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

Guidelines & Syllabus

DEPARTMENT OF ZOOLOGY

2023-2026

(With effect from the academic year 2024-2025)

Issued from

THE DEANS' OFFICE

Vision

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

Mission

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

Graduate Attributes

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

- **Creative thinking:**

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

- **Personality development:**

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

- **Environmental consciousness and social understanding:**

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

- **Communicative competence:**

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

- **Aesthetic skills:**

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

- **Research and knowledge enrichment:**

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

- **Professional ethics:**

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

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

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

- **Employability:**

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

- **Women empowerment and leadership:**

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

Programme Educational Objectives (PEOs)

PEOs	Upon completion of M.A./ M. Sc. /MSW Degree Programme, the graduates will be able to:	Mapping with Mission
PEO1	apply scientific and computational technology to solve socio ecological issues and pursue research.	**M1, M2**
PEO2	continue to learn and advance their career in industry both in private and public sectors	**M4 & M5**
PEO3	develop leadership, teamwork, and professional abilities to become a more cultured and civilized person and to tackle the challenges in serving the country.	**M2, M5 & M6**

Programme Outcomes (POs)

POs	Upon completion of M.Sc. Degree Programme, the graduates will be able to:	Mapping with PEOs
PO1	apply their knowledge, analyze complex problems, think independently, formulate and perform quality research.	**PEO1 & PEO2**
PO2	carry out internship programmes and research projects to develop scientific and innovative ideas through effective communication.	**PEO1, PEO2 & PEO3**
PO3	develop a multidisciplinary perspective and contribute to the knowledge capital of the globe.	**PEO 2**
PO4	develop innovative initiatives to sustain ecofriendly environment	**PEO1, PEO2**
PO5	pursue active career, team work and using managerial skills guide people to the right destination in a smooth and efficient way.	**PEO 2**
PO6	employ appropriate analysis tools and ICT in a range of learning scenarios, demonstrating the capacity to find, assess, and apply relevant information sources.	**PEO1, PEO2 & PEO3**
PO7	learn independently for lifelong to execute professional, social and ethical responsibilities promoting sustainable development.	**PEO3**

Programme Specific Outcomes (PSOs)

PSOs	Upon completion of M.Sc. Programme, the graduates will be able to:	PO Addressed
PSO1	explain the various aspects of life sciences including Biochemistry, Cell and Molecular Biology, Biosystematics, Genetics, Evolution, Physiology, Developmental Biology, Exobiology, Immunology, Microbiology, Endocrinology, Bioinformatics, Biotechnology and Nanobiology.	**PO1, PO2**
PSO2	carryout experimental techniques, analyze statistically, draw conclusions, write report, present effectively and publish in indexed journals effectively	**PO2, PO4, PO5, PO6**
PSO 3	develop personal and key transferable skills and entrepreneurial skills through industrial / field visits and internships.	**PO2, PO3**
PSO 4	independently assemble facts, summarize and draw conclusions from scientific text and develop competence in the design and execution of research.	**PO1, PO2, PO3, PO4, PO6**
PSO 5	discriminate societal and environmental problems, adopt relevant technology, synthesis solution and claim for IPR	**PO4, PO5, PO7**

Mapping of POs and PSOs

POs	PSO1	PSO 2	PSO3	PSO4	PSO5
PO1	M	S	M	S	M
PO2	M	S	S	S	S
PO3	S	M	M	S	S
PO4	S	S	S	S	S
PO5	M	S	S	S	S
PO6	S	S	M	S	S
PO7	S	S	S	S	S

***S - Strong; M - Medium; L - Low**

Eligibility

For Admission: A candidate who is a graduate of this college or any other recognized University in the main subject/subjects as given below against each or who has passed an examination accepted as equivalent by the Syndicate of Manonmaniam Sundaranar University, Tirunelveli, is eligible for admission.

Duration of the Programme: 2years

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 M.Sc. Programme

Core Course	8x 100	800
Core Lab Course	4 x 100	400
Elective Course	7 x 100	700
Elective Lab Course	2x100	200
Core Project	1 x 100	100
Total Marks		**2200**

Course Structure

Distribution of Hours and Credits

(i) Curricular Courses:

Course	SEMESTER				Total	
	I	II	III	IV	Hours	Credits
Core Theory	7 (5) + 7 (5)	6 (5) + 6 (5)	6 (5) + 6 (5)	6 (5) + 6 (5)	70	54
Core Lab course	4 (2)	4 (2)	6 (5)	6 (5)		
Elective Course	5 (3) + 5 (3)	4 (3) + 4 (3)	4 (3) -	4 (3) + 4 (3)	34	25
Elective Lab Course	2 (2)	2 (2)				
Core Research Project		-	5 (4)	-	5	4
Skill Enhancement Course		4 (2)	3 (2)	4 (2)	11	6
Internship			(2)		-	2
Total	**30 (20)**	**30 (22)**	**30 (26)**	**30 (23)**	**120**	**91**

Total Number of Hours =120

(ii) Co-curricular Courses

Course	SEMESTER				Total
	I	II	III	IV	Credits
Life Skill Training –I	-	(1)	-	-	1
Life Skill Training –II	-	-	-	(1)	1
Field Project	(1)		-		1
Specific Value-Added Courses	(1)		(1)		2
Generic Value-Added Courses		(1)		(1)	2
MOOC		(1)		(1)	2
Community Engagement Activity (UBA)		(1)			1

Total Number of Credits = 91 + (10)

Courses Offered

SEMESTER I

Course Code	Name of the Course	Credit	Hours/ Week
ZP231CC1	Core Course I: Structure and function of Invertebrates	5	7
ZP231CC2	Core Course II: Comparative anatomy of Vertebrates	5	7
ZP231CP1	Core Lab Course I: Lab Course in Invertebrates and Vertebrates	2	4
ZP241EC1	Elective Course I: a) Biomolecules and their interaction	3	5
ZP241EC2	Elective Course I: b) Global environmental issues		
ZP231EC3	Elective Course I: c) Wildlife Management		
ZP231EC4	Elective Course II: a) Biostatistics	3	5
ZP231EC5	Elective Course II: b) Applied Zoology		
ZP231EC6	Elective Course II: c) Pest Management		
ZP241EP1	Elective Lab Course I: Biomolecules and their interaction and Biostatistics	2	2
	Total	**20**	**30**

SEMESTER II

Course Code	Title of the Course	Credits	Hours / Week
ZP232CC1	Core Course III: Cellular and Molecular Biology	5	6
ZP242CC2	Core Course IV: Developmental Biology	5	6
ZP232CP1	Core Lab Course II: Lab Course in Cell Biology and Developmental Biology	2	4
ZP232EC1	Elective Course III: a) Economic Entomology	3	4
ZP232EC2	Elective Course III: b) Parasitology		

ZP232EC3	Elective Course III: c) Agrochemicals and Pest management		
ZP232EC4	Elective Course IV: a) Research methodology	3	4
ZP232EC5	Elective Course IV: b) Apiculture		
ZP232EC6	Elective Course IV: c) Sericulture		
ZP232EP1	Elective Lab Course II: Economic Entomology and Research Methodology	2	2
ZP232SE1	Skill Enhancement Course I: Poultry Farming	2	4
	Total	**22**	**30**

SEMESTER III

Course Code	Title of the Course	Credits	Hours / Week
ZP233CC1	Core Course V: Genetics and Evolution	5	6
ZP233CC2	Core Course VI: Advanced Animal Physiology	5	6
ZP233CP1	Core Lab Course: Lab on Genetics and Evolution and Advanced Animal Physiology	5	6
ZP233RP1	Core Research Project	4	5
ZP233EC1	Elective Course V: a) Animal Behaviour and Chronobiology	3	4
ZP233EC2	Elective Course V: b) Biotechnology and Nanobiology		
ZP233EC3	Elective Course V: c) Bioinformatics		
ZP233SE1	Skill Enhancement Course II: Dairy Farming	2	3
ZP233IS1	Internship	2	-
	Total	**26**	**30**

SEMESTER IV

Course Code	Title of the Course	Credits	Hours/ Week
ZP234CC1	Core Course VII: Immunology	5	6
ZP234CC2	Core Course VIII: Microbiology	5	6
ZP234CP1	Core Lab Course: Lab on Immunology and Microbiology	5	6
ZP234EC1	Elective Course VI: a) Aquaculture	3	4
ZP234EC2	Elective Course VI: b) Forensic Biology		
ZP234EC3	Elective Course VI: c) Ecology		
ZP234EC4	Elective Course VII: a) Ornamental Freshwater fish production	3	4
ZP234EC5	Elective Course VII: b) Biodiversity Conservation and Sustainable Development		
ZP234EC6	Elective Course VII c): Medical Lab Technology		
ZP234SE1	Skill Enhancement Course III: Animal Food Processing and Quality Control	2	4
	Total	**23**	**30**
	TOTAL	**91**	**120**

Co-curricular Courses

Semester	Code	Title of the Course	Credit
I & II	PG23LST1	Life Skill Training	1
II & IV	-	MOOC	1+1
II	PG232CE1	Community Engagement Activity (UBA)	1
III & IV	PG23LST2	Life Skill Training	1
I	ZP231FP1	Field Project	1
I & III	ZP231V01 / ZP233V01	Specific Value-added Course	1+1
II & IV	GVAC2401 -	Generic Value-added Course	1+1
		Total	**10**

Specific Value-added Course

Semester	Title of the Course	Course Code
I	Basics of excel	ZP231V01
I	Fermentation Techniques	ZP231V02
III	Preservation of Food Products	ZP233V01
III	Honey Bee Products	ZP233V02

Self-Learning Course

Semester	Title of the Course	Course Code
III	Solid Waste Management	ZP233SL1
IV	Environmental Sustainability	ZP234SL1

Examination Pattern

Curricular Courses:

i) Core Course / Elective Course

Internal: 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
Seminar (10 marks)	5
Assignment: (Model Making, Exhibition, Role Play, Group Discussion, Problem Solving, Class Test, Open Book Test (Minimum three items per course) (30 marks)	5
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) Core 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	
Minor Practical / Spotters /Record	75
Total	**75**

iii) Core Research Project:

Ratio of Internal and External **25: 75**

Internal (Supervisor)	**Marks**
I Review	5
II Review	5
Report	15
External (External Examiner)	
Report	40
Viva-voce (individual, open viva-voce)	35
Total	**100**

iv) Skill Enhancement Course

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

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, Album, Group Activity (Mime, Skit, Song) (Minimum three items per course)	10
Total	**25**

Question Pattern

Internal Test	**Marks**	**External Exam**	**Marks**
Part A 2 x 2 (No Choice)	4	Part A 5 x 2 (No Choice)	10
Part B 3 x 4 (Open choice **Three** out of **Five**)	12	Part B 5 x 4 (Open choice any **Five** out **of Eight**)	20

Part C 1 x 9 (Open choice O**ne** out of **Three**)	9	Part C 5 x 9 (Open choice any **Five** out **of Eight**)	45
Total	**25**	**Total**	**75**

v) Internship

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

Co-Curricular Courses:

(i) Life Skill Training

Internal Component

Components		**Marks**
Life Skill Training -I	Album (20 pages)	30
	Group Activity (Group of 5 students)	20
	Total	**50**
Life Skill Training -II	Case Study (30 pages)	50
	Total	**50**

External Component

Written Test	Five out of Seven (5 x 10)	50
	Total	**50**

(ii) Field Project:

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

(iii) Specific Value-Added Courses & Generic Value-Added Courses:

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

(iv) Community Engagement Activity-UBA

Internal Component	
Component	**Marks**
Attendance (Field Work)	30
Participation	20
Total	**50**

External Component

Component	**Marks**
Group Project Report/ Case Study (10-15 pages in print)	50
Total	**50**

(v) Self Learning Course

Question Pattern

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

Outcome Based Education (OBE)

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

S. No.	Level	Parameter	Description
1	KI	Knowledge/Remembering	It is the ability to remember the previously learned
2	K2	Comprehension/Understanding	The learner explains ideas or concepts
3	K3	Application/Applying	The learner uses information in a new way
4	K4	Analysis/Analysing	The learner distinguishes among different parts
5	K5	Evaluation/Evaluating	The learner justifies a stand or decision
6	K6	Synthesis /Creating	The learner creates a new product or point of view

(ii) Weightage of K – levels in Question Paper

Number of questions for each cognitive level:

Assessment	Cognitive Level	KI			K2			K3			K4, K5, K6			Total
Internal Test	Part	A	B	C	A	B	C	A	B	C	A	B	C	
	No. of Questions	1	1	-	-	-	-	1	-	1	2	1	1	8
External Examination	Part	A	B	C	A	B	C	A	B	C	A	B	C	
	No. of Questions	3	-	1	3	1	1	1	2	1	3	2	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 for each Course shall be done by a 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 re-appear in such failed course (s) in the subsequent examination to be held in October / November or April / May. However, candidates who have arrears in Practical Examination(s) shall be permitted to re-appear for their arrears only along with Regular Practical examinations in the respective semester.
v. Viva- voce: Each candidate shall be required to appear for Viva-voce Examination in defense of the Project.

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

Conferment of the Master's Degree

A candidate shall be eligible for the conferment of the Degree of Master of Arts / Science/ Commerce only if the minimum required credits for the programme thereof (91 +10 credits) is earned.

Grading System

For a semester examination:

Calculation of Grade Point Average for End Semester Examination:

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

For the entire programme:

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

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

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
00-49	0.0	U	Re-Appear
ABSENT	0.0	AAA	ABSENT

Overall Performance

CGPA	Grade	Classification of Final Results
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+	
6.0and above but below 6.5	A	
5.5and above but below 6.0	B+	Second Class
5.0 and above but below 5.5	B	
0.0 and above but below 5.0	U	Re-appear

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

SEMESTER I

CORE COURSE I: STRUCTURE AND FUNCTION OF INVERTEBRATES

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP231CC1	5	1	-	1	5	7	105	25	75	100

Pre-requisite:

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

Learning Objectives:

1. To realize the range of diversification of invertebrate animals.
2. To understand the concept of classification and their characteristic features of major group of invertebrates.
3. To know the functional morphology of system biology of invertebrates
4. To enable to find out the ancestors or derivatives of any taxon.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	remember the general concepts and major groups in animal classification, origin, struct5re, functions and distribution of life in all its forms.	**K1**
2	understand the evolutionary process. All are linked in a sequence of life pattern	**K2**
3	apply this for pre-professional work in agriculture and conservation of life forms.	**K3**
4	analyze what lies beyond our present knowledge of life process.	**K4**
5	evaluate and to create the perfect phylogenetic relationship in classification.	**K5**

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

Units	Contents	No. of Hours
I	Structure and function in invertebrates: Principles of Animal taxonomy; Species concept; International code of zoological nomenclature; Taxonomic procedures; New trends in taxonomy	**21**
II	Organization of coelom: Acoelomates; Pseudocoelomates; Coelomates: Protostomia and Deuterostomes; Locomotion: Flagella and ciliary movement in Protozoa; Hydrostatic movement in Coelenterata, Annelida and Echinodermata	**21**
III	Nutrition and Digestion: Patterns of feeding and digestion in lower metazoan; Filter feeding in Polychaeta, Mollusca and Echinodermata. Respiration: Organs of respiration: Gills, lungs and trachea; Respiratory pigments; Mechanism of respiration	**21**
IV	Excretion: Organs of excretion: coelom, coelomoducts, Nephridia and Malpighian tubules; Mechanisms of excretion; Excretion and osmoregulation. Nervous system: Primitive nervous system: Coelenterata and Echinodermata; Advanced nervous system: Annelida, Arthropoda (Crustacea and lnsecta) and Mollusca (Cephalopoda); Trends in neural evolution	**21**
V	Invertebrate larvae: Larval forms of free-living invertebrates - Larval forms of parasites; Strategies and Evolutionary significance of larval forms. Minor Phyla: Concept and significance; Organization and general characters	**21**
	Total	**105**

Textbooks:

1. Ekambaranatha Iyer, 2000. A Manual of Zoology, 10th edition, Viswanathan, S., Printers & Publishers Pvt Ltd.

2. Barrington, E. J.W. 1979. Invertebrate Structure and Function. The English Language Book Society.
3. Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition.

Reference Books:

1. Barnes, R. D. 1974. Invertebrate Zoology, (Second Edition), Holt-Saunders International Edition.
2. Barnes, R. S. K., P. Calow, P. J. W. Olive, D. W. Golding, J. J. Spicer. 2013. The Invertebrates: A Synthesis. Third Edition. John Wiles & Sons Inc., Hoboken. New Jersey, New Delhi.
3. Dechenik, J. A. 2015. Biology of Invertebrates (Seventh Edition). Published by McGraw Hill Education (India) Private Limited.

Web Resources

1. https://www.uou.ac.in/sites/default/files/slm/MSCZO-501.pdf
2. https://manoa.hawaii.edu/exploringourfluidearth/biological/invertebrates/structure-and-function
3. https://www.zoologytalks.com/category/structure-and-functions-of- invertebrates/
4. https://www.bilasagirlscollege.ac.in/newsData/D54.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	3	2	3	3	3	2	3	3	2	3	2
CO2	3	3	2	2	3	3	2	3	3	2	3	3
CO3	3	2	3	2	3	3	2	2	2	3	3	2
CO4	3	2	3	2	3	3	2	3	3	3	3	3
CO5	3	2	3	2	3	3	2	2	2	2	2	2
TOTAL	**15**	**12**	**13**	**11**	**13**	**11**	**10**	**13**	**13**	**12**	**14**	**12**
AVERAGE	**3**	**2.4**	**2.6**	**2.2**	**2.6**	**2.2**	**2**	**2.6**	**2.6**	**2.4**	**2.8**	**2.4**

3 – Strong, 2- Medium, 1- Low

SEMESTER I

CORE COURSE II: COMPARATIVE ANATOMY OF VERTEBRATES

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP231CC2	5	1	-	1	5	7	105	25	75	100

Pre-requisite:

Students with knowledge and comprehension on zoology

Learning Objectives:

1. To impart conceptual knowledge about vertebrates and their anatomy.
2. To understand the evolutionary changes that occurred in the life of vertebrates.

Course Outcomes:

On successful completion of the course, the student will be able to:		
1	remember the general concepts and major groups in animal classification, origin, structure, functions, and distribution of life in all its forms.	K1
2	understand the evolutionary process. All are linked in a sequence of life patterns.	K2
3	apply this for pre-professional work in agriculture and conservation of life forms.	K3
4	analyze what lies beyond our present knowledge of life process.	K4
5	evaluate and to create the perfect phylogenetic relationship in classification.	K5

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

Units	Contents	No. of Hours
I	**Origin of vertebrates:** Concept of Protochordata; The nature of vertebrate morphology; Definition, scope and relation to other disciplines; Importance of the study of vertebrate morphology.	21
II	**Origin and classification of vertebrates:** Vertebrate integument and its derivatives. Development, general structure and functions of skin and its derivatives; Glands, scales, horns, claws, nails, hoofs, feathers and hairs.	21
III	**General plan of circulation in various groups:** Blood; Evolution of heart; Evolution of aortic arches and portal systems. Respiratory system: Characters of respiratory tissue; Internal and external respiration; Comparative account of respiratory organs	21
IV	**Skeletal system:** Form, function, body size and skeletal elements of the body; Comparative account of jaw suspensorium, Vertebral column; Limbs and girdles; Evolution of Urinogenital system in vertebrate series.	21
V	**Sense organs:** Simple receptors; Organs of Olfaction and taste; Lateral line system; Electroreception. Nervous system: Comparative anatomy of the brain in relation to its functions; Comparative anatomy of spinal cord; Nerves-Cranial, Peripheral and Autonomous nervous systems.	21
	Total	105

Self-Study	Scope and relation of vertebrate morphology to other disciplines, Vertebrate integument and its derivatives, Evolution of aortic arches and portal systems, Comparative account of jawsuspensorium, Comparative anatomy of spinal cord

Textbooks:

1. Yong, J. Z. 1981. The life of Vertebrates, English language Book society, London.
2. Romer, A.S. 1971. The Vertebrate body, W.B.S. Saunders, Philadelphia.

