *A Manual of Practical Zoology: Invertebrates*, 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 Jersey, 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
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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 & 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	evaluate 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
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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/11YOAwAABAJ?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/9u96DwAAQBAJ?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
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Textbooks:

1. Chavan, S.P., Kadam, M.S., Niture S.D. 2008. Aquaculture & Aquarium Keeping, 1stedn. 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: Classification, 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
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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. Culture 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
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Textbooks:

1. Ankitha Joshi, Chauhan, 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 Dagainawala, H.F. 2008. *General Microbiology*, Vol. 2, Chennai: Himalaya Publishing House.
4. Singh, R.P. 2007. *General Microbiology*, New Delhi: Kalyani Publishers.
5. 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 [Co ₂ and O ₂] - 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
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Textbooks:

1. Arora, M. P. 2007. *Animal Physiology* (6thed.). Mumbai: Himalayan Publishing House.
2. Agarwal R.A., Srivastava, A.K. and Kaushal Kumar. 2015. *Animal Physiology and Biochemistry* (5thed.). 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* (7thed.). 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*. (3rded.). New Delhi: Prentice Hall of India Publications.
5. Nagabhushan, R. Kodarkar, M.S. and Sarojini, R. 1982. *Text book of Animal Physiology* (2nded.). 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
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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 <i>Bombyx mori</i> .	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, <i>Catla catla</i> , <i>Rohu</i> , <i>Mrigala</i> .		

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=5-5gIR19uCg>
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
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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=fACEzzmXeIY>

**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
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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:

- To develop human values through value education
- 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

- Valvukku Valikattuvom*, Christian Life Committee, Kottar Diocese
- 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 dairy 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, Ruminant 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%200&%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