3. Ayyar, E.K. and T.N. Ananthakrishnan, 1992. Manual of Zoology Vol. II (Chordata), S. Viswanathan (Printers and Publishers) Pvt Ltd., Madras.
4. Jordan, E.K. and P.S. Verma, 1995. Chordate Zoology and Elements of Animal Physiology, 10th edition, S. Chand & Co Ltd., Ram Nagar, New Delhi.
5. Ganguly, Sinha, Bharati Goswami and Adhikari, 2004. Biology of animals Vol.II - New central book Agency (p) Ltd.

Reference Books:

1. Waterman, A.J. 1972. Chordate Structure and Function, MacMillan Co., New York,
2. Parker T. J. and W. A. Haswell. 1962. A text book of Zoology, Vol. 2, Vertebrates, 7th Edition, Mac Millan Press, London.
3. Ekambaranatha Ayyar and T. N. Ananthakrishnan. 2009. Manual of Zoology, Vol – II, S. Viswanathan Pvt. Ltd. Chennai.
4. Kotpal, 2019. R.L. Modern Text Book of Zoology Vertebrates, 4th Edition, Rastogi Publications, Meerut.

Web sources:

1. Swayam Prabha: https://www.swayamprabha.gov.in/index.php/program/archive/9
2. https://bit.ly/3Av1Ejg/
3. https://bit.ly/3kqTfYz/
4. https://biologyeducare.com/aves/
5. https://www.vedantu.com/biology/mammalia/

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	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	1	2	2	2	2	2	2	3	2	2
CO4	3	1	1	3	1	3	2	3	3	3	3	3
CO5	3	2	1	2	3	3	2	2	3	2	2	2
TOTAL	**15**	**8**	**5**	**13**	**10**	**14**	**10**	**13**	**14**	**12**	**12**	**12**
AVERAGE	**3**	**1.6**	**1**	**2.6**	**2**	**2.8**	**2**	**2.6**	**2.8**	**2.4**	**2.4**	**2.4**

3 – Strong, 2- Medium, 1- Low

SEMESTER I

CORE LAB COURSE I: LAB COURSE IN INVERTEBRATES & VERTEBRATES

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP231CP1	-	-	4		3	4	60	25	75	100

Pre-requisite

Basic knowledge on the animals living in different habitats

Learning Objectives:

1. Understanding the salient features and functional anatomy of different systems and the skeletal system in invertebrates & vertebrates.
2. Developing the skill in mounting techniques of the biological samples.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	understand the structure and functions of various systems in animals	**K1**
2	learn the adaptive features of different groups of animals	**K2**
3	learn the mounting techniques	**K3**
4	acquire strong knowledge on the animal skeletal system	**K4**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyz

INVERTEBRATES

Dissection

Earthworm : Nervous system
Pila : Digestive and nervous systems
Sepia : Nervous system
Cockroach : Nervous system
Grasshopper : Digestive system and mouth parts
Prawn : Appendages, nervous and digestive systems
Crab : Nervous system

Study of the following slides with special reference to their salient features and their modes of life

1. *Amoeba*
2. *Entamoeba histolytica*
3. *Paramecium*
4. *Hydra* with bud
5. Sporocyst – Liver fluke
6. *Cercaria* larva
7. *Tape worm (Scolex)*
8. *Ascaris* T. S.
9. Mysis of prawn

Spotters

1. Scorpion
2. *Penaeus indicus*
3. *Emerita* (*Hippa*)
4. *Perna viridis*

Mounting

Earthworm : Body setae
Pila : Radula
Cockroach : Mouth parts

Grasshopper : Mouth parts

VERTEBRATES
Study the nervous system of Indian dog shark – Dissection
1. Nervous system of *Scoliodon laticaudatus* – 5th or Trigeminal nerve 2. Nervous system of *Scoliodon laticaudatus* – 7th or Facial nerve 3. Nervous system of *Scoliodon laticaudatus* – 9th and 10th or Glossopharyngeal & Vagus nerve
Study of the following specimens with special reference to their salient features and their modes of life
1. *Amphioxus* sp. (Lancelet) 2. *Ascidia* sp. (sea squirt) 3. *Scoliodon laticaudatus* (Indian dog shark) 4. *Trygon* sp. (Sting ray) 5. *Torpedo* sp. (Electric ray) 6. *Arius maculatus* (Cat fish) 7. *Belone cancila* (Flute fish) 8. *Exocoetus poecilopterus* (Flying fish) 9. *Mugil cephalus* (Mullet) 10. *Tilapia mossambicus* (Tilapia) 11. *Rachycentron canadum* (Cobia) 12. *Tetrodon punctatus* (Puffer fish) 13. *Dendrophis* sp. (Tree snake)
Study of the different types of scales in fishes
1. Cycloid scale 2. Ctenoid scale 3. Placoid scale
Study of the frog skeleton system (Representative samples)
1. Entire skeleton 2. Skull 3. Hyoid apparatus 4. Pectoral girdle and sternum 5. Pelvic girdle 6. Fore limb 7. Hind limb
Mounting
1. Weberian ossicles of fish

Textbooks:

1. Lal, S.S. 2009. Practical Zoology, Rastogi Publications.
2. Iuliis G. D. and D. Pulerà, 2007. The Dissection of Vertebrates: A Laboratory Manual. Academic Press, Imprint of Elsevier Publication..
3. Verma, P.S. 2000. Manual of Practical Zoology: Chordates, S. Chand Publishing Company.

Reference Books:

1. Preeti, G., and C. Mridula, 2000. Modern Experimental Zoology, Indus International Publication.
2. Sinha, J., A. K. Chatterjeee, P. Chattopadhya. 2011. Advanced Practical Zoology, Arunabha Sen Publishers.

Web Resources:

1. http://www.csrtimys.res.in/
2. http://csb.gov.in/

3. https://iinrg.icar.gov.in/
4. https://www.nationalgeographic.com/animals/invertebrates/
5. https://www.youtube.com/watch?v=b04hc_kOY10
6. https://bit.ly/3CzTEy8
7. http://tolweb.org/Chordata/2499
8. https://www.nhm.ac.uk/

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	3	3	2	3	2	2	3	3	2	3
CO2	3	2	3	3	3	2	2	2	3	3	2	2
CO3	3	2	3	3	3	2	2	2	2	2	3	2
CO4	3	2	3	3	2	2	2	2	3	3	3	3
TOTAL	**12**	**6**	**12**	**12**	**10**	**9**	**8**	**8**	**11**	**11**	**10**	**10**
AVERAGE	**3**	**1.5**	**3**	**3**	**2.5**	**2.25**	**2**	**2**	**2.75**	**2.75**	**2.5**	**2.5**

3 – Strong, 2- Medium, 1- Low

SEMESTER I

ELECTIVE COURSE I: a) BIOMOLECULES AND THEIR INTERACTION

Course Code	L	T	P	S	Credits	Inst. Hours	Total hrs	Marks		
								CIA	External	Total
ZP241EC1	3	1	-	1	3	5	75	25	75	100

Pre-requisite:

Understanding fundamental properties of elements, atoms, molecules, chemical bonds, linkages and structure, composition, metabolism, and functions of biomolecules.

Learning Objectives

1. Students should know the fundamentals of biochemistry.
2. To develop analytical and communicative skills to conduct experiments and interpret the results

Course Outcome

On the successful completion of the course, student will be able to:		
1	define structure and types of chemical bonds in biomolecules such as hydrogen ions, water, protein, carbohydrate, lipid, nucleotides, enzymes and vitamins.	**K1**
2	explain the fate of biomolecules in different metabolic pathways.	**K2**
3	apply cognitive, technical and creative skills to pursue higher studies and employability in industrial, biomedical and research laboratories.	**K3**
4	analyse biomolecules in biological systems and relate deficiency disorders.	**K4**
5	design biochemical experiments and publish the results through effective written and oral communication after drawing accurate conclusions.	**K5**

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

Units	Contents	No. of Hours
I	**Basics of biophysical chemistry and biochemistry**: Atoms - molecules - chemical bonds Stabilizing interactions in biomolecules: stability of protein and nucleic acid structures - hydrogen bonding, covalent bonding, hydrophobic interactions, and disulfide linkage. pH and Hydrogen ion concentration - buffers - 'Henderson- Hasselbalch' equation - buffer systems in blood - acidosis and alkalosis. Water – colligative properties - water turnover and balance - electrolyte balance - dehydration and water intoxication. Thermodynamics - Enzyme kinetics	**15**
II	**Carbohydrates:** Classification, structure, properties of mono, oligo and polysaccharides and biological role of carbohydrates - Carbohydrate metabolism - glycogenesis, glycogenolysis, glycolysis, Krebs cycle, Electron transport and Oxidative phosphorylation, Energetics of glucose metabolism - Pasteur effect–HMP shunt - gluconeogenesis -glyoxylate pathway - Cori cycle - Regulation and hormonal control of carbohydrate metabolism.	**15**
III	**Proteins:** Classification, structure, Ramachandran plot, properties and biological role. Amino acids - classification, structure and properties - metabolism of proteins - deamination, transamination - transmethylation and decarboxylation of amino acids - glycogenic and ketogenic amino acids - formation and transport of ammonia - glucose-alanine cycle - Ornithine cycle.	**15**
IV	**Lipids** Classification, structure and biological role - chylomicrons, VLDL, LDL, HDL - Lipid metabolism - theories of oxidation of fatty acids - oxidation of any one fatty acid and its bioenergetics (palmitic acid) -	**15**

	ketogenesis - biosynthesis of palmitic acid - metabolism of cholesterol. Integration of carbohydrate, protein and lipid metabolism	
V	**Nucleotide, Enzymes and Vitamins:** Biosynthesis and degradation of purines and pyrimidines. Enzymes: classification, nomenclature, Michaelis - Menten constant, enzyme inhibition, mechanism of enzyme action, factors affecting enzyme activity, isozymes, coenzymes. Vitamins: Classification and structure of fat soluble and water soluble, biochemical role of vitamins. Biosynthesis of vitamin C.	**15**
	Total	**75**

Self-study	Structure of atoms, Hydrophobic inter actions, Nucleic acid structures Enzymes: classification, nomenclature

Textbooks

1. Satyanarayana U. and U. Chakrapani, 2006. *Biochemistry*. (3rd Edition). Books and Allied (P) Ltd. Calcutta.
2. Ambika Shanmugam (2012). *Fundamentals of Biochemistry for Medical Students,* (7thed.). Published by Wolters Kluwer. Madras: Navabharat Offset Works.

References Books

1. Buchanan, B.B., W. Gruissem and R.L. Jones. 2015. *Biochemistry and Molecular Biology of Plants.* John Wiley and Sons Ltd., UK.
2. Murray, R.K., D.K. Granner, P.A. Mayes and V.W. Rodwell. 2003. Harper's Illustrated B*iochemistry* (26th Edition), The McGraw-Hill Companies, Inc., USA.
3. Palmer, T. 2004. *Enzymes.* Affiliated East-West Press Pvt. Ltd., New Delhi.
4. Voet D. and J.G. Voet. 2011. *Biochemistry*. (4th Edition). John Wiley & Sons (Asia) Pvt. Ltd.

Web Resources:

1. http://biochemical-pathways.com/#/map/1
2. https://www.ebi.ac.uk/chembl/
3. http://www.iubmb-nicholson.org/chart.html
4. https://www.sigmaaldrich.com/IN/en/search/enzymes?focus=products&page=1&per page=30&sort=relevance&term=enzymes&type=product

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	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

ELECTIVE COURSE I: b) GLOBAL ENVIRONMENTAL ISSUES

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP241EC2	3	1	-	1	3	5	75	25	75	100

Pre-requisite:

Basic knowledge in biology and environmental science.

Learning Objectives:

1. To understand the diversity of living forms particularly animals.
2. To infer on the loss of species due to various reasons and the need of their conservation.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	relate the fundamental issues of environment.	**K1**
2.	classify the different sources of environmental problems and remedial measures.	**K2**
3.	solve the environmental issues for a better economic growth and quality of life.	**K3**
4.	analyse the global changes in the environment and the various schemes for mitigation.	**K4**
5.	assess the environmental problems and how the environment management system can save the environment.	**K5**

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

Units	Contents	No. of Hours
I	**Environment and Environmental Problems:** Basic concepts and issues, global environmental problems - ozone depletion, UV-B, greenhouse effect and acid rain due to anthropogenic activities, Fisheries depletion, Eutrophication, their impact, and biotechnological approaches for management	**15**
II	**Environmental Pollution:** Environmental pollution - types of pollution, Air, water and land pollution. Sources of pollution, measurement of pollution, fate of pollutants in the environment, Ocean acidification, Bioconcentration, bio /geomagnification.	**15**
III	**Use of Microbes in Waste Water Treatment:** Aerobic decomposition process - activated sludge, oxidation ponds, trickling filter, towers, rotating discs, rotating drums, oxidation ditch. Anaerobic decomposition process – anaerobic filters, up-flow anaerobic sludge blanket reactors. Treatment schemes for sewage from dairy, distillery, tannery, sugar and pharma industries.	**15**
IV	**Environmental Economics:** Basic concept; methods of evaluation; Economic growth, Gross National Productivity and the quality of life, Tragedy of Commons, Economics of Pollution control, Cost-benefit ratio and cost effectiveness analysis. Environmental education, public awareness, people's participation in resource conservation and environmental protection.	**15**
V	**Environmental Management System and Ethics:** Environmental management system (EMS): ISO-14000; environmental audit; environmental clearance for establishing industries; Environmental Impact Assessment (EIA); EIA 129 guidelines, environmental taxes, international trade and environment; Trade Related Intellectual Properties (TRIPs), Intellectual Property Rights (IPRs).	**15**
	Total	**75**

Self-study	Eutrophication, Types of pollution, Environmental education

Textbooks:

1. Sharma, P.D. (1999). Ecology and Environment. Meerut: Rastogi Publications.

2. Trivedi, R.N. (1993). Textbook of Environmental Sciences. New Delhi: Anmol Publications Pvt. Ltd.

Reference Books:

1. Frances H, 2012. *Global Environmental Issues* (2nd edition) Willey-Blackwell
3. Mahesh R, 2007. *Environmental Issues in India*: A Reader. Pearson-Longman.
4. Sapru, R. K. (1987). Environmental Management in India (Vol. I & II). Ashish Publishing House.
5. Bryan, F.J. Manly. (2009). Statistics for Environmental Science and Management. CRC Press.
6. Naik, S.C. and Tiwari, T.N. (2006). Society and Environment. Oxford & IBH Publishers.
7. Santra, S.C. (2011). Environmental Science. New Central Book Agency.

Web Resources:

1. https://pressbooks.bccampus.ca/environmentalissues/
2. https://www.amazon.in/Understanding-Environmental-Issues-OU-Wiley Environment/dp/0470849983
3. https://books.google.co.in/books/about/Environmental_Issues_in_India_A_Reader.html?id=ho3rW62qeGoC&redir_esc=y
4. https://www.free-ebooks.net/environmental-studies-academic#gs.7m71jy
5. https://www.ebooks-for-all.com/bookmarks/list/onecat/Electronic-books+Environment-and-nature./0/all_items.html#google_vignette

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER I

ELECTIVE COURSE I: c) WILDLIFE CONSERVATION AND MANAGEMENT

Course Code	L	T	P	S	Credits	Inst. Hours	Total hrs	Marks		
								CIA	External	Total
ZP231EC3	3	1	-	1	3	5	75	25	75	100

Pre-requisite:

Students should know the importance of wild-life and be responsible to conserve the environment and the ecosystem.

Learning Objectives

1. To equip students with adequate knowledge of various biodiversity monitoring methodologies, conservation, and management
2. To identify the issues of vertebrate pests, wildlife conflict and over abundant species, wildlife health and diseases.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	develop the ability to use the fundamental principles of wildlife ecology to solvelocal, regional and national conservation and management issues	K1
2	develop the ability to work collaboratively on team-based projects	K2
3	demonstrate proficiency in the writing, speaking, and critical thinking skills neededto become a wildlife technician	K3
4	gain an appreciation for the modern scope of scientific inquiry in the field of wild life conservation management	K4
5	develop an ability to analyze, present and interpret wildlife conservation management information.	K5

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

Units	Contents	No. of Hours
I	Definition and importance of wildlife; Types of ecosystems. Causes of depletion of wildlife; Classification of wetland and animal inhabitants; Population vulnerability analysis and its components; Factors responsible for the extinction of animals; Types of protected areas and the concept of zoning within the protected areas.	15
II	Wildlife Sanctuaries and National Parks in India: Theories of population dispersal; Animal movement, concept of home range and territory; Tracking movement by remote sensing and GIS. Wildlife conservation, ethics and importance of conservation; Impact of habitat destruction and fragmentation on wildlife; Biological parameters such as food, cover, forage and their impact on wild life;	15
III	Population attributes; concepts of exponential and logistic growth rates of wildlife; Density dependent and independent population regulation; Impact of introduced species on preexisting flora and fauna of wildlife; Identification and estimation of wild animals by fecal sample analysis, hair identification, pug marks and census methods. Predator-prey models and impact of predation.	15
IV	Wildlife conservation objectives- Captive breeding techniques andtranslocation and reintroduction; Inviolate area and critical habitats and their impact on wildlife; Different terrestrial habitats of wildlife in India; Restoration of degraded habitat. Damage caused by wildlife in India and its mitigation; Sick animal refuges in protected areas. Type of wildlife management-manipulative, custodial; Management of over abundant wild animal populations causing damages to nearby inhabitants and their crops and animals;	15

V	Tools and techniques to control the menace of wild animals; man, wildlife conflict resolution and mitigation; Management of exotic and invasive wetland species in India. Habitat manipulation– control and regulation of grazing. Weed eradication; Major diseases of domestic and wild animals and their control and impact of wild life tourism.	**15**
	Total	**75**

Self-study	Types of ecosystems, Wild life sanctuaries and national parks in India, Wild life conservation, Weed eradication

Textbooks

1. Caughley, G., and Sinclair, A.R.E. (1994) Wildlife Ecology and Management. Blackwell Science.
2. Goutam Kumar Saha & Subhendu Mazumdar (2017). *Wildlife Biology: An Indian Perspective*. New Delhi: PHI Learning Pvt. Ltd.
3. Singh, S.K (2015). *Textbook of wildlife management* (2nd ed.). Delhi: CBS Publishers and Distributors Pvt. Ltd.

Reference Books

1. Woodroffe, R., Thirgood, S. and Rabinowitz, A. (2005) People and Wildlife, Conflict or Co-existence? Cambridge University.
2. Bookhout, T.A. (1996) Research and Management Techniques for Wildlife and Habitats (5th edition) The Wildlife Society, Allen Press.
3. Sutherland, W.J. (2000) The Conservation Handbook: Research, Management and Policy.Blackwell Sciences
4. Taj Rawat (2012). *Biodiversity Conservation and Wildlife Tourism*. Delhi: Discovery Publishing House Pvt. Ltd.
5. Kumar, U. &Asija, M.J. (2007). *Biodiversity - Principle and Conservation* (2nd ed.). Jodhpur Student Editors.
6. Seshadiri Balakrishnan, (1969). *The Twilight of India's Wildlife*. Chennai: Oxford University Press.
8. Gee, E.P. (1969). *Wildlife in India* (1sted.). London: Collins Foundation Books.
9. Anthony R.E. Sinclair, John M. Fryxell& Graeme Caughley (2006). *Wildlife Ecology*, Conservation, and Management (2nd ed.). USA: Blackwell Publishing.

Web Sources

1. https://education.nationalgeographic.org/resource/wildlife-conservation/
2. https://www.clearias.com/wildlife-conservation-projects/
3. https://www.wii.gov.in/
4. https://www.mdpi.com/2673-7159/1/2/9

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	3	3	2	2	3	3	3	3	3
CO2	3	2	3	3	3	2	2	2	3	2	2	3
CO3	3	2	3	3	3	2	2	2	2	3	2	2
CO4	3	2	3	3	3	2	2	3	3	3	3	3
CO5	3	2	3	3	3	2	2	3	2	2	3	3
TOTAL	**15**	**10**	**15**	**15**	**15**	**10**	**10**	**13**	**13**	**13**	**13**	**14**
AVERAGE	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**2.8**	**2.6**	**2.6**	**2.6**	**2.8**

3 – Strong, 2- Medium, 1- Low

SEMESTER I

ELECTIVE COURSE II: a) BIOSTATISTICS

Course Code	L	T	P	S	Credits	Inst. Hours	Total hrs	Marks		
								CIA	External	Total
ZP231EC4	3	1	-	1	3	5	75	25	75	100

Pre-requisite:

Students should be aware of the importance of analysis of quantitative and qualitative information from biological studies

Learning Objectives:

1. To enable the students to understand the basic concepts in Biostatistics and analyse the data to derive inferences in various biological experiments.
2. To develop analytical skills of statistics and draw valid conclusions in research.

Course outcomes

On the successful completion of the course, student will be able to:		
1	recall different biological data, methods of collection and analysis of data.	**K1**
2	comprehend the design and application of biostatistics relevant to experimental and population studies.	**K2**
3	acquire skills to perform various statistical analyses using modern statistical techniques and software.	**K3**
4	analyze the data and interpret the results manually or by using software	**K4**
5	evaluate on the merits and limitation of practical problems in biological/ health management study as well as to propose and implement appropriate statistical design/ methods of analysis.	**K5**

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

Units	Content	No. of hours
I	Definition, scope and application of statistics; Primary and secondary data: Source and implications; Classification and tabulation of biological data: Types and applications. Variables: Definition and types. Frequency distribution: Construction of frequency, distribution table for grouped data; Graphic methods: Frequency polygon and ogive curve; Diagrammatic representation: Histogram, bar diagram, pictogram, and pie chart.	**15**
II	Measures of central tendency: Mean, median and mode for continuous and discontinuous variables. Measures of dispersion: Range, variation, standard deviation, standard error, and coefficient of variation.	**15**
III	Probability: Theories and rules; Probability - Addition and multiplication theorem; Probability distribution: Properties and application of Normal, Binomial and Poisson distributions.	**15**
IV	Hypothesis testing: Student '*t*' test - paired sample and mean difference '*t*' tests. Correlation: Types - Karl Pearsons Co-efficient, Rank correlation, Significance test for correlation coefficients. Regression analysis: Computation of biological data, calculation of regression co-efficient, graphical representation and prediction.	**15**
V	Analysis of variance: one way and two-way classification. Data analysis with	**15**

	comprehensive statistical software using Statistical Package for the Social Sciences (SPSS).	
	Total	**75**

Self-Study	Graphic methods: Frequency polygon and ogive curve; Diagrammatic representation: Histogram, bar diagram, pictogram and pie chart.

Textbooks

1. Arora, P. N. and P. K. Malhan. (1996). *Biostatistics*, Himalaya Publishing House, Mumbai.
2. Gurumani, N. (2005). *Introduction to Biostatistics*, M.J.P. Publishers, Delhi.
3. Das, D. and A. Das. (2004). *Academic Statistics in Biology and Psychology*, Academic Publisher, Kolkata.
4. Palanichamy, S. and Manoharan, M. (1990). *Statistical Methods for Biologists*, Palani Paramount Publications, Tamil Nadu.

Reference books

1. Pillai, R.S.N. and V. Bagavathi (2016). S*tatistics Theory and Practice* (8th ed.). New Delhi: S. Chand Publishing Company Ltd.
2. Khan, I. and Khanum, A. (2014). *Fundamentals of Biostatistics* (3rd ed.): Hyderabad. Ukaaz Publications.
3. Zar, J.H. (1984). *Biostatistical Analysis* (2nd ed.). London: Prentice-Hall International Inc.
4. Bailey, N.T.J. (1997). *Statistical methods in Biology* **(**3rd ed.). New York: Cam. University Press.
5. Sokal, R. and James, F. (1973). *Introduction to Biostatistics.* Tokyo, Japan: W.H. Freeman and Company Ltd.
6. Gupta, S.P. (1998). *Statistical Methods.* New Delhi: S. Chand and Company Ltd.
7. Banerjee, P.K. (2005). *Introduction to Biostatistics.* New Delhi: S. Chand and Company Ltd.
8. Pranab Kumar Banerjee (2009). *Introduction to Biostatistics*, New Delhi: S. Chand and Company Ltd.

Web Resources

1. https://faculty.ksu.edu.sa/sites/default/files/introduction_to_biostatistics-106.pdf
2. https://www.youtube.com/watch?v=1Q6_LRZwZrc
3. https://www.youtube.com/watch?v=7CqolAC_owc
4. https://www.ibm.com/docs/en/spss-statistics/25.0.0?topic=tutorial
5. https://www.statisticshowto.com/probability-and-statistics/spss-tutorial-beginners/

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	3	3	3	3	3	3	3	3	3
CO2	2	3	3	3	2	3	3	2	3	3	2	3
CO3	2	2	2	1	1	2	2	2	3	3	3	2
CO4	3	2	2	2	2	2	2	3	3	3	3	3
CO5	3	3	2	2	2	2	3	3	2	3	3	3
TOTAL	**13**	**12**	**12**	**11**	**10**	**12**	**13**	**13**	**14**	**15**	**14**	**14**
AVERAGE	**2.6**	**2.4**	**2.4**	**2.2**	**2**	**2.4**	**2.6**	**2.6**	**2.8**	**3**	**2.8**	**2.8**

3 – Strong, 2- Medium, 1- Low

SEMESTER I

ELECTIVE COURSE II: b) APPLIED ZOOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total hrs	Marks		
								CIA	External	Total
ZP231EC5	3	1	-	1	3	5	75	25	75	100

Prerequisite:

A genuine passion towards the culture of economically important cultivable organisms.

Learning Objectives

1. To deepen the knowledge of students in general and applied areas of Zoology.
2. To provide employment and job opportunities in the public, private and government sector.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	apply the knowledge of animal husbandry in economic development.	**K1**
2	identify the kinds of bees and the methods of bee keeping.	**K2**
3	rear silkworms, harvest and market the cocoons.	**K3**
4	apply skills and experience about the management of poultry and Dairy farming.	**K4**
5	culture of economically important finfish and shell fishes.	**K5**

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

Units	Content	Hours
I	**Apiculture:** Scope – classification and kinds of bees – bees and their society – life cycle of *Apis indica* – food of honey bees - relationship between plants and bees. Methods of bee keeping (primitive and modern) – Honey bee products: honey, bee wax, bee venom. **Lac culture** – scope – lac insect *Laccifer lacca* and its life cycle – processing of lac - lac products and importance.	**15**
II	**Sericulture:** Scope – Silk Road - CSB - Moriculture: varieties of mulberry, methods of propagation, harvesting of leaves – Common species of Silkworm– Life cycle of mulberry silkworm – Diseases of silkworm: pebrine, grasserie, sotto diseases, muscardine – pest of silkworm: uzifly. Rearing of silkworm – mounting – spinning - harvesting of cocoons – silk reeling and marketing.	**15**
III	**Poultry Keeping:** Scope – commercial layers and broilers - poultry housing - types of poultry houses – management of chick, growers, layers and broilers – debeaking - sexing in chicks - Nutritive value of egg. Diseases of poultry – Ranikhet, Fowl pox, Coryza, Coccidiosis, Polyneuritis – vaccination.	**15**
IV	**Dairy Farming:** Scope – Breeds of Dairy animals – Establishment of a typical Dairy farm – Management of cow (Newborn, calf, Heifer, milking cow) – Diseases (Mastitis, Rinder Pest, FMD). Nutritive value of milk - dairy products (Standard milk, skimmed milk, toned milk and fermented milk-curd, ghee, cheese) Pasteurization. Leather industry – scope – processing of skin**.**	**15**
V	**Integrated Farming**: Definition and Scope. Agri-based fish farming – paddy cum fish culture – Horticulture-cum-fish farming. Integrated bee keeping - Live-stock fish farming - Duck-cum fish culture, fish-cum poultry farming, fish cum dairy farming, goat-cum fish integration, fish cum pig farming - multi-trophic aquaculture – Livestock – Poultry – Fish – Horticulture	**15**

	Total	**75**

Self Study	Bees, Poultry,Silk Worm

Text Books

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

Reference Books

1. Vasantharaj David, B. (2004). *General and Applied Entomology* (2nd ed.). New Delhi: Tata McGraw-Hill Publishing Company Ltd.
2. Johnson, J. and Jeya Chandra, I. (2005). *Apiculture.* Marthandam: Olympic Grafix.
3. Tharadevi, C.S., Jayashree, K.V. and Arumugam, N. (2014). *Bee Keeping.* Nagercoil: Saras Publications.
4. Johnson, M. and Kesary, M. (2015). *Sericulture* (5th ed.). Marthandam: CSI Press.
5. Ganga, G. and Sulochana Chetty (1997). *An Introduction to Sericulture.* Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.
6. Gnanamani, M.R. (2005). *Profitable Poultry Farming*. Madurai: J. Hitone Publications.
7. Shukla, G.S. and Upadhyay, V.B. (1998). *Economic Zoology.* Jaipur: Rastogi Publications.
8. John Moran (2005). *Tropical Dairy Farming.* Australia: Landlinks Press.
9. Uma Shankar Singh (2008). *Dairy Farming.* New Delhi: Anmol Publishers.

Web Resources

1. https://guides.library.charlotte.edu/c.php?g=173165&p=1142033
2. https://www.slideshare.net/ManoKhan88/1-basic-concepts-in-economic-zoologypptx
3. https://egov.uok.edu.in/elearning/tutorials/1011020512BR15103CR15Apiculture%20Lac%20culture%20and%20%20sericultureapiculture%20lac%20culture%20and%20%20sericulture%20upload.pdf
4. https://www.echocommunity.org/en/resources/e7940e6c-ebbb-4b78-9115-fa5de38fa0d7
5. https://www.fao.org/documents/card/en?details=cb5353en

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	3	3	1	3	3	3	3	3	3
CO2	3	3	3	2	2	2	3	2	3	3	2	3
CO3	3	2	2	1	1	3	3	2	3	3	3	2
CO4	3	2	1	3	3	3	3	3	3	3	3	3
CO5	2	3	2	3	3	3	3	3	2	3	3	3
TOTAL	**15**	**12**	**11**	**12**	**12**	**12**	**15**	**13**	**14**	**15**	**14**	**14**
AVERAGE	**3**	**2.4**	**2.2**	**2.4**	**2.4**	**2.4**	**3**	**2.6**	**2.8**	**3**	**2.8**	**2.8**

3 – Strong, 2- Medium, 1- Low

SEMESTER I

ELECTIVE COURSE II: c) PEST MANAGEMENT

Course Code	L	T	P	S	Credits	Inst. Hours	Total hrs	Marks		
								CIA	External	Total
ZP231EC6	3	1	-	1	3	5	75	25	75	100

Pre requisite:

Need to have a fundamental understanding of entomology, plant pathology, and integrated pest management strategies.

Learning Objectives

1. To provide awareness on various pests and their control measures.
2. To apply Integrated Pest Management strategies to resonate home based food products with the general public.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	outline the pest groups affecting different agricultural crops and control measures.	**K1**
2	select correct IPM in cropping systems with traditional and alternative control measures.	**K2**
3	analyze the impact of pesticides on environment and adopt better agricultural practices.	**K3**
4	evaluate the control measures adopted for pests of household and stored products.	**K4**

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

Units	Content	No. of hours
I	**Introduction:** definition of pest – outline of pest groups affecting agricultural crops – population dynamics of pests – causes for pest out breaks. Pest control methods: cultural, chemical and biological - pesticides, precautions, safety devices - pesticide poisoning symptoms and first aid.	**15**
II	**Pesticides:** organochlorine, organophosphorus and organo carbamates – inorganic and natural pesticides. Preparation of pesticides: formulations – packages, manufacture. Toxicity levels – LD_{50} values. Mode of action of pesticides.	**15**
III	**Pests of Agricultural importance:** bionomics and life cycles of any two pests of the following: **c**ereals (rice); oilseeds (coconut, groundnut); vegetables (brinjal); pulses; plantation crops (coffee); fruits (citrus) and pesticide formulations.	**15**
IV	**Household pests and Pests of stored products:** household pests (cockroaches, termites, silverfish, flies and mosquitoes) and their control measures. Rodents as pests – local rodents, life history, feeding habits, reproduction, and behaviour – methods of rodent control. Stored grain pest (rice weevil, flour beetle, cigarette beetle).	**15**
V	**Mode of Pest Control:** Pesticide spraying appliances. Residual toxicity of pesticides – Environment degradation and its prevention. Biological control of pest – parasites, predators, and pathogens – chemosterilants – pheromones - Bacculovirus-mediated pest control. Integrated pest management and its relevance to 21^{st} century.	**15**

	Total	**75**

Self Study	Pesticides,Pests

Textbook:

1. Dhawan, A.K., Balwinder Singh, Manmeet B Bhullar (2012). *Integrated Pest Management*. Chennai: Scientific Publishers.

Reference Books

1. Nayar, Ananthakrishnan and David (1976). *General and Applied Entomology*. New Delhi: Tata McGraw Hill Publishers.
2. Metcalf and Flint (1973). *Destructive and useful Insects* (4^{th} ed.). New Delhi: Tata McGraw Hill Publishers.
3. Roya, D.N. and Abrown, A.W. (1981). *Entomology: Medical and Veterinary* (3^{rd} ed.). Bangalore: The Bangalore Printing and publishing company.
4. Cremlyn, R. (1979). *Pesticides: Preparation and mode of Action.* New Jersey: John Wiley and Sons Ltd.
5. Ignacimuthu, S. and B V David (2009). *Ecofriendly Insect Pest Management.* Delhi: Elite Publishing House Pvt Ltd (Ind).

Web Sources

1. https://guides.library.cornell.edu/c.php?g=672215&p=4733120
2. https://growingsmallfarms.ces.ncsu.edu/growingsmallfarms-insectlinks/
3. https://content.ces.ncsu.edu/insect-and-related-pests-of-vegetables
4. https://content.ces.ncsu.edu/insect-management-on-organic-farms
5. https://www.epa.gov/ipm/integrated-pest-management-tools-resources-support-ipm-implementation

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	1	2	1	3	3	3	3	3	3
CO2	3	3	2	2	2	2	3	2	3	3	2	3
CO3	2	2	3	3	3	3	3	2	3	3	3	2
CO4	3	2	3	3	2	3	3	3	3	3	3	3
TOTAL	**11**	**9**	**11**	**9**	**9**	**9**	**12**	**10**	**12**	**12**	**11**	**11**
AVERAGE	**2.75**	**2.25**	**2.75**	**2.25**	**2.25**	**2.25**	**3**	**2.5**	**3**	**3**	**2.5**	**2.5**

3 – Strong, 2- Medium, 1- Low

SEMESTER I

ELECTIVE LAB COURSE I: BIOMOLECULES AND THEIR INTERACTION AND BIOSTATISTICS

Course Code	L	T	P	S	Credits	Inst. Hours	Total hrs	Marks		
								CIA	External	Total
ZP231EP1	-	-	2	-	2	2	30	25	75	100

Pre-requisite

Basic practical knowledge on the molecules and their interaction to animal body and analysis of quantitative and qualitative information from biological samples.

Learning Objectives:

1. Understanding the salient features and functional anatomy of different systems and the skeletal system in invertebrates & vertebrates.
2. To design experimental problems, analyze and evaluate critically with inferential biostatistics.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	learn and study of chemical and physical structure of biological macromolecules.	**K1**
2	explain the role pf biomolecules in the system of animals. Explains about probability.	**K2**
3	apply appropriate statistical methods to analyze the data. Estimate the quantity of biomolecules in various tissue samples.	**K3**
4	analyze the phsyico-chemical properties of samples and interpret the results using statistical methods and interpret the collected data using statistical methods.	**K4**
5	evaluate quantitatively the biological experiments and asses the hypothesis.	**K5**

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

Molecules and their Interaction Relevant to Biology	**Hours**
1. Colorimetry- Verification of Beer-Lambert's law.	**15**
2. Preparation of solutions in normality, percentage, ppt, ppm	
3. Quantitative estimation of glucose (Blood/ tissue) Standard graph method	
4. Determination of velocity of salivary amylase activity by applying Michaelis - Menten equation.	
5. Determination of pH of unknown solution using Known pKa – Application of Henderson – Hasselbalch equation.	
Instruments/Charts/Models: Colorimeter, pH Meter, Centrifuge, Chromatogram, PAGE	
Biostatistics	**15**
6. Measures of central tendency: mean, median and mode.	
7. Measures of dispersion- Standard deviation and standard error.	
8. Correlation co-efficient: Length and width of molluscan shells.	
9. Probability: Coin tossing (two coin and three coin)	
10. Test of significance (student's *t*-test).	
Charts/ Models: Histogram, polygon frequency, pie chart, cartogram, bar diagram	

	30

Textbooks:

1. Geetha K. Damodaraan, 2010. Practical Biochemistry. Jaypee Brothers Medical Publishers Pvt. Ltd. New Delhi.
2. Gupta, S.P.(1998). Statical methods. S. Chand and Company Ltd. New Delhi.

Reference Books

1. Divya Shanthi, 2018. An easy guide for practical Biochemistry. Jaypee Brothers Medical Publishers Pvt. Limited, New Delhi.
2. Divya Shanthi, 2010. An easy guide to practical Biochemistry. Jaypee Brothers Medical Publishers Private Limited; 1st edition, New Delhi.
3. Sattanathan, G., S.S. Padmapriya, S.S., Balamuralikrishnan, B. 2020. Practical Manual of Biochemistry. Skyfox Publishing Group Skyfox Press, Medical College Road Thanjavur.
4. Sushan White. 2015. Basic & Clinical Biostatistics. Cengage Learning, India.
5. Gurumani, N. An introduction to Biostatistics. 2004. MJP publishers, Triplicane, Chennai.

Web resources:

1. https://jru.edu.in/studentcorner/lab-manual/bpharm/2nd-sem/Lab%20Manual%20-%20Biochemistry.pdf
2. https://skyfox.co/wp-content/uploads/2020/12/Practical-Manual-of-Biochemistry.pdf
3. https://www.slideshare.net/slideshow/biochemistry-lab-manual/127518512
4. https://www.sjsu.edu/faculty/gerstman/hs167/lab-manual.pdf
5. https://www.sjsu.edu/faculty/gerstman/hs167/lab-manual.pdf

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	1	3	3	3	3	3	3
CO2	3	2	2	2	2	2	3	2	3	2	2	3
CO3	3	3	2	2	3	2	3	2	2	3	3	2
CO4	3	2	2	1	3	2	2	3	3	3	3	3
CO5	3	2	3	3	3	3	3	2	2	2	3	3
TOTAL	**15**	**12**	**11**	**10**	**14**	**10**	**14**	**12**	**13**	**13**	**14**	**14**
AVERAGE	**3**	**2.4**	**2.4**	**2**	**2.8**	**2**	**2.8**	**2.4**	**2.6**	**2.6**	**2.6**	**2.8**

3 – Strong, 2- Medium, 1- Low

SEMESTER I

SPECIFIC VALUE-ADDED COURSE: BASICS OF EXCEL

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP231V01	2	-	-	-	1	2	30	25	75	100

Prerequisite:

Basic computer literacy and familiarity with navigating computer applications.

Objectives:

To equip the students to present data using Excel's various features and printing options.

Course Outcomes

On the successful completion of the course, student will be able to:		KL
1	recall the components of Excel's interface and basic cell formatting.	K1
2	summarize the significance of relative, absolute, and mixed cell references in formulae.	K2
3	apply data entry techniques and utilize basic calculations and formulas.	K3
4	analyze different chart types to determine their suitability for presenting specific types of data.	K3
5	evaluate the effectiveness of using functions and charts to ensure clarity and effective visualization.	K5

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

Units	Contents	No. of hours
I	**Excel Essentials and Interface:** Introduction to Excel's - Excel interface, workbooks, and sheets – selection of cells, rows, and columns - basic cell formatting: font, alignment, and fill.	6
II	**Data Entry, Formulas, and Functions:** Data entry techniques and AutoFill - Introduction to formulas and basic calculations - Using SUM, AVERAGE, COUNT, and other functions - cell references: relative, absolute, and mixed	6
III	**Data Management and Analysis:** Sorting and filtering data using find and replace to manipulate data – Data analysis using excel (t test, Regression, Correlation, ANOVA), data validation for data integrity.	6
IV	**Charts and visualization**: Creating different chart types: bar, column, and pie charts - formatting and enhancing charts for clarity - Adding labels, titles, and legends to charts.	6
V	**Printing, Sharing, and Review:** Setting up print options and page layout - printing worksheets and workbooks - sharing workbooks via email and cloud storage - review of key concepts and practical exercises.	6
	Total	30

Self Study	Excel basics

Reference books:

1. Kabir Das. 2021.Microsoft Excel: Short keys and formulas. Notion Press, India.
2. Maneet Singh Mehta. 2021. Microsoft Excel Professionals. 2021 guide. BPB Publications, India.
3. Lokesh Lalwani. 2019. Excel 2019 – All in one. 1st Edn. BPB Publications, India.

4. John Walkaenbach. 2015. Microsoft Excel 2016 Bible – Comprehensive tutorial resource. John Wiley and Sons, Indiana.
5. Greg Harvey. 2016. Microsoft Excel 2016. Dummis Publisher

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	2	3	3	3
CO2	3	3	1	2	2	2	2	3	1	2	2	1
CO3	3	3	3	3	3	3	2	2	3	2	3	2
CO4	3	3	1	2	2	2	2	2	3	2	3	2
CO5	2	3	3	3	3	3	3	2	3	3	2	3
TOTAL	**14**	**15**	**11**	**13**	**13**	**13**	**12**	**12**	**12**	**12**	**13**	**11**
AVERAGE	**2.8**	**3.0**	**2.2**	**2.6**	**2.6**	**2.6**	**2.4**	**2.4**	**2.4**	**2.4**	**2.6**	**2.2**

3 – Strong, 2- Medium, 1- Low

SEMESTER I

SPECIFIC VALUE-ADDED COURSE: FERMENTATION TECHNIQUES

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP231V02	2	-	-	-	1	2	30	25	75	100

Pre-requisite:

Basic knowledge on the application and handling of microbes in the production food products.

Learning Objectives

1. To provide the knowledge of basic principle of fermentation process, quality control and good manufacturing practices in the production of fermented food product.
2. To develop skills of the students in the area of downstream processing.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	describe the role of microbes in food production and importance of fermentation	**K1**
2.	differentiate the microbes and the food products produced by using those microbes	**K2**
3.	analyse the quality and benefits of fermented products.	**K3**
4.	apply Food Laws and Food safety regulations of India for the preparation of fermented food	**K4**
5.	evaluate the fermented food products prepared out of milk, cereal and fruits for marketing in the local area.	**K5**

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

Units	Contents	No. of hours
I	**Introduction. Industrial Microbiology**: Importance of microorganisms in food fermentation, Starter Culture Technology, Culture Collection. Fermentation process and common fermenting microorganism	**6**
II	**Indian Traditional Fermented Food**: Introduction to Indian fermented foods, traditional fermentation processes for Dhokla, Panner, Appam, Cheese, Shrikant, etc.	**6**
III	**Fermentation with Acetic Acid Bacteria and Lactic Acid Bacteria:** Acetic Acid Bacteria and Fermented Food – Vinegar & Kefir Lactic Acid Bacteria and Fermented Food - Milk products. Health benefits.	**6**
IV	**Fermentation Technology for Fruit & cereals Products:** Alcoholic beverages and fruit-based fermented foods, Role of yeast and other microorganisms Alcoholic Beverage and cereal – bread & Roti.	**6**
V	**Quality Control for Fermented Food Products:** Food Safety Standard for Fermented Food Production (GMP, GHP, HACCP). Regulatory guidelines and international standards for fermented food production	**6**
	Total	**30**

Self-study	Microbiology, Food Safety Measures

Textbooks:

1. Singh, B.D. 2007. *Biotechnology - Expanding Horizon*, Chennai: Kalyani Publishers.
2. Trevan, M.D. Boffey, S., Goulding, K.H. and Stanbury, P. 2004. *Biotechnology – The Biological Principles*: Tata McGraw-Hill Publishing Company Ltd., New Delhi.

Reference Books

1. Rema, L. P. 2006. *Applied Biotechnology*: MJP Publishers. Chennai
2. Prakash S. Lohar 2005. *Biotechnology*. Kalyani Publishers. Chennai
3. Gupta P. K. 2004. *Elements of Biotechnology*. Rastogi Publications, Meerut.
4. Ema Sushan Minj, 2015. Handbook on Fermentation Technology. Astitva Prakashan, India.
5. Gary M Toban, 2017. Fermentation: The Ultimate Guide (fermented vegetables, wild fermentation, yeast, ferment beer, ferment cheese), Kindle Edition, Brazil.

Web Resource

1. https://www.healthifyme.com/blog/top-6-unique-fermented-indian-superfoods/
2. https://www.youtube.com/watch?v=3mu9jhI1xDA
3. https://yuvaap.com/blogs/indias-fermented-foods/ #5_ Pitha_ Taste_ the_ Mouthwatering_ Rice Cakes
4. https://ebooks.inflibnet.ac.in/esp15/chapter/fermentation-technology/
5. https://www.youtube.com/watch?v=qrX7XKtIVsE

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 -Strong; 2 -Medium; 1 -Low

SEMESTER II

CORE COURSE III: CELLULAR AND MOLECULAR BIOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP232CC1	4	1	-	1	5	6	90	25	75	100

Pre-requisite

Students should have knowledge of the basic cellular structures and their salient functions.

Learning Objectives

1. To acquire knowledge on molecular organization of the cell and cell organelles, growth, and communications.
2. To develop skills needed to innovate and contribute to the advancement in cell and molecular biology.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall general concepts of cell biology and fundamental cellular structures and organelles.	**K1**
2.	explain the various cellular components and their activities.	**K2**
3.	identify the changes or losses in cell function caused by dysregulation.	**K3**
4.	compare different cellular processes, their regulation, and their significance.	**K4**
5.	assess the societal and environmental impacts through cellular and molecular research.	**K5**

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

Units	Contents	No. of Hours
I	General features of the cell: Cell theory; Diversity of cell size and shapes. Protoplasm and deutroplasm – cell organelles; Membrane structure and functions - membrane models, membrane/channel proteins, diffusion, osmosis, active transport, ion pumps (Sodium and potassium pump).	**18**
II	Cell organelles: Ultra-structure and functions of intracellular organelles – nucleus, nuclear pore complex, nucleolus, chromosomes, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, centrosomes, peroxisomes, ribosomes.	**18**
III	Cell cycle and cell division: Phases of Cell Cycle – Mitosis, Significance of Mitosis - meiosis, significance of meiosis. Control of the cell cycle - regulator molecules - positive regulation - negative regulation. Structure of DNA and RNA; Process of DNA replication, transcription, and translation in pro- and eukaryotic cells.	**18**
IV	Cell communication and cell signaling: Membrane - associated receptors for peptide and steroid hormones - signaling through G-protein coupled receptors, signal transduction pathways (RTK pathway and MAP kinase pathway). Gap junction and tight junction, extracellular space and matrix, interaction of cells with other cells and non-cellular structures.	**18**
V	Cancer cells: Characteristic features of normal and cancer cells. Carcinogens: types and cancer induction. Metastasis. Oncogenes and	**18**

	tumor suppressor genes, therapeutic interventions of uncontrolled cell growth. Apoptosis – mechanism and regulation. Ageing and senescence.	
	Total	**90**

Self-study	Diversity of cell size and shapes, Ultra-structure and functions of lysosomes, Stages in cell cycle, Gap junction and tight junction, Characteristic features of normal and cancer cells.

Textbooks

1. Plopper, G., D. Sharp, and E. Sikorski. 2015. *Lewin's Cells* (Third Edition), Jones & Bartlett, New Delhi.
2. Ajoy Paul, 2011. *Textbook of Cell and Molecular Biology*, Books and Allied Pvt. Ltd.

Reference Books

1. Alberts, B., A. Johnson, J. Lewis, *et al*., 2015. *Molecular Biology of the Cell* (Sixth Edition), Garland Science, New York.
2. Lodish, H., C. A. Kaiser, A. Bretscher, *et al*., 2013. *Molecular Cell Biology* (Seventh Edition), Macmillan, England.
3. Karp, G. 2010. *Cell Biology* (Sixth Edition), John Wiley & Sons, Singapore.
4. Tropp, B, 2008. *Molecular Biology Genes to Proteins* (Third Edition), Jones & Bartlett, US.
5. Abbas, A. K., A. H. Lichtman and S. Pillai, 2007. *Cell and Molecular Immunology* (Sixth Edition), Saunders, Philadelphia.

Web Resources

1. https://www.inspiritvr.com/general-bio/cell-biology/passive-and-active-transport-study-guide
2. https://www.khanacademy.org/test-prep/mcat/cells/eukaryotic-cells/a/organelles-article
3. https://www.khanacademy.org/science/ap-biology/cell-communication-and-cell-cycle/changes-in-signal-transduction-pathways/a/intracellular-signal-transduction
4. https://bio.libretexts.org/Bookshelves/Cell_and_Molecular_Biology/Book%3A_Cells Molecules_and_Mechanisms_(Wong)/11%3A_Protein_Modification_and_Traffickin g/11.02%3A_Protein_Trafficking
5. https://openoregon.pressbooks.pub/mhccmajorsbio/chapter/control-of-the-cell-cycle/

MAPPING WITH PROGRAMME OUTCOMES

PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	2	3	3	3
CO2	3	3	1	2	2	2	2	3	1	2	2	1
CO3	3	3	3	3	3	3	2	2	3	2	3	2
CO4	3	3	1	2	2	2	2	2	3	2	3	2
CO5	2	3	3	3	3	3	3	2	3	3	2	3
TOTAL	**14**	**15**	**11**	**13**	**13**	**13**	**12**	**12**	**12**	**12**	**13**	**11**
AVERAGE	**2.8**	**3.0**	**2.2**	**2.6**	**2.6**	**2.6**	**2.4**	**2.4**	**2.4**	**2.4**	**2.6**	**2.2**

3-Strong, 2- Medium, 1- Low

SEMESTER II

CORE COURSE IV: DEVELOPMENTAL BIOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total hours	Marks		
								CIA	External	Total
ZP242CC2	4	1	-	1	5	6	90	25	75	100

Pre-requisite

A basic understanding of biology and genetics is recommended to effectively grasp the concepts in developmental biology.

Learning Objectives

1. Understand the principles of developmental biology to analyze and compare the embryonic development of different animal species.
2. Study the concepts, procedures, and uses of genes and hormones to propose strategies to improve and control the development of certain animal species.

Course Outcome

On the successful completion of the course, student will be able to:		
1	recall and summarize the chief events in animal development, recognizing their significance and historical context	**K1**
2	understand the different mechanisms and how extrinsic and intrinsic factors influence embryonic development in various animal embryos.	**K2**
3	apply their knowledge to explain the role of hormones in animal development.	**K3**
4	analyze the different stages of embryonic development and the genetic control mechanisms involved.	**K4**
5	critically evaluate ethical issues associated with cryopreservation in mammalian reproduction.	**K5**

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

Units	Contents	No. of Hours
I	Pattern of animal development: Chief events in animal development. Gametogenesis: Origin of germ cells, spermatogenesis in mammals - sperm morphology in relation to the type of fertilization. Oogenesis - oogenesis in mammals; composition and synthesis of yolk in invertebrates (insects and crustaceans); Genetic control of vitellogenin synthesis in amphibians.	**18**
II	Fertilization: Sperm aggregation, sperm activation, chemotaxis, sperm maturation and capacitation in mammals, acrosome reaction. sperm – egg interaction. Sperm entry into the egg - egg activation - intracellular calcium release - cortical reaction - physiological polyspermy - fusion of male and female pronuclei - post fertilization metabolic activation – parthenogenesis.	**18**
III	Cleavage and gastrulation: Pattern of embryonic cleavage, mechanisms of cleavage – Gastrulation - morphogenic movements - gastrulation in respective animal embryos (Sea urchin, Amphibians, Mammals); Fate maps - (Amphibian and Chick), Epigenesis and preformation – Formation of primary germ layers	**18**
IV	Embryonic Development; Embryonic development of fish and birds, formation of extra embryonic membranes in mammal –Formation and migration of neural crest cells - types of neural crest cells - primary and secondary neurulation. Organogenesis (mammal): Development of	**18**

	ectodermal derivatives (nervous system). endodermal (digestive system), mesodermal (circulator system). Gene and development: Anterior-posterior axis in determination in drosophila, Maternal effect genes - *Bicoid* and *Nanos* proteins; Generation of dorsal - ventral polarity- Genetic control of segmentation – Gap genes; pair rule genes; Homeotic genes	
V	Post embryonic development metamorphosis: Endocrine control of metamorphosis in insect and amphibian - Endocrine control of moulting and growth in crustaceans and insects - Neoteny and pedogenesis. Regeneration: Types of regeneration, Regeneration in planaria and frog - Regenerative ability in different animal groups. Factors stimulating regeneration. Mammalian reproduction: Mammalian reproductive cycle, Hormonal regulation, Endocrine changes associated with normal pregnancy, Induced ovulation in humans – Cryopreservation of gametes/embryos - Ethical issues in cryopreservation	**18**
	Total	**90**
Self-study	Spermatogenesis**,** Oogenesis in amphibians, parthenogenesis, Fate maps, Regenerative ability in different animal groups.	

Textbooks

1. Gilbert. S. F. 2006. *Developmental Biology,* 8th Edition, INC Publishers, USA
2. Balinsky, B. I. 1981. *Introduction to Embryology*. (5th Edition), CBS College Publishers, New York.

Reference books

1. Tyler, M.S. 2000. *Developmental Biology - A Guide for Experimental Study,* Sunderland, MA.
2. Subramoniam, T. 2011. *Molecular Developmental Biology* (2nd Edition), Narosa Publishers, India.
3. Slack J.M.W. 2012. *Essential Developmental Biology* (3rd Edition), Wily-Blackwell Publications, USA.
4. Mari-Beffa, M. and J. Knight. 2005. *Key Experiments in Practical Developmental Biology,* Cambridge University Press, UK.
5. Lewis Wolpert, Cheryll Tickle, Alfonso Martinez Arias. 2019. *Principles of Development*. Sixth Edition. Oxford University Press, USA.

Web resources

1. https://www.easybiologyclass.com/tag/developmental-biology/
2. www.studocu.com › document › lecture-notes › view
3. ocw.mit.edu › courses › 7-22-developmental-biology-f.
4. https://learninglink.oup.com/access/barresi-12e
5. https://www.khanacademy.org/science/biology/developmental-biology

MAPPING WITH PROGRAMME OUTCOMES

PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PO7
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 II

CORE LAB COURSE II: LAB COURSE IN CELL BIOLOGY AND DEVELOPMENTAL BIOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total hrs	Marks		
								CIA	External	Total
ZP232CP1	-	-	4	-	2	4	60	25	75	100

Pre-requisite

Students should have acquired basic knowledge relevant to this lab course.

Learning Objectives

1. To demonstrate significant cellular, molecular biological principles into practical understanding.
2. To gain theoretical knowledge and hands-on skills in developmental biology.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	recall the principles of using a micrometer for cell size determination and the stages of mitosis & meiosis and their characteristics.	**K1**
2.	comprehend the steps involved in preparing blood smears and mounting the muscle fibres using microscopy.	**K2**
3.	develop handling - skills through the wet-lab course.	**K3**
4.	interpret observations & make connections between reproductive processes and the ecological context of the organisms studied	**K4**
5.	evaluate and compare different developmental stages in chick embryos.	**K5**

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

Cell and Molecular Biology

1. Determination of cell size using micrometer.
2. Identification of Mitotic stages in onion root tips.
3. Identification of various stages of meiosis in the testes of grasshopper.
4. Observation of polytene chromosome in salivary gland cells of Chironomus larva.
5. Detection of sex chromatin in squamous epithelium.
6. Identification of blood cells in the haemolymph of the cockroach.
7. Identification of blood cells in human blood.
8. Mounting of the coxal striated muscle fibers of cockroach.
9. Observation of adipocytes - fat body of cockroach.
10. Isolation of total RNA from bacterial cells/ tissues. (Demonstration)

Spotters: Fluid mosaic model, Golgi complex, Cancer cell, Cadherins, Karyotype, Haemocytometer.

Developmental Biology

Gametogenesis - Observation of gametes from gonadal tissue sections

1. **Oogenesis:** Section through ovary of shrimp, fish, frog and mammals
2. **Spermatogenesi**s: Section through testis of shrimp, fish, calottes and mammals.
3. **Fertilization**: Induced spawning in fish.
4. **Embryogenesis**: Observation and whole mount preparation of the
   i. Chick blastoderm - 18 hours of development
   ii. Chick embryonic stage - 24 hours of development
   iii. Chick embryonic stage - 48 hours of development
   iv. Chick embryonic stage - 72 hours of development
   v. Chick embryonic stage - 96 hours of development
5. **Histological observation:** Section through various developmental stages in chick embryo

6. **Experimental Embryology:** Regeneration in Frog Tadpoles - Blastema formation.
7. **Metamorphosis:** Demonstration of metamorphosis in Frog Tadpole using exogenous Iodine
8. **Cryopreservation:** Demonstration of cryopreservation of gametes of fin fish/shell fish

Reference books:

1. Renu Gupta, Seema Makhija, Dr. Ravi Toteja, 2018. *Cell Biology : Practical Manual*. Prestige Publishers, Idia.
2. Mamta Verma, 2023. Practical Book Cell Biology & Cytogenetics Lab. Krishna Prakashan Media (P) Ltd., Idia.
3. Wilt, F.H. and N.K. Wessel, 1967. Methods in Developmental Biology, Thomas Y Crowell, New York.
4. Slack J.M.W, 2012. Essential Developmental Biology (3rd Edition), Wily-Blackwell Publications, USA, pp-496.
5. Mari-Beffa, M. and J. Knight, 2005. Key Experiments in Practical Developmental Biology, Cambridge University Press, UK, pp-404.

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	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	1	2	2	2	2	2	2	3	2	2
CO4	3	1	1	3	1	3	2	3	3	3	3	3
CO5	3	2	1	2	3	3	2	2	3	2	2	2
Total	**15**	**8**	**5**	**13**	**10**	**14**	**10**	**13**	**14**	**12**	**12**	**12**
Average	**3**	**1.6**	**1**	**2.6**	**2**	**2.8**	**2**	**2.6**	**2.8**	**2.4**	**2.4**	**2.4**

3 - Strong; 2 - Medium; 1 - Low

SEMESTER II

ELECTIVE COURSE III: a) ECONOMIC ENTOMOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP232EC1	2	1		1	3	4	60	25	75	100

Pre-requisite

Basic background in biological sciences with a special emphasis on the study of insects.

Learning Objectives

1. Develop the ability to identify and classify insects into major orders and understand their economic importance.
2. Acquire practical skills in observing and documenting the life cycles and behaviors of beneficial and destructive insects.

Course Outcomes

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

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

Unit	Contents	No. of hours
I	Overview of insects and insect taxonomy: Insects and their biological success - Man and insects; **S**alient features of Class Insecta and orders - Orthoptera, Isoptera, Hemiptera, Diptera, Coleoptera, Lepidoptera, Dermaptera, Odonata, Neuroptera and Hymenoptera. Basic concepts in Insect Taxonomy and classification.	**12**
II	Beneficial insects: Silkworms - types, life cycle of *Bombyx mori*, diseases and its management and rearing methods - Types of honey bees, life history, social organization (colonies and caste system), honey bee care and management of bee hive - Lac insects - life history, lac cultivation; Pollinators, predators, parasitoids, scavengers, weed killers, soil-builders.	**12**
III	Destructive insects: Insect pests - definition - Categories of pests - Types of damage to plants by insects - Causes of pest outbreak - Economic threshold level - Biology of the insect pests - Pests of paddy, cotton, sugarcane, vegetables, coconut and stored grains cereals.	**12**
IV	Pest management/Control strategies: Methods and principles of pest control - Natural control, Artificial control, Merits and demerits or limitations of these methods in pest control - Development and uses of pest resistant plant varieties - Integrated pest management - Concepts and practice.	**12**
V	Vector biology: Stable fly and cattle fly; Fowl - shaft louse and chicken flea; sheep and goat - head maggot and sheep ked. Insects associated with medical	**12**

	importance and management - head louse *Pediculus humanuscapitis*, mosquitoes - *Anopheles, Culex, Aedes*, flea – *Xenopsylla cheopis*, eye fly, sand fly, ticks, mites and bed bug. Insects associated with household insects - cockroaches, termites and silverfish. Vectors of veterinary and public health importance - Mosquitoes as potential vectors of human diseases-control measures.	
	Total	**60**

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

Textbooks

1. Ayyar, L.V. R, 1936. Hand book of Economic Entomology for South India. Narendra Publishing House. New Delhi.
2. Vasantharaj David, B. and V.V. Ramamurthy, 2016. Elements of Economic Entomology, Eighth Edition, Brillion Publishing, New York.
3. Ross. H.H. 195. A Text Book of Entomology, John Wiley & Sons Inc., New York.

Reference Books

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

Web Resources

1. https://egyankosh.ac.in/bitstream/123456789/85342/1/Unit-4.pdf
2. https://www.rlbcau.ac.in/pdf/PGCourse/Entomology/Insect%20Taxonomy%20(APE%20503).pdf
3. https://egov.uok.edu.in/elearning/tutorials/1011020512BR15103CR15Apiculture%20Lac%20culture%20and%20%20sericultureapiculture%20lac%20culture%20and%20%20sericulture%20upload.pdf
4. https://agritech.tnau.ac.in/farm_enterprises/fe_api_pestanddiseases.html
5. https://cpacollege.ac.in/assets/uploads/1645091697APPLIED_ZOOLOGY_SEM_NOTE_pdf.pdf

MAPPING WITH PROGRAMME OUTCOMES

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

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

S - Strong; 2 - Medium; 1-Low

SEMESTER II

ELECTIVE COURSE III: b) PARASITOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hrs.	Marks		
								CIA	External	Total
ZP232EC2	2	1	-	1	3	4	60	25	75	100

Pre-requisite:

The students with a basic background in biological sciences with a special emphasis on the study of parasites.

Course Objectives:

1. To enable the students to be aware of the cosmopolitan distribution ofparasites.
2. Develop skills for employment in clinical laboratories and healthdepartments.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	define the basic biology and life cycle of parasites including epidemiology, diagnosis, and treatment.	**K1**
2.	explain morphological characters of parasites, developmental stages and their infestation.	**K2**
3.	identify appropriate techniques and develop basic skills for detection of parasites.	**K3**
4.	analyse the medical and public health aspects of human parasitic infections.	**K4**
5.	compare the diagnostic methods of parasitic infestation in veterinary hospitals, clinics and research laboratories.	**K5**

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

Unit	Contents	No. of hours
I	Taxonomy and classification of parasites - origin and evolution of parasitism - host parasite relationship, classification of parasites and hosts - transmission of parasites - Parasitic zoonoses- pathogenesis - clinical manifestationsof parasitic diseases.	**12**
II	Protozoan parasites: Introduction and classification. Intestinal Amoeba - Pathogenic free-living amoeba - Intestinal flagellates - Trypanosomiasis, Leishmaniasis, Balantoidiasis, Malaria, Isosporiasis, *Toxoplasmosis, Cryptosporidiosis, Pneumocystis.* Protozoans of minor medical importance.	**12**
III	Helminth parasites: *Trichuriasis, Trichinellosis*, Strongyloidiasis, Ascariasis, Enterobiasis, Filariasis, hookworm diseases, Dracunculiasis, Onchocerciasis, Loiasis, Larva migrants. Nematodes of lesser medical importance - Diphyllobothriasis, Taeniasis, Echinococcosis, Sparganosis, Schistosomiasis, Fascioliasis, Fasciolopsiasis, Paragonimiasis, Clonorchiasis, Trematodes of minor medical importance.	**12**
IV	**Parasitic Insects**: Prevalence, transmission, and control of parasitic infections. Parasitic infection in a compromised host. Applied Parasitology - Eosinophilia in parasitic infections, Nosocomial parasitic infections. Evasion and parasitic mode of life - morphological, biochemical, and	**12**

	ethological adaptations. Quality assurance and laboratory safety.	
V	**Diagnostic methods in parasitology**: General rules for microscopical examination. Microscopical examination of blood, stool, urine, sputum and biopsy material for parasites. Cultural examination - preparation of media - techniques for cultivation of *E. histolytica*, Leishmania, Plasmodium. *Immunodiagnostic methods - IFA, AGD, IHA, IFAT, CFT, DAT, BF, DFAT*. Molecular characterization of stage specific antigennucleotide probes for diagnosis of protozoan diseases.	**12**
	Total	**60**

Self-study	Host parasite relationship, Intestinal Amoeba, Quality assurance and laboratory safety, General rules for microscopical examination

Textbooks

1. Jayaram Panicker C. K. & Sougata Ghosh, 2013. Panicker's Textbook of Medical Parasitology. Jaypee Brothers Medical Publishers, Maharashtra, India.
2. Rajesh Karyakarte & Ajit Damle, 2008. *Medical Parasitology* (2nd ed.). Books and Allied (P) Ltd., Kolkata.

Reference Books

1. Ichhpujani R.L. & Rajesh Bhatia, 2002. *Medical Parasitology.* Jaypee printers. New Delhi
2. Patvaik, B.D, 2001. *Parasitic Insects.* Delhi: Dominant Publishers and Distributors.
3. Jones, A.W, 1976. *Introduction to Parasitology*.: Addison -Wesley Publishing Company. Boston, USA
4. Subah, C.P, 2001. *Textbook of Medical Parasitology*: All Publishers and Distributors. Chennai.
5. Elizabeth Zeibig, 2012. *Clinical Parasitology: A Practical Approach*. 2nd Edition. Saunders, United States.

Web Resources

1. https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/health_science_students/medicalparasitology.pdf
2. https://www.amboss.com/us/knowledge/general-parasitology/
3. https://www.jaypeedigital.com/eReader/chapter/9789352704804/ch1
4. https://www.physio-pedia.com/Parasitic_Infections
5. https://www.mdpi.com/2414-6366/7/10/253

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	3	3	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	2	3	3
CO3	2	2	2	2	2	2	2	2	2	3	2	2
CO4	2	3	3	3	3	2	2	2	3	3	3	3
CO5	2	2	3	3	2	2	2	2	2	2	3	3
Total	**12**	**13**	**14**	**13**	**12**	**12**	**12**	**12**	**13**	**13**	**14**	**14**
Average	**2.4**	**2.6**	**2.8**	**2.6**	**2.4**	**2.4**	**2.4**	**2.4**	**2.6**	**2.6**	**2.6**	**2.8**

S - Strong; 2 - Medium; 1-Low

SEMESTER II

ELECTIVE COURSE III: c) AGROCHEMICALS AND PEST MANAGEMENT

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hrs.	Marks		
								CIA	External	Total
ZP232EC3	2	1		1	3	4	60	25	75	100

Pre-requisite

The students with a basic background in biological sciences with a special emphasis on the study of fertilizers and insects' pests.

Learning Objectives

1. To enable the students to be aware of the various types of biological pesticides and their uses.
2. Able to control pestand about their selective mode of action. It also gives an account of eco-friendly biological pesticides.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	outline agrochemicals, their modes of action and their fate in the agro-ecosystem.	**K1**
2.	recognize pesticide families based on their specific modes of activity.	**K2**
3.	apply appropriate pesticide management strategies by evaluating specific pest type.	**K3**
4.	analyze the impact of agrochemicals and pesticides for effective pest management.	**K4**
5.	evaluate the efficacy of organic manures, chemical fertilizers, conventional pesticides and bio-pesticides for agronomical practices.	**K5**

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

Unit	Contents	No. of hours
I	Definition, classification, morphology, and internal systems; Plant pests – weeds, bacteria, fungi, Viruses, nematodes, molluscs, Arthropods, birds, mammals etc.; Causes of outbreak of pest, growth and development; Classification based on nature of damage: Public health pests, Agricultural pests, Domestic pests, Animal husbandry pests, Structural pests.	**12**
II	Manures: types, composition and value, sources of manures, Compost-Different composting technologies-Mechanical compost. plants-Vermicomposting- Green Manures - Oil cakes, Sewage Sludge-Biogas plant slurry.	**12**
III	Chemical fertilizers: Classification and value. N- fertilizers: Manufacturing of Ammonium Sulphate, Ammonium Chloride, Ammonium Nitrate and urea; P- fertilizers: sources, processing rock phosphate, bones for bone meal preparation; K- fertilizers: sources, Potassium Chloride, Potassium Sulphate and Potassium Nitrate; Biofertilizers: Classification and value; *viz*., *Rhizobium*, *Azotobacters*, *Azolla*, Blue Green Algae, VAM	**12**

IV	Conventional chemicals/ pesticides based on target species: Acaricides, Fungicides, Rodenticides, Nematicides, Molluscicides, Fumigants and Repellents; Based on chemical nature: Organophosphates; Organochlorines, Carbamates etc.; Structure, chemical name, physical and chemical properties; Mode of action, uses, toxicity; Application of Pesticides, devices used; dose estimation for field application.	**12**
V	Potential pesticidal plants; Plant extracts and Bio-organisms: Azadirachtin and its role in pest control; Other biopesticides: Pyrethrins, Pyrethroids, Rotenone, Nicotine and Nicotinoids.Growth inhibitors or physiological antagonists, chemo-sterilant; pheromones and attractants;Insect growth regulators, juvenile hormones, moulting hormones; BT methodology, genetically modified and transgenic plants	**12**
	Total	**60**

Self-study	Types of manure, Biofertilizer: *Rhizobium*, *Azotobacters*, *Azolla*, Blue Green Algae,

Textbooks

1. Sathe, T. V. 2008. *Agrochemicals and Pest Management.* Daya Publishing House, New Delhi.
2. Patil, T. V. Sathe. 2003. *Insect Predators and Pest Management*. Daya Publishing House, New Delhi.

Reference books

1. Dent, D, 2000. *Insect pest management.* 2nd edition. CAB International. E-pdf.
2. Roberts, D.A, 1978. Fundamentals of Plant Pest Control. First Edition. W. H. Freeman.
3. Koul, O. and Dhaliwal, G.S, 2003. Phytochemical Biopesticides, Harwood Academic Publishers, Amsterdam.
4. Pedigo, L.P, 1996. Entomology and pest management, Prentice Hall, N. Delhi.

Web Resources

1. https://ugcmoocs.inflibnet.ac.in/assets/uploads/1/165/5582/et/35%20script200306101003033939.pdf
2. https://byjus.com/biology/effects-of-agrochemicals/
3. https://www.vedantu.com/biology/agrochemicals
4. https://www.gov.nl.ca/ecc/files/env-protection-pesticides-business-manuals-applic-chapter7.pdf
5. https://courseware.cutm.ac.in/wp-content/uploads/2020/06/Lecture-Notes-IPDM.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	3	3	2	2	3	3	2	3	3	3
CO2	3	2	3	3	2	2	2	3	3	2	2	3
CO3	3	2	3	3	2	2	2	2	2	3	2	2
CO4	3	2	3	3	2	2	2	2	3	3	3	3
CO5	3	2	3	3	2	2	2	2	2	2	3	3
Total	**15**	**10**	**15**	**15**	**10**	**10**	**10**	**12**	**12**	**13**	**13**	**14**
Average	**3**	**2**	**3**	**3**	**2**	**2**	**2**	**2.4**	**2.4**	**2.6**	**2.6**	**2.8**

S - Strong; 2 - Medium; 1-Low

SEMESTER II

ELECTIVE COURSE IV: a) RESEARCH METHODOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total hours	Marks		
								CIA	External	Total
ZP232EC4	2	1		1	3	4	60	25	75	100

Pre-requisite

Students should have a good understanding of the fundamental methods used in experimental biology.

Learning Objectives

1. To impart knowledge on the basic principle, methodologies and applications of instruments in biological sciences.
   Develop essential research skills to operate and apply various biological science instruments.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall the principles of laboratory equipment, research techniques and the process of scientific report writing.	**K1**
2.	explain the procedures involved in operating laboratory equipment, applying research techniques, and engaging in scientific writing.	**K2**
3.	apply biological techniques in laboratory settings to gain practical experience in research processes and scientific report writing.	**K3**
4.	analyze the principles and techniques to make wise choices in experimental design, data interpretation, and research reports in biological sciences.	**K4**
5	evaluate the quality, reliability, and limitations of data generated by research techniques and obtained from literature for specific research goals.	**K5**

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

Units	Contents	No. of hours
I	Analytical Techniques: Good laboratory practice (GLP), pH meter, Colorimeter, Spectrophotometer - UV-Visible, Atomic Absorption, Flame photometer, FTIR spectrometry.	**12**
II	Microscopy & Micro technique: Principle, Working mechanism and applications of Bright field, Phase contrast, Electron, Confocal Microscope and Atomic force microscope. Histology – Fixation, Sectioning and Staining. Histochemistry for carbohydrates, proteins, lipids.	**12**
III	Separation Techniques: Centrifugation – Differential and Density gradient, types and applications of Centrifuges. Chromatography - Principle, HPLC and Affinity chromatography, GAS Chromatography Mass Spectrometry. Electrophoresis - Principle, Agarose gel electrophoresis and PAGE.	**12**
IV	Tracer techniques: Radioactive **i**sotopes, Radiolabeling**,** Radiocarbon dating**,** Radio activity counters - Scintillation Counter, Geiger Muller Counter.	**12**
V	Scientific Writing: Essential steps in research, Review of literature,	**12**

	Literature citation, Research report – Abstract, Tables - Figures - Formatting and typing, Open access journals, Predatory journals, Impact factor, Citation index, H-index, Plagiarism, Copy Right.	
	Total	**60**

Self-study	Principle, Working mechanism and applications of Electron and Phase contrast Microscope, Centrifugation - Principle, types and applications of Centrifuges, Bioinstrumentation of pH meter, Colorimeter, and UV-Visible Spectrophotometer, Quantification of carbohydrate, protein, lipid, Essential steps in research.

Textbooks

1. Veerakumari. L, 2006. *Bioinstrumentation*. MJP Publishers. Triplicane, Chennai.
2. Gurumani. N, 2006. *Research Methodology for Biological Sciences*. MJP Publishers. Triplicane, Chennai

Reference Books

1. Marimuthu. R, 2008. *Microscopy and Microtechnique*. MJP Publishers. Chennai.
2. Keith Wilson and John Walker, 2018. *Principles and Techniques of Practical Biochemistry* (8th ed.). Cambridge University Press. India.
3. Pranav Kumar, 2018. *Fundamentals and Techniques of Biophysics and Molecular Biology*. Pathfinder publication. India.
4. Paneerselvam R, 2016. *Research Methodology*. PHI Learning Pvt. Ltd. India.
5. Gurumani N, 2010.*Scientific thesis writing and paper presentation*. MJP Publishers. Chennai

Web Resources

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

MAPPING WITH PROGRAMME OUTCOMES
MAPPING WITH 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	1	3	2	3	2	3	3	2	2	3
CO3	3	2	1	2	2	2	2	2	2	3	2	2
CO4	3	1	1	3	1	3	2	3	3	3	3	3
CO5	3	2	1	2	3	3	2	2	3	2	2	2
Total	**15**	**8**	**5**	**13**	**10**	**14**	**10**	**13**	**14**	**12**	**12**	**12**
Average	**3**	**1.6**	**1**	**2.6**	**2**	**2.8**	**2**	**2.6**	**2.8**	**2.4**	**2.4**	**2.4**

3 -Strong; 2 -Medium; 1 -Low

SEMESTER II

ELECTIVE COURSE IV: b) APICULTURE

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP232EC5	3	1	-	-	3	4	60	25	75	100

Pre-requisite

Students should be aware of importance of honey bees and their impacts on the ecosystem.

Learning Objectives

1. Impart knowledge on the morphology, life cycle, characteristics of honey bees and bee keeping.
2. Acquired skills to perform bee keeping from managing colonies of bees to harvest honey and other bee related by-products in different setups and as an Entrepreneurial venture.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	understand the morphology, life cycle, characteristics of honey bees and bee keeping.	**K1**
2.	acquire skills to perform bee keeping from managing colonies of bees in order to harvest honey and other Bee related by-products in different setups and as an Entrepreneurial venture.	**K2**
3.	knowledge on the harvesting, preserving and processing of bee products and identification of the appropriate markets to sell the produce.	**K3**
4.	identify of different bee enemies and diseases and control measures and its management	**K4**
5.	evaluate the honey chemical composition of different environment.	**K5**

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

Units	Contents	No. of Hours
I	Introduction to Apiculture. Scope and importance. History, classification, types of honey bees - morphology, mouth parts and sting of Honey bees – life cycle of different species and their behavioural patterns. Social organization of bee colony. morphology, mouth parts and sting of Honey bees –	**12**
II	Bee-keeping system, tools and equipment's needed for bee keeping. Types of bee hives, structure, and functional features. Criteria for site selection for apiculture and factors affecting them. Flora for apiculture – selection of Bees for apiculture, Method of bee keeping.	**12**
III	Identification and Preventive measures to be taken against pests (The Greater wax moth & Wasps and Hornets) and parasites (tracheal mite). Diseases (Nosema disease, Sac-brood disease, European foulbrood disease), and their control measures. Colony collapse disorder and its management.	**12**
IV	Bee products, uses and importance- Honey, Royal jelly, Propolis, Pollen and Bee venom. Harvesting, Processing, Packaging and Marketing of bee products.	**12**
V	Apiculture industry around the world and Role of Central Bee Research & Training institute in India. Apiculture as an	**12**

	Entrepreneurial venture.	
	Total	**60**

Self-study	Introduction to Apiculture. History, classification, types, life Cycle, Tools and equipment's needed for bee keeping, Diseases affecting honey bees and their control measures. Bee products, uses and importance- Honey, Royal jelly, Propolis, Pollen and Bee venom.

Textbooks:

1. Singh, D., Singh, D. Pratap. 2006. *A Handbook of Beekeeping*. Agrobios, India.
2. Mishra R.C. 2002. *Perspectives in Indian Apiculture,* Agrobios, India.

Reference Books

1. Dharam P. Abrol, 2019. Beekeeping: A compressive guide to bees and beekeeping. Scientific Publishers. Jodhpur, India.
2. Caron, D.W, 2013 (revised from 1999). Honey Bee Biology and Beekeeping. Wicwas Press. United States.
3. Dewey M. Caron, Lawrence John Connor, 2013. Honey Bee Biology and Beekeeping, Revised Hardcover. Wicwas Press. United States.
4. Ross Conrad, Gary Paul Nabhan, 2007. *Natural Beekeeping: Organic Approaches to Modern Apiculture.* Chelsea Green Publishing. United States.
5. Alphonse Avitabile, Jan Propst, 1998. The Beekeeper's Handbook. Comstock Pub. Associates. Cornell University Press.

Web Resources

1. https://www.britannica.com/topic/beekeeping
2. https://nbb.gov.in/pdf/Pests&DiseasesHoneybees&Management.pdf
3. https://www.aakash.ac.in/important-concepts/biology/apiculture-in-indian
4. https://vikaspedia.in/agriculture/farm-based-enterprises/bee-keeping-1/about-bee-keeping
5. https://beebuilt.com/pages/beekeeping-for-beginners

MAPPING WITH PROGRAMME OUTCOMES

PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	2	2	2	3	3	2	2	3	2	2
CO2	3	1	2	2	1	3	2	2	2	3	2	2
CO3	3	2	2	2	2	2	1	2	2	3	2	2
CO4	2	3	3	2	2	3	3	2	3	3	2	2
CO5	3	2	3	2	3	2	3	2	3	3	2	2
TOTAL	**13**	**9**	**12**	**10**	**10**	**13**	**12**	**10**	**12**	**15**	**10**	**10**
AVERAGE	**2.6**	**1.8**	**2.4**	**2**	**2**	**2.6**	**2.4**	**2**	**2.4**	**3**	**2**	**2**

3 – Strong, 2- Medium, 1- Low

SEMESTER II

ELECTIVE COURSE IV: c) SERICULTURE

Course Code	L	T	P	S	Credits	Inst. Hours	Total hours	Marks		
								CIA	External	Total
ZP232EC6	2	1	-	1	3	4	60	25	75	100

Pre-requisite:

Students should have a fundamental knowledge of biology, an entrepreneurial mindset, and an appreciation for the economic and cultural significance of sericulture.

Learning Objectives:

1. To gain in-depth knowledge of silk fiber types, sources, properties, and the significance of sericulture in India.
2. To develop practical skills in moriculture, silkworm rearing, and cocoon processing.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall and describe the fundamental concepts, terminology, and processes related to sericulture, and sericulture industry practices.	**K1**
2.	demonstrate the key concepts, processes, properties of silk fiber, mulberry cultivation techniques, cocoon characteristics, and the significance of sericulture practices in the silk production industry.	**K2**
3.	apply their knowledge of sericulture principles and practices to solve practical problems and optimizing cocoon processing techniques.	**K3**
4.	critically analyze the challenges and opportunities in the sericulture industry and assess the economic and environmental implications of sericulture practices.	**K4**
5.	evaluate the effectiveness of different sericulture practices, technologies, and policies, and make informed decisions to optimize silk production.	**K5**

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

Unit	Contents	No. of hours
I	Introduction to textile fibers; types - natural and synthetic fibers; sources of silk fiber - Tasar, Muga, Anaphe, Gonometa, Fagara, spider and mussel; properties and importance of silk fiber. History, development, status, characteristics, and advantages of sericulture in India.	**12**
II	Host plants; Moriculture - distribution, morphology, propagation- seedling, cutting, grafting, layering and micropropagation methods, maintenance-irrigation, manuring and pruning, pests and diseases of mulberry.	**12**
III	*Bombyx mori* - morphology, anatomy, life cycle, geographical locations, larval moults, voltinism, indigenous and commercial races. Diapause. Egg-storage and transportation.	**12**
IV	Rearing houses and equipment. Rearing operations- disinfection, brushing, feeding and spacing. Moulting and spinning. Harvest. Rearing methods-chawki, lasso, showa, shelf-rearing, floor-rearing and shoot rearing. Diseases of *Bombyx mori*- protozoan, bacterial, viral and fungal. Pests of silkworm- Uzi fly, dermestids, mites, ants, nematodes, aves and mammals.	**12**
V	Physical and commercial characteristics of cocoons. Cocoon harvesting and marketing. Cocoon sorting, stifling, deflossing, riddling, cooking, brushing, reeling and re-reeling. Weaving. By-products of sericulture industry.	**12**
	Total	**60**

Self-study	Sources of silk fiber - Tasar, Muga, Anaphe, Gonometa, Fagara, spider and mussel.

Textbooks

1. Ganga, G and J. Sulochana Chetty, 2019. An Introduction to sericulture (2nd edn). Oxford and IBH Pub. Co. Pvt. Ltd., Delhi.
2. Johnson, M. and Kesary, M, 2019. Sericulture. Saras publications, Nagercoil.

Reference Books

1. Food and Agriculture organization 1976. Manual on sericulture I, II & III. Delhi: Oxford and IBH Pub. Co. Pvt. Ltd., Delhi.
2. M.S. Jolly, 1987. Appropriate Sericulture Techniques. CSR & TI, Mysore
3. S.R. Ullal and M.N. Narasimhanna, 1987. Hand book of practical sericulture. CSB, Bangalore.
4. M.N. Narasimhanna, 1988. Manual on silkworm egg production. CSB, Bangalore.
5. Dandin, S.B., Jayaswal, J. and Giridhar. K, 2010. Handbook of sericulture technologies, Central Silk Board, Bangalore, India.

Web Resources

1. https://agritech.tnau.ac.in/sericulture/
2. https://csb.gov.in/
3. https://silks.csb.gov.in/
4. https://www.britannica.com/topic/sericulture
5. https://agritech.tnau.ac.in/sericulture/seri_index.html
6. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/sericulture
7. https://vikaspedia.in/agriculture/farm-based-enterprises/sericulture/sericulture-in-india

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2 – Medium, 1 - Low

SEMESTER II

ELECTIVE LAB COURSE II: ECONOMIC ENTOMOLOGY AND RESEARCH METHODOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total hours	Marks		
								CIA	External	Total
ZP232EP1	2	1	-	1	3	2	30	25	75	100

Pre-requisite:

Students should have knowledge relevant to economic entomology & research methodology.

Learning Objectives:

1. To equip students with skills in both the practical aspects of economic entomology and the essential research methodology.
2. To acquire skills necessary for conducting meaningful studies in these field.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	comprehend the principles and concepts of economic entomology & research methodology.	**K1**
2.	summarize the economic impact of insect pests. explain the principles behind different ttechniques & research designs	**K2**
3.	utilize appropriate methodologies to collect and analyze data of insects and apply statistical techniques to interpret and draw conclusions.	**K3**
4.	interpret practical solutions to address challenges in economic entomology, incorporating research methodology principles.	**K4**
5.	evaluate research methodologies and experimental designs used in economic entomology studies.	**K5**

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

Economic Entomology

1. Collect and identify common insect pests in your local environment.
2. Dissection: Silk glands of silkworm.
3. Mounting: Mouth parts of honey bee. Mosquito.
4. Phototactic behavior of insect pests.
5. Collection and Identification of insect pests in the mulberry plants.

Specimen/Spotters/Models: Silk worm larva, pupa and adult, honey bee colony, Rhinoceros beetle, Red Palm Weevil, Banana Stem Weevil.

Research Methodology

1. Whole mount preparation of two specimens.
2. Separation of amino acids using thin layer chromatography.
3. Sectioning and staining of a tissue.
4. Separation of pigments by column chromatography using plant extract (Demonstration).
5. Agarose Gel electrophoresis (Demonstration).

Instruments/ Charts/ Models: Phase contrast microscope, fluorescent microscope, spectrophotometer, HPLC, flame photometer, microtome, electrophoretic apparatus.

Textbooks

1. Bajia, R., R.N. Kencharaddi, B. Bairwa, K. Kumar, V. Kumar. *Practical handbook on fundamentals of entomology.* Second edition. Kalyani Publishers. Chennai.
2. Gurumani N, 2019. *Research Methodology: For Biological Sciences.* Kindle Edition. Chennai.

Reference Books

1. Trigunayat, M.M, 2016. *A Manual of Practical Entomology*. 3rd Ed. Scientific Publishers. Jodhpur, Rajasthan.
2. Agrawal, N, 2022. *Fundamental Entomology: A Practical Manual*. Narendra Publishing House, New Delhi.
3. Ch Raja Goud, 2022. *Practical Manual on Fundamentals of Entomology*. Om Publishers. New Delhi
4. Vinayak Bairagi & Mousami Vaibhav Munot, 2019. *Research Methodology: A Practical and Scientific Approach*. CRC press. Florida, United States.
5. Catherine Dawson, 2002. *Practical Research Methods*: *A User-Friendly Guide to Mastering Research Techniques and Projects*. Ubs Publishers' Distributors Pvt.Ltd. Ernakulam, Kerala.

Web Resources

1. https://www.researchgate.net/publication/327282644_A_Textbook_of_Economic_Entomology_M_Dayib
2. https://academic-accelerator.com/encyclopedia/economic-entomology
3. https://books.google.co.in/books?id=z2s6nQAACAAJ&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false
4. https://jru.edu.in/studentcorner/labmanual/agriculture/Insect%20morphology%20and%20%20systematics.pdf
5. https://www.scribbr.com/dissertation/methodology/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2 – Medium, 1 - Low

SEMESTER II

SKILL ENHANCEMENT COURSE I: POULTRY FARMING

Course Code	L	T	P	S	Credits	Inst. Hours	Total hours	Marks		
								CIA	External	Total
ZP232SE1	2	1		1	2	4	60	25	75	100

Pre-requisite

Students should be aware of economic and cultural importance of Poultry farming**.**

Learning Objectives:

1. To know the needs for Poultry farming and the status of India in global market.
2. Acquire the skills to apply the techniques and practices needed or Poultry farming.

Course Outcomes:

On the successful completion of the course, students will be able to:		
1.	recall the key components of a poultry house to ensure optimal living conditions for poultry.	**K1**
2.	explain the different methods of rearing and the significance of proper vaccination programs in poultry farming.	**K2**
3.	develop a practical feeding plan for a specific stage of poultry considering their nutritional requirements.	**K3**
4.	analyze the impact of different housing systems on poultry welfare and productivity,	**K4**
5.	critically assess the effectiveness of poultry feeds and the disease control measures in poultry farming,	**K5**
6.	design a comprehensive waste management and recycling system for poultry farms.	**K6**

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

Unit	Contents	No. of hours
I	General introduction to poultry farming - Definition of Poultry - Past and present scenario of poultry industry in India - Principles of poultry housing - Poultry houses - Systems of poultry farming	**12**
II	Management of chicks - growers and layers - Management of Broilers. - Preparation of project report for banking and insurance.	**12**
III	Poultry feed management-Principles of feeding, Nutrient requirements for different stages of layers and broilers - Feed formulation and Methods of feeding.	**12**
IV	Poultry diseases-viral, bacterial, fungal and parasitic (two each); symptoms, control and management; Vaccination programme.	**12**
V	Selection, care and handling of hatching eggs - Egg testing. Methods of hatching. - Brooding and rearing -. Sexing of chicks. - Farm and Water Hygiene - Recycling of poultry waste.	**12**
	Total	**60**

Textbooks

1. Sreenivasaiah., P. V, 2015. *Textbook of Poultry Science*. 1st Edition. Write & Print Publications, New Delhi.
2. Jull A. Morley, 2007. *Successful Poultry Management*. 2nd Edition. Biotech Books, New

Delhi.

Reference Books

1. Jadhav, J, Siddique, M.F., Kavitha Meena, 2019. *Handbook of Poultry Production and Management*. 3rd Edition. Jaypee Brothers Medical Publishers, Chennai.
2. Jagdish Prasad, 2015. *Poultry Production and Management Paperback – 1*. 5h Edition Kalyani Publishers, Chennai.
3. Das, D, 2021. *Textbook on Poultry Management.* Narendra Publishing House, New Delhi.
4. Eiri Board, 2008. *Hand Book of Poultry Farming and Feed Formulations*. Engineers India Research Institute. India.
5. Sharma R P et al. *Poultry Production in India*. Poultry Science, India.

Web Resources

1. https://dahd.nic.in/sites/default/filess/Excerpts%20of%20Poultry%20Farmn%20Manual.pdf
2. https://www.fao.org/3/i3531e/i3531e.pdf
3. https://egyankosh.ac.in/bitstream/123456789/59735/1/Poultry%20farming%20in%20india.pdf
4. https://seyianwo.files.wordpress.com/2015/04/poultry-lecture-note.pdf
5. https://surendranathcollege.ac.in/new/upload/SUMAN_TAMANGPoultry%20Farming2021-02-14Poultry%20Farming-converted.pdf

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	1	2	2	2	2	1	1	3	3	3
CO2	1	1	2	3	1	2	2	1	2	2	1	2
CO3	2	1	2	2	1	3	2	1	2	2	2	2
CO4	3	2	1	2	1	2	1	2	2	1	1	1
CO5	1	2	2	2	2	2	3	2	3	2	2	3
CO6	2	3	3	2	3	3	3	3	2	3	2	2
TOTAL	**13**	**11**	**11**	**14**	**10**	**14**	**13**	**10**	**12**	**13**	**11**	**13**
AVERAGE	**2.1**	**1.8**	**1.8**	**2.3**	**1.6**	**2.3**	**2.1**	**1.6**	**2**	**2.1**	**1.8**	**2.1**

3 – Strong, 2 – Medium, 1 - Low

SEMESTER I & II

LIFE SKILL TRAINING I: ETHICS

Course Code	L	T	P	S	Credits	Inst Hours	Total Hours	Marks		
								CIA	External	Total
PG23LST1	1	-	-	-	1	1	15	50	50	100

Prerequisites:

Value education-its purpose and significance in the present world

Learning Objectives

1. To familiarize students with values of the individual, society, culture, one's own health and life philosophy,
2. To impart knowledge of professional ethical standards, codes of ethics, obligations, safety, rights, and other worldwide challenges.

Course Outcomes

On completion of this course the student will be able to		
1	understand deeper insight of the meaning of their existence.	K1
2	recognize the philosophy of life and individual qualities	K2
3	acquire the skills required for a successful personal and professional life.	K3
4	develop as socially responsible citizens.	K4
5	create a peaceful, communal community and embrace unity.	K3

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

Unit	Contents	No. of Hours
I	**Goal Setting:** Definition - Brainstorming Session – Setting Goals – Few components of setting goals.	3
II	**Group Dynamics:** Definition - Nature of Groups – Types of Groups – Determinants of group behavior	3
III	**Conflict Resolution:** Definition – What is a conflict resolution – Wh should conflicts be resolved? - Lessons for life	3
IV	**Decision Making:** Definition – 3C's of decision making – Seven Steps to effective decision making – Barriers in effective decision making	3
V	**Anger Management:** Effects of anger – Tips to reduce anger – Anger warning signs – Identify your triggers – Ways to cool down your anger.	3
TOTAL		15
Self-Study: Salient values for life, Human Rights, Social Evils and how to tackle them, Holistic living, Duties and responsibilities.		

Textbooks

1. Life Skill Training – I Ethics, Holy Cross College (Autonomous), Nagercoil

Reference Books

1. Holy Cross College (Autonomous), Nagercoil (2007). Foundation Course Life's Challenges. Sipca Computers.
2. Mathew, Sam (2010). Self Help Life Book. Opus Press Publisher.

3. Swati Mehrotra. (2016). Inspiring Souls Moral Values and Life Skills (1st ed.) [English]. Acevision Publisher Pvt. Ltd.
4. Irai Anbu, v. (2010, August). Random Thoughts (1st ed.) [English]. THG Publishing Private Limited, 2019.
5. Holy Cross College (Autonomous), Nagercoil (2007). Foundation Course Life's Challenges. Sipca Computers.

Web Resources

1. https://positivepsychology.com/goal-setting-exercises/
2. https://www.gov.nl.ca/iet/files/CCB_GroupDynamicsGuide.pdf
3. https://en.wikipedia.org/wiki/Conflict_resolution
4. https://asana.com/resources/decision-making-process
5. https://www.mayoclinic.org/healthy-lifestyle/adult-health/in-depth/anger-management/art-20045434

SEMESTER III

CORE COURSE V: GENETICS AND EVOLUTION

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP233CC1	5	-	-	1	5	6	90	25	75	100

Pre-requisite:

Students should have a foundational understanding of basic biological concepts.

Learning Objectives:

1. To explore the molecular principles of heredity and the evolutionary processes.
2. To develop skills to assess heritability, identify genetic disorders, and construct phylogenetic trees.

Course Outcomes

On the successful completion of the course, students will be able to:		
1	relate the principles of inheritance and evolution.	K1
2	describe the mechanisms of heredity and speciation.	K2
3	apply the genetic and evolutionary concepts to real-world scenarios.	K3
4	analyse the cause for variation and adaptation.	K4
5	evaluate the impact of genetic variation on biodiversity.	K5

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

Units	Contents	No. of Hours
I	**Mendelian Genetics**: Mendelian principles. Gene interactions - complementary, supplementary and epistatic, Multiple allelism. Linkage and crossing over – types – mechanism – theories. Chromosome mapping - linkage maps, tetrad analysis, mapping with molecular markers and somatic cell hybrids. Polygenic inheritance. Heritability and its measurements.	18
II	**Molecular and Human Genetics**: Gene concept. Mutation – types and effects of gene mutation - mutagens - Chromosomal mutation. DNA damage and repair. Human chromosomes, Karyotyping, Chromosomal banding and painting. Pedigree analysis. Genetic Disorders - Phenylketonuria, Alkaptonuria, albinism, Gout, ADA deficiency, Von Gierke's disease, G6PD deficiency, Tay Sach's disease, Gaucher's disease, sickle cell anemia, thalassemia. Genetic counseling.	18
III	**Population Genetics and Evolution**: Mendelian populations - Hardy Weinberg law and genetic equilibrium. Calculation of gene frequencies for autosomal - dominant and recessive alleles, codominant alleles and multiple alleles. Elementary evolutionary forces. Genetic load and death, neutralist hypothesis, genetic polymorphism.	18
IV	**Molecular evolution**: Origin of life. Principles of molecular evolution studies. Molecular clock. Phylogenetic tree - Distance Matrix and Parsimony based approach - kinds of molecular phylogenies – Universal Tree of Life. Phylogenetic and biological concept of species. Speciation - allopatry and sympatry. Adaptive radiation.	18
V	**Origin of higher categories**: Major trends in the origin of higher categories. Microevolution, macroevolution, mega evolution and	18

	coevolution. Evolution rates, phyletic gradualism and punctuated equilibrium. Origin and Evolution of Primates: Evolution of Anthropoid Primates - The first hominids - Australopithecines and origin of modern man. Bipedalism – communication - speech - language - altruism and morality.	
	Total	**90**

Self-study	Mendelian principles, Polygenic inheritance, Gene concept. Pedigree analysis. Hardy Weinberg law, Elementary evolutionary forces, Origin of life, Speciation - allopatry and sympatry, Microevolution, macroevolution, mega evolution and coevolution. origin of modern man

Textbooks:

1. Verma, P.S., Agarwal, V.K. 2010. *Genetics* (9th ed.), S. Chand Publishing, New Delhi.
2. Sanjib Chattopadhyay. 2008. *Evolution, Adaptation and Ethology*. Books and Allied Pvt. Ltd., Kolkata.

Reference Books:

1. Peter Snustad, D., Michael J. Simmons. 2009. *Principles of Genetics* (5th ed.). John Wiley & Sons, Inc. USA.
2. Monroe W. Strickberger. 2015. *Genetics* (3rd ed.). Pearson Education, India.
3. Arora, M.P. 2000. *Organic Evolution*. Himalaya Publish House, Mumbai.
4. Ahuja, N. 2008. *Evolution and Population Genetics*. Pearl Books, New Delhi.
5. Eldon John Gardner, Michael J. Simmons, Peter Snustad, D. 2005. *Principles of Genetics* (8th ed.). Wiley (India) Pvt. Ltd., New Delhi.

Web Resources:

1. https://en.wikipedia.org/wiki/Mendelian_inheritance
2. https://en.wikipedia.org/wiki/Genetics
3. https://en.wikipedia.org/wiki/Population_genetics
4. https://en.wikipedia.org/wiki/Molecular_evolution
5. https://en.wikipedia.org/wiki/Evolution_of_primates

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	3	1	2	2	3	3	1	1	1	1
CO2	3	3	3	1	2	2	3	3	1	2	3	1
CO3	3	2	3	2	1	2	3	3	3	3	2	3
CO4	3	2	2	2	1	2	3	3	2	3	2	2
CO5	3	1	2	1	3	2	3	3	2	2	3	2
TOTAL	**15**	**9**	**13**	**7**	**9**	**10**	**15**	**15**	**9**	**11**	**11**	**9**
AVERAGE	**3**	**1.8**	**2.6**	**1.4**	**1.8**	**2**	**3**	**3**	**1.8**	**2.2**	**2.1**	**1.8**

3 – Strong, 2- Medium, 1- Low

SEMESTER III

CORE COURSE VI: ADVANCED ANIMAL PHYSIOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP233CC2	5	-	-	1	5	6	90	25	75	100

Pre-requisite:

Students should have fundamentals of different organ system.

Learning Objectives:

1. To impart knowledge on the structure and functions of various organs, organ systems and associated disorders.
2. To develop skills relevant for pursuing higher education and apply the knowledge in their life.

Course Outcomes

On the successful completion of the course, students will be able to:		
1	recall the structure and functions of organ systems.	**K1**
2	compare the structure, functions and regulation of the different organs and organ systems of animals.	**K2**
3	relate the functions of different organ system in maintaining homeostasis.	**K3**
4	analyze the physiological changes in relation to environmental conditions.	**K4**
5	evaluate the effect of physical factors on physiological functioning of different organs.	**K5**

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

Units	Contents	No. of Hours
I	**Nutrition**: types of nutrition and feeding mechanisms in animals. Digestion - functional anatomy of the digestive system of man, Movements of gastrointestinal tract, Secretory functions of the alimentary tract and glands, digestion and absorption. Gastrointestinal disorders - Gallstones, liver cirrhosis, gastritis, peptic ulcer and appendicitis.	**18**
II	**Respiration and Homeostasis**: Functional anatomy of the respiratory system of man, transport of respiratory gases, regulation of respiration, respiratory problems - bronchial asthma, pneumonia and pulmonary tuberculosis. Homeostasis - Osmoregulation - types and mechanism, Thermoregulation – classification and mechanism, Deep Sea physiology, High altitude and space physiology, Bioluminescence - physiology and functions.	**18**
III	**Circulation**: Haemopoiesis, Blood clotting. Myogenic and neurogenic heart. Functional anatomy of the human heart, cardiac cycle, pacemaker, heart rate, regulation of cardio-vascular system. heart diseases - atherosclerosis, coronary thrombosis and angina pectoris, Angiogram and Angioplasty. Lymphatic system - organization, composition and functions.	**18**
IV	**Neuro-muscular system**: Structure neuron, neurotransmitters, synapse, nerve impulse conduction, reflex activity, electroencephalogram (EEG), MRI, Neural disorders - meningitis and epilepsy. Types of muscle, structure and properties of skeletal muscle, mechanism of muscle	**18**

	contraction, neuromuscular junction. Sense organs - structure and functions of skin and eye.	
V	**Excretion and Reproduction**: Patterns of excretion, structure and function of kidney of man, nephron, formation of urine – counter current mechanism, micturition, renal disorders – nephritis, renal calculi, dialysis. Structure of testis and ovary (human), oestrus and menstrual cycle, ovulation, pregnancy, parturition and lactation, hormonal regulation of reproduction.	**18**
	Total	**90**

Self-study	Feeding mechanisms in animals.

Textbooks:

1. Sembulingam, K. & Prema Sembulingam 2013., *Essentials of Medical Physiology (*6th ed.). Jaypee Brothers Medical Publishers Pvt. Ltd., Bangalore
2. Nagabushanam, R., Kadarkar, M.S. & Sarojini, R., 2002. *Textbook of Animal Physiology.* Oxford and IBH Publishing Company, New Delhi.

Reference Books:

1. Guyton & Hall, 2010. *Textbook of Medical Physiology* (12th ed.). John E. Hall, Saunders Elsevier, Philadelphia
2. William. S. Hoar, 1984. *General and Comparative Animal Physiology* (2thed.). Prentice Hall of India.
3. Prosser, C. L., 1991. *Comparative Animal Physiology* (4th ed.). John Wiley and Sons Ltd., United States
4. Nielsen Knut Schmid, 2007. *Animal Physiology, Adaptation and Environment* (5th ed.). Cambridge University Press.
5. Rastogi, S.C., 2007. *Essentials of Animal Physiology* (6th ed.). JBA Publishers. New Delhi

Web Resources:

1. https://www.acko.com/health-insurance/health-guides/types-of-nutrition-and-nutrients/
2. https://www.zoologytalks.com/bioluminescence-in-animals/
3. https://www.zoologytalks.com/respiratory-pigments/
4. https://students.aiu.edu/submissions/profiles/resources/onlineBook/d5X2x8_practical-physiology-nutrition.pdf
5. https://www.hoddereducation.com/media/Documents/International/Biology-for-the-IB-Diploma/Biology-for-the-IB-Diploma_Chapter-11-Summary.pdf

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	2	3	3	2	3	3	3	3	3	3
CO2	2	3	2	3	3	2	3	3	3	3	3	3
CO3	3	3	2	3	3	2	3	3	1	3	1	1
CO4	3	3	2	3	3	2	3	3	3	3	3	3
CO5	3	3	2	3	3	2	3	3	3	3	3	3
TOTAL	**15**	**15**	**10**	**15**	**15**	**10**	**15**	**15**	**13**	**15**	**13**	**13**
AVERAGE	**3**	**3**	**2.0**	**3**	**3**	**2**	**3**	**3**	**2.6**	**3**	**2.6**	**2.6**

3 – Strong, 2- Medium, 1- Low

SEMESTER III

CORE LAB COURSE III: LAB ON GENETICS AND EVOLUTION AND ADVANCED ANIMAL PHYSIOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP233CP1	-	-	6	-	5	6	90	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.	explain the fundamental principles of Mendelian inheritance, population genetics, adaptive radiation and function of organ and organ systems	**K1**
2.	interpret the importance of genic inheritance, changes in gene and gene frequencies in a population and physiology of the organ system.	**K2**
3.	apply the genetic, evolutionary, and physiological concepts.	**K3**
4.	analyse the causes of genetic variation, adaptation and physiological changes.	**K4**
5.	design experiments based on Hardy-Weinberg Law, enzyme activity and effect of physical factors on physiological activities.	**K5**

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

Units	Contents	No. of Hours
	GENETICS AND EVOLUTION	
1	Demonstration of dihybrid cross using beads.	**45**
2	Identification of sex and mutant forms of *Drosophila*.	
3	Observation of frequency of the following Mendelian genetic traits in a human population: widow's peak, attached ear lobe, dimple in chin,	
4	Study of mode of inheritance of the following Mendelian traits by pedigree charts: interlocking of fingers, ABO blood group	
5	Calculation of gene frequencies of multiple alleles (ABO blood group) using Hardy-Weinberg formula.	
6	Demonstration of natural selection using beads.	
7	Demonstration of genetic drift using beads.	
8	Study of analogy (wings of animals).	
9	Study of homology (fore limbs and hind limbs of vertebrates).	
10	Study of adaptive radiations in feet and beaks of birds.	
Charts/ Slides/ Models/ Bookplates/ Instruments: Karyotype of syndromes (Down's syndrome, Klinefelter's syndrome and Turner's syndrome), Chromosomal banding, Fossils (Ammonite, Trilobite, Nautiloid fossil), Geographical isolation (Indian and African Elephants), Seasonal Isolation (Sea Urchin), Phylogram, Universal Tree of Life		

	ADVANCED ANIMAL PHYSIOLOGY	
1	Effect of temperature on heart rate of Freshwater Mussel	**45**
2	Effect of temperature on salivary amylase activity and calculation of Q10	
3	Effect of pH on salivary amylase activity.	
4	Salt loss and salt gain in a freshwater fish.	
5	Examine the relative activity of enzymes in the fore, mid, and hindgut of a typical insect	
6	Examination of excretory products of fish, bird and mammals	
7	Counting of blood cells using a hemocytometer.	
8	Haemolysis of blood – Demonstration.	
9	Observation of haemin crystals in blood.	
10	Estimation of haemoglobin.	
Charts/ Slides/ Models/ Bookplates/ Instruments: EEG, ECG, Conditional reflex, Skeletal muscle, Kymograph, Sphygmomanometer, Intestine, Nervous tissue, Liver, Lungs, Heart, Kidney.		

Textbooks:

1. Don W. Bailey, 1983. *Laboratory Manual for Animal Physiology* (2nd edition) Tichenor Publication. Michigan State University.
2. Lal, S.S. 2004. *A textbook of Practical Zoology Vertebrate.* Rastogi Publications, Meerut.

Reference Books:

1. Mark Beaumont, 2025. *Genetic Data Analysis for the Evolutionary Biologist*. University of Bristol, UK.
2. Rashmi Ramanathan. 2023. *Physiology Practical Manual.* Elsevier; 1st ed, India.
3. Sinha, J., Chatterjee, A.K., Chattopadhyay. 2011. *Advanced Practical Zoology*. Books and Allied (P) Ltd. Kolkata.
4. Abraham, J.C.B. 1987. *Evolution: A laboratory Manal*. MacMillian India Ltd. Delhi.
5. Mali, R.P.& Afsar S.K., 2015 *A Practical Manual on Innovative Animal Physiology* Oxford Book Company, Kochi, Ernakulam, Kerala.

Web Resources:

1. https://www.youtube.com/watch?v=1QU2phs-hws
2. https://www.youtube.com/watch?v=NTKPDlXRuFo
3. https://www.youtube.com/watch?v=u4SnmXMuwsg
4. https://students.aiu.edu/submissions/profiles/resources/onlineBook/d5X2x8_practical-physiology-nutrition.pdf
5. https://www.sethtichenor.com/files/Tichenor&Yaruss_2020b_PP.pdf

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO 5
CO1	3	3	3	3	3	2	3	3	3	2	3	3
CO2	3	3	2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	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	2	3	3	3	2	3	3
TOTAL	**15**	**15**	**14**	**15**	**15**	**13**	**15**	**15**	**15**	**13**	**15**	**15**
AVERAGE	**3**	**3**	**2.8**	**3**	**3**	**2.6**	**3**	**3**	**3**	**2.6**	**3**	**3**

3 – Strong, 2- Medium, 1- Low

SEMESTER III
CORE RESEARCH PROJECT

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP233RP1	-	-	5	-	4	5	75	25	75	100

Pre-requisite:

Basic knowledge of research skills, and writing academic reports while adhering to ethical guidelines.

Learning Objectives:

1. To enable students to design experiment, analyze data and interpret results.
2. To develop skills to identify subject related problems in the neighborhood and report to the scientific community.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	learn to manage research projects, adhering to timelines, and effectively adapting to challenges.	**K1**
2.	understand ethical considerations in research, collaborate effectively with peers and advisors, and maintain integrity throughout the research process.	**K2**
3.	conduct independent research, proficiently formulating research questions, designing methodologies, and gathering relevant data.	**K3**
4.	communicate research findings clearly and persuasively through well-structured written reports and articulate oral presentations.	**K4**
5.	develop critical thinking skills, analyzing findings and drawing informed conclusions.	**K5 & K6**

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

Guidelines for Project Work

- **Project Undertaking**: All students must undertake a project during the III semester.
- **External Projects**: Students, with the consent of the Supervisor, HoD, and Principal, can pursue their project in another institution, especially those with MoU/Collaboration agreements, for successful completion of the project work.
- **Review Schedule**: There will be two reviews during the months of August and September.
- **Presentation Mode**: Presentations should be made using PowerPoint.
- **Completion**: The dissertation must be completed within the stipulated time.
- **Plagiarism:** Respect academic integrity by acknowledging sources appropriately to uphold scholarly credibility.
- **Submission Requirements**: Submission should include one soft copy (PDF format on CD) and three hard copies (soft binding), duly signed and endorsed by the Supervisor and the Head.

Dissertation Framework Format

General Formatting

- **Font**: Times New Roman
- **Heading**: Font size 14 (Bold) - Uppercase

- **Subheadings**: Font size 12 (Bold) - Lowercase; should be numbered (e.g., Introduction 1; Subheading 1.1; 1.2 …)
- **Text Content**: Font size 12 (Normal)
- **Citation**: Any works of other researchers, if used either directly or indirectly, should be indicated at appropriate places in the text.

Dissertation Structure

The dissertation will have three main parts:

I. Initial Pages

1. Title Page
2. Certificate from the Supervisor
3. Declaration by the candidate, endorsed by the Supervisor and HoD
4. Acknowledgment (within one page, signed by the candidate)
5. Table of Contents
6. List of Abbreviations
7. Abstract

II. Main Body of the Dissertation

1. Introduction with Literature Review and Objectives
2. Methodology
3. Results
4. Discussion
5. Summary
6. References (DOI numbers of journals can be included)

III. Appendices

- Primary data, articles published during the tenure of the program, if any.

Additional Formatting

- **Line Spacing**: 1.5
- **Margins**: 2" on the left, 1" on the right, Gutter 0.5"
- **Page Numbering**: Bottom middle alignment, excluding initial pages and references
- **Total Pages**: Minimum 30 - Maximum 50 (excluding initial pages and references)
- **Tables and Figures**: Should be included subsequently after referring to them in the text of the thesis
- **Printing**: The thesis chapters should be printed on both sides of the paper.

Guidelines for References

1. Journal Article: Single Author

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

2. Journal Article: Two Authors

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

3. Journal Article: More than Two Authors

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

4. Books

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

5. E-book

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

6. Conference Proceeding Paper with Editors

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

7. Conference Proceeding Paper without Editors

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

8. Website

Australian Securities Exchange 2009, *Market Information*. Available from: http://www.asx.com.au/professionals/market_information/index.htm. [5 July 2009].

9. Patent

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

10. Thesis: Unpublished

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

11. Newspaper: Print

Ionesco, J 2001, 'Federal election: new chip in politics', *The Advertiser*, 23 October.

Reference List Order

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER III

ELECTIVE COURSE V: a) ANIMAL BEHAVIOUR AND CHRONOBIOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP233EC1	2	1	-	1	3	4	60	25	75	100

Prerequisite

Students should have the basic understanding of animal biology, strong observational and analytical skills.

Learning Objectives

1. To understand the biological aspects of animal behaviour, focusing on evolution and ecology.
2. To develop hands-on skills essential for studying and analyzing animal behaviour.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	attain a thorough comprehension of the fundamental principles concerning genetics, evolution, perception, learning, decision-making, and chronobiology in animal behaviour.	**K1**
2.	elucidate the evolutionary and ecological elements impacting social behaviour, the interplay between animal physiology and behaviour, the intricacies of decision-making processes in animals, and the principles underlying biological clocks.	**K2**
3.	interpret animal behaviour patterns, social behaviour dynamics, predict and manage animal physiology and behaviour, solve behavioural problems, optimise human health and well-being.	**K3**
4.	critically analyse and assess the impact of environmental changes on physiology and behaviour, evaluate the decision-making processes in complex behavioural scenarios and role of biological clocks in human health and disease management.	**K4 & K5**

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

Units	Contents	No. of hours
I	**Understanding Animal Behaviour** : Significance and need for studying animal behavior, Approaches to behavioural studies, Genetic basis of behavior, Heritability of behaviour, Habitat and its impact on influencing behavior, Social interactions and their role in shaping behavior, Ethology and recording animal behaviour.	**12**
II	**Evolution and Social Behavior: I**mpact of natural selection on social behavior, sexual selection, altruism, mating systems, sexual strategies. Exploring social organization and animal perception, communication within social animals, group living dynamics, parental care, visual adaptations in challenging environments.	**12**
III	**Animal and the Environment:** Habitat selection, Coordination and Orientation, Homeostasis and Behaviour, Physiology and Behaviour in changing environments, Conditioning and Learning, Biological aspects of learning, Cognitive aspects of learning. Foraging behaviour, Competition, Environmental challenges and stressors.	**12**

IV	**Understanding Complex Behaviour:** Instinct, learning, Cognition and Memory, Decision making behaviour in Animals, Mechanism of Decision making, Complex reproductive behaviours, Complex behaviour of honey bees, Languages and mental representation, Animal awareness and Emotion.	**12**
V	**Chronobiology**: Circadian Rhythm, Biological Clock, Concept of central and peripheral clock system; Circadian pacemaker system; Photoperiodism, Influence of circadian rhythms on mating, feeding, and other behaviors, Ultradian and Infradian Rhythms, Chronobiology and Aging, Chrono pharmacology, chrono medicine, chronotherapy.	**12**
	Total	**60**

Self-study	Visual adaptations in challenging environments., Cognition and Memory, Decision making behaviour in Animals

Textbooks

1. Agarwal, V.K. 2009. *Animal Behaviour* (*Ethology*). S. Chand and Company Ltd. New Delhi
2. Sanjib Chattopadhyay. 2012. *Life: Evolution, Adaptation and Ethology*. Books and Allied (P) Ltd. Kolkata

Reference Books

1. Chandrashekaran, M.K. 1985. *Biological Rhythms*. Madras Science Foundation.
2. Mohan P. Arora. 2016. *Animal Behavior*. Himalaya Publishing House, Chennai.
3. Auprey Manning and Mariam Stamp Dowkins. 2012. *An Introduction to Anima behavior*. Cambridge University Press, UK
4. Saha T. K. 2009. *An Introduction to Animal Behaviour*. Emkay Publications, Delhi
5. Machve K. K. 2016. *Evolution of Animal Behaviour*. Manglam Publications, Thiruvananthapuram

Web Resources

1. https://www.ncbs.res.in/content/animal-behaviour
2. https://bit.ly/3i6wUxR
3. https://www.behaviour.univie.ac.at/
4. http://www.apiindia.org/pdf/progress_in_medicine_2017/mu_75.pdf
5. https://www.pharmatutor.org/articles/chronopharmacology-overview

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER III

ELECTIVE COURSE V: b) BIOTECHNOLOGY AND NANOBIOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP233EC2	3	-	-	1	3	4	60	25	75	100

Pre-requisite:

Students should have fundamentals of Biotechnology and Nanobiology.

Learning Objectives:

1. To enable the students to understand the essence of biotechnology and become aware of the advances in Nanobiology.
2. To develop skills to apply biotechnological principles in research related to genetic manipulations, industrial and environmental biotechnology.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	explain the various techniques used in modern biotechnology.	**K1**
2.	outline the basic concepts of Biotechnology and Nanobiology, its application and threat to the society.	**K2**
3.	apply the biotechnological principles in research and judicial use of bio- and nanotechnology to solve societal problems.	**K3**
4.	analyze the impact of biotechnological products and genetically modified organisms in bioremediation.	**K4**
5.	evaluate the function, gene modulation and their effects on improvement of crops and animals after the applications of cloned genes.	**K5**

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

Units	Contents	No. of Hours
I	**Gene cloning**: Basic steps of gene cloning, restriction and modifying enzymes, linkers and adaptors, cloning and expression vectors, construction of chimeric DNA, nucleic acid probes, DNA libraries, blotting techniques, molecular markers, DNA sequencing, synthesis of oligonucleotides.	**12**
II	**Animal Biotechnology**: Culture media, primary culture and cell lines, pluripotent stem cell lines, tissue engineering. *In vitro* fertilization and embryo transfer in animals; gene transfer methods. Primary explanation techniques – organ and embryo culture.	**12**
III	**Medical and Enzyme Biotechnology**: Medical Biotechnology - hybridoma technology and monoclonal antibodies – applications of biotechnology in medicine, vaccines. Gene therapy – pharmacogenomics. Enzyme biotechnology - isolation and purification of enzymes, uses of enzymes in industries, immobilization of enzymes and their uses, Biosensors.	**12**
IV	**Industrial and Environmental Biotechnology**: Industrial Biotechnology -design of fermenter, sterilization, media design, production of metabolites - downstream processing, microbial biotransformation, microbial biomass production (SCP). Environmental Biotechnology - bioremediation and phytoremediation - genetically engineered microorganisms (GEMs) - treating oil spills, Biomining and	**12**

	Biofuels.	
V	**Nano Biotechnology**: Nanomaterials - types and properties, DNA and protein nanoarrays, biosystems (microbes) as nano factories. Application of nanotechnology - medical diagnostics, drug delivery, dental implants, cosmetics, agro-practices and nano food products. Risks and threats of nanoparticles in the environment.	**12**
	Total	**60**

Self-study	Gene therapy, bioremediation and phytoremediation

Textbooks:

1. Satyanarayana V. 2004. *Biotechnology.* Books and Allied (P) Ltd., Kolkata.
2. Singh B.D. 2003. *Biotechnology - Expanding Horizons.* Kalyani Publishers, Chennai.

Reference Books:

1. Gupta P.K, 2009. *Elements of Biotechnology*. Rastogi Publications, Meerut.
2. Dubey R.C. 2006. *A Textbook of Biotechnology* (4th ed). S. Chand and Co. Ltd., New Delhi
3. Prakash S. Lohar, 2012. *Biotechnology.* MJP publishers, Chennai
4. Madhuri Sharon, Maheshwar Sharon, Sunil Pandey & Goldie Oza 2012. *Bio Nanotechnology: Concepts and Applications.* Ane Books Pvt. Ltd., New Delhi.
5. Vinod Labhasetwar & Diandra. L. Leslie-Pelecky, 2007. *Biomedical applications of Nanotechnology.* Wiley Publications, New Jersey.

Web Resources:

1. https://www.youtube.com/watch?v=vi7MeqD2_FY
2. https://byjus.com/biology/pcr/
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5178364/
4. https://www.nature.com/scitable/topicpage/genetically-modified-organisms-gmos-transgenic-crops-and-732/
5. https://en.wikipedia.org/wiki/Nanotechnology

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	3	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	3	2	2	2	2	2	3	3	2	2
CO5	1	3	2	2	1	3	3	3	2	2	3	2
TOTAL	**10**	**13**	**12**	**12**	**11**	**13**	**12**	**14**	**13**	**13**	**13**	**12**
AVERAGE	**2**	**2.6**	**2.4**	**2.4**	**2.2**	**2.6**	**2.4**	**2.8**	**2.6**	**2.6**	**2.6**	**2.4**

3 – Strong, 2- Medium, 1- Low

SEMESTER III
ELECTIVE COURSE V: c) BIOINFORMATICS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP233EC3	2	-	1	1	3	4	60	25	75	100

Pre-requisite:

Students should have fundamentals knowledge on sequences and their alignment.

Learning Objectives:

1. To enable the students to understand the tools of bioinformatics.
2. To trace the evolutionary history of living organisms. aware

Course Outcome

On the successful completion of the course, students will be able to:		
1	define the scope and applications of bioinformatics in biological research and data analysis.	**K1**
2	explore methods for querying, retrieving, and interpreting data from biological databases.	**K2**
3	apply sequence alignment techniques to identify similarities, homologies, and evolutionary relationships between biological sequences.	**K3**
4	make phylogenetic predictions or prediction of structure of proteins and nucleic acids	**K4**
5	trace the evolutionary relationship among different organisms.	**K5**

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

Units	Contents	No. of Hours
I	Bioinformatics data and databases: Genomic survey sequences; Primary Databases: - GenBank, EMBL, DDBJ; Composite Databases: - NRDB, UniProt. Introduction to data retrieval systems, Search engines, Entrez, sequence retrieval system (SRS) and protein identification resource (PIR). Types of Biological data: Genomic DNA, Complementary DNA, Recombinant DNA.	**12**
II	**Data base management**: Introduction to data archiving systems (FASTA format, Accession, and GI-Number). Literature Databases: - Open access and open sources, PubMed, PLoS, Biomed Central, NAR databases; Bioinformatic Resources: - NCBI, EBI, ExPASy, RCSB.	**12**
III	Bio informatic Software, packages: Introduction to molecular sequence analysis software packages and tools, Prediction of motifs, folds and domains, Sequences, alignments and Dynamic Programming; Local alignment and Global alignment (algorithm and example), Pairwise alignment (BLAST and FASTA Algorithm) and multiple sequence alignment (Clustal W algorithm).	**12**
IV	Phylogenetic trees: Software and tools: MEGA, Paup, Phylp, GenLyb. Phylogenetic tree: Types, Methods of phylogenetic tree construction. - Parsimony, Maximum likelihood, Neighbourhood joining.	**12**
V	Drug designing: Structure-based drug designing Introduction, Structure-based drug designing approaches: - Target Identification and Validation,	**12**

	homology modeling and protein folding, receptor mapping, active site analysis and pharmacophore mapping.	
	Total	**60**

Textbooks:

1. Barnes, M.R. and Gray, I.C. 2003. *Bioinformatics for geneticists*, Wiley.
2. Martina Bremer and Rebecca W. Doerge (2015). *Using R at the Bench: Step-by-Step Data Analytics for Biologists*. CSHL Press, New York.

Reference Books

1. Stuart M. Brown, 2013. *Next-Generation DNA Sequencing Informatics.* CSHL Press New York.
2. David Mount, 2004. *Bioinformatics: Sequence and Genome Analysis* (2nded.). CSHL Press New York.
3. Attwood, T.K. & Parry-Smith, D.J. 2006. *Introduction to Bioinformatics*. Dorling Kindersley Publication, Delhi.
4. Mount, D.W. 2005. *Bioinformatics* (2nd edition), CBS, India.
5. Harisha, S. 2013. *Fundamentals of Bioinformatics*. I.K. Internationals, New Delhi.

Web resources:

1. https://byjus.com/biology/bioinformatics/
2. https://www.lkouniv.ac.in/site/writereaddata/siteContent/202003291612341467kuaum_yadav_Bioinformatics.pdf
3. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBB1609.pdf
4. https://www.slideshare.net/sardar1109/bioinformatics-lecture-notes
5. https://www.vedantu.com/biology/bioinformatics

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	3	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	3	2	2	2	2	2	3	3	2	2
CO5	1	3	2	2	1	3	3	3	2	2	3	2
TOTAL	**10**	**13**	**12**	**12**	**11**	**13**	**12**	**14**	**13**	**13**	**13**	**12**
AVERAGE	**2**	**2.6**	**2.4**	**2.4**	**2.2**	**2.6**	**2.4**	**2.8**	**2.6**	**2.6**	**2.6**	**2.4**

3 – Strong, 2- Medium, 1- Low

SEMESTER III

SKILL ENHANCEMENT COURSE II: DAIRY FARMING

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP233SE1	2	-	1	-	2	3	45	25	75	100

Pre-requisite:

Students should be aware of economic and cultural importance of Dairy farming.

Learning Objectives:

1. To identify and apply effective breeding techniques to enhance the genetic quality of dairy herds.
2. To demonstrate proficiency in designing and implementing feeding plans for specific nutritional needs of different stages of dairy animal.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	categorize cattle breeds and the diverse feed options for livestock.	**K1**
2.	understand the various housing options and the nutritional needs of dairy animals at different life stages.	**K2**
3.	apply breeding techniques and implement managerial parameters to uphold optimal conditions in dairy housing.	**K3**
4.	analyze and explore milk composition and factors leading to spoilage.	**K4**
5.	prepare and asses new variety of dairy products and their nutritional values.	**K5**

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

Units	Contents	No. of Hours
I	Introduction to Dairy Farming - Advantages of dairying - Classification of breeds of cattle - Indigenous and exotic breeds - Selection of dairy cattle. Breeding - artificial insemination - Dairy cattle management - General Anatomy.	**9**
II	Construction of Model Dairy House - Types of Housing (open housing, shed) - layout planning, ventilation, drainage, and waste management. Different Managemental Parameters - Winter Management - Summer Management.	**9**
III	Feedstuffs available for livestock - Roughages -Concentrates - Energy rich concentrates - Protein rich concentrates - Mineral Supplements - Vitamin Supplements - Feed additives - Feeding management - Calves Feeding - Feeding of adults - Feeding of pregnant dairy animals - Feeding pregnant heifer.	**9**
IV	Milk - composition of milk - milk spoilage - pasteurization - role of milk and milk products in human nutrition – Dairy products - Dairying as a source of additional income and employment.	**9**
V	Contagious disease - Common Bacterial (Mastitis; Johne's Disease) – Protozoal (Coccidiosis; Theileriosis) - Helminth (Tapeworm Infections; lung fluke) and Viral Diseases (Foot and Mouth Disease; Infectious Bovine Rhinotracheitis) - Parasitic Infestation (Trypanosomiasis) - Vaccination - Biosecurity.	**9**
	Total	**45**

Self-study	Advantages of dairying, Composition of milk

Textbooks:

1. Pandey B.N. 2019. *Textbook of Dairy Farming,* - 5th Edition, Kalyani Publishers, Ernakulam, Kerala.
2. A.K. Mishra. 2020. Dairy Farming: A Practical Manual for Beginners, 3rd Edition. New Vishal Publications, New Delhi.

Reference Books:

1. Singh, R. K., and Chauhan, M. S., 2020. *Dairy Farming: Principles and Practices*, 1st Edition, Agrobios (India), Jodhpur.
2. Reddy, M. R., 2019. *Modern Dairy Farming: A Practical Guide*, 2nd Edition, BS Publications, Hyderabad.
3. Gupta, S. K., and Sharma, S. K., 2018. *Dairy Production Management*, 3rd Edition, Kalyani Publishers, New Delhi.
4. Pathak, M. C., and Sharma, R. K., 2022. *Dairy Farming Techniques and Management*, 4th Edition, Satish Serial Publishing House, Delhi.
5. Hafez, E. S. E., 1962. Reproduction in Farm Animals, Lea & Fabiger Publisher, Philadelphia.

Web Resources:

1. https://agritech.tnau.ac.in/farm_enterprises/Farm%20enterprises_%20Dairy%20unit.html
2. https://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Tata,+S.N.,+ed%22
3. National Dairy Development Board (NDDB): https://www.nddb.coop/]
4. Indian Council of Agricultural Research (ICAR) - Dairy Knowledge Portal: [https://dairyknowledge.in/] (https://dairyknowledge.in/)
5. Indian Dairy Association (IDA): [https://www.indairyasso.org/]

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	3	3	3	3	3	2	3	3	3
CO2	3	3	1	2	2	2	2	3	1	2	2	1
CO3	3	3	3	3	3	3	2	2	3	2	3	2
CO4	3	3	1	2	2	2	2	2	3	2	3	2
CO5	2	3	3	3	3	3	3	2	3	3	2	3
TOTAL	**14**	**15**	**11**	**13**	**13**	**13**	**12**	**12**	**12**	**12**	**13**	**11**
AVERAGE	**2.8**	**3.0**	**2.2**	**2.6**	**2.6**	**2.6**	**2.4**	**2.4**	**2.4**	**2.4**	**2.6**	**2.2**

3 – Strong, 2- Medium, 1- Low

SEMESTER III

SPECIFIC VALUE-ADDED COURSE: PRESERVATION OF FOOD PRODUCTS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP233V01	2	-	-	-	1	2	30	25	75	100

Prerequisite:

Basic understanding of food science and microbiology.

Learning Objectives:

1. To equip students with the knowledge on food products and its preservation techniques.
2. To provide skills necessary to preserve products.

On completion of this course, students will be able to:		
1	recognize a variety of animal products, such as meat, poultry, fish, and dairy.	K1
2	explain food spoilage and the contribution of microorganisms to the deterioration of food products.	K2
3	select and utilize suitable preservation techniques for different animal products.	K3
4	select appropriate preservation methods based on product characteristics, storage conditions, etc.	K4
5	assess the effectiveness, safety, and sustainability of different preservation technique	K5

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

Units	Contents	No. of hours
I	Introduction to Food Preservation: Importance and significance of food preservation - Factors influencing food spoilage - Principles of microbial control	6
II	Preservation techniques: Chilling and refrigeration methods - Freezing techniques and principles - Preservation of fresh meat and seafood	6
III	Drying and Dehydration: Drying methods and equipment - Dehydration of animal products - Preservation of fruits and meats through drying	6
IV	Canning and Bottling: Canning processes and principles - Bottling and packaging techniques - Preservation of dairy and vegetable products.	6
V	Smoking, Curing, and Fermentation: Smoking and curing of meats - Fermentation in preservation - Preservation of fish and sausages	6
	Total	30

Self-study	Food preservation techniques

Textbooks:

1. Vijay K. Juneja, John N. Sofos, and Hari P. Dwivedi. 2017. *Food Preservation and Safety*. Wiley, New Jersey. USA.
2. Leo M.L. Nollet and Fidel Toldrá. 2012. *Handbook of Meat, Poultry, and Seafood Quality*.

Wiley-Blackwell, New Jersey. USA.

Reference Books:

1. Shafiur Rahman, M. 2007. *Handbook of Food Preservation*. CRC Press, Boca Raton, Florida.
2. Roy, A. K. and K. K. Balachandran. 2009. *Fish and Seafood: Identification, Fabrication, Utilization*. Wiley, New Jersey. USA.
3. Chris R. Kerth and Casey M. Owens. 2020. *Principles of Meat Science.* Publisher: CRC Press, Boca Raton, Florida
4. Herbert W. Ockerman, Conly L. Hansen, 2000. *Animal By-Product Processing & Utilization.* CRC Press, Boca Raton, Florida.
5. NIIR Board of Consultants & Engineers, 2005. *The Complete Book on Meat Processing and Preservation with Packaging Technology*. Asia Pacific Business Press Inc, Kamla Nagar, New Delhi.

Web Resources:

1. https://www.youtube.com/watch?v=HNJ_FK9132I
2. https://www.youtube.com/watch?v=tWjfmMRy7-E
3. https://www.youtube.com/watch?v=hZkZxfSAG94
4. https://www.youtube.com/watch?v=dwLzRyUStxM
5. https://www.primescholars.com/articles/brief-note-on-animal-feed-processing.pdf

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	2	3	3	3	2	2	3	3	3	3	3
CO4	3	3	3	3	3	2	3	3	2	3	2	2
CO5	3	3	3	2	3	2	3	2	3	2	2	3
Total	**14**	**14**	**13**	**12**	**15**	**11**	**14**	**13**	**12**	**12**	**12**	**12**
Average	**2.8**	**2.8**	**2.6**	**2.2**	**3**	**2.2**	**2.8**	**2.6**	**2.4**	**2.4**	**2.4**	**2.4**

3 -Strong; 2 -Medium; 1 -Low

SEMESTER III

SPECIFIC VALUE-ADDED COURSE: HONEY BEE PRODUCTS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP233V02	2	-	-	-	1	2	30	25	75	100

Prerequisite:

Basic knowledge of beekeeping and honey production.

Objectives

1. To learn various techniques for processing and adding value to honey.
2. To explore different value-added honey products and their market potential.

Course Outcomes

On completion of this course, students will be able to:		
1.	identify different value-added honey bee products.	**K1**
2.	interpret the quality standards for honey and honey-based products.	**K2**
3.	demonstrate practical skills in producing and packaging value-added bee keeping products.	**K3**
4.	formulate strategies to ensure the regulatory standards of honey bee products.	**K4**
5.	assess the quality of value-added bee keeping products	**K5**

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

Units	Contents	No. of hours
I	Introduction to value addition in honey products: Definition and importance of value addition. Market trends and opportunities, overview of value-added honey products.	**6**
II	Processing Techniques: Extraction and purification of honey, Techniques for flavouring and infusing honey, introduction to crystallization and creaming methods, processing methods for comb honey and cut comb.	**6**
III	Value-added Honey Products: Flavoured and infused honey products (e.g., cinnamon honey, lavender-infused honey), Creamed and crystallized honey products, Comb honey and cut comb products, Honey-based spreads, and sauces.	**6**
IV	Practical Production: Hands-on activities in processing and producing value-added honey products, quality control and packaging considerations, safety measures in production.	**6**
V	Marketing and Regulations: Market analysis and target audience identification, packaging and branding strategies, regulatory requirements, and quality standards for value-added honey products.	**6**
	Total	**30**

Self-study	Processing techniques in honey

Textbooks:

1. Himadri Panda, 2017. Complete Technology Book on Honey Processing and Formulations (Harvesting, Extraction, Adulteration, Chemistry, Crystallization,

Fermentation, Dried Honey, Uses, Applications and Properties). Engineers India Research Institute, India.
2. Krell, R. 1996. Value-added products from Bee keeping. In: FAO, Agricultural Services Bulletin 124.

Reference books:

1. Aijaz Ahmad Wachkoo, Gulzar Ahmad Nayik, Jalal Uddin, Mohammad Javed Ansari, 2024. Honey Bees, Beekeeping and Bee Products. CRC Press. Florida, United States.
2. NPCS Board of Consultants & Engineer**,** 2015. The Complete Book on Beekeeping and Honey Processing. NIIR Project Consultancy Services, New Delhi,
3. Belsare, K., Rakesh Kumar Singh, Shashikala D Belsare, Ravindra Aliai Raviraj, Himmatrao Deshmukh. 2019. Textbook of Apiculture (Beekeeping). Himalaya Publishing House, Girgaon, Mumbai.
4. Abrol, D. P. 2010. Bee and Beekeeping in India. Kalyani Publishers, New Delhi.
5. Douglas, J. C. 2020. A hand-book of bee-keeping for India. Facsimile Publisher, Delhi.

Web Resources:

1. https://www.researchgate.net/publication/374782456_Honey_Bees_Beekeeping_and_Bee_Products
2. https://openknowledge.fao.org/server/api/core/bitstreams/8f6c8745-aaed-49df-8f71-2e7b29016e33/content
3. https://www.apiservices.biz/documents/articlesen/value_added_products_from_beekeeping.pdf
4. https://www.youtube.com/watch?v=t6RRU0Gb1QM
5. https://www.youtube.com/watch?v=1RIOZrGT5y8

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	3	2
CO2	2	3	2	2	2	3	3	2	3	2	3	3
CO3	3	3	3	3	3	2	2	2	2	3	3	2
CO4	3	3	3	3	3	2	3	3	2	3	2	2
CO5	3	3	3	2	3	2	3	2	2	2	2	3
Total	**14**	**14**	**13**	**13**	**14**	**11**	**14**	**12**	**11**	**12**	**13**	**12**
Average	**2.8**	**2.8**	**2.6**	**2.6**	**2.8**	**2.2**	**2.8**	**2.4**	**2.2**	**2.4**	**2.6**	**2.4**

3 -Strong; 2 -Medium; 1 -Low

SEMESTER III

SELF-LEARNING COURSE: SOLID WASTE MANAGEMENT

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP233SL1	-	-	-	-	1	-	-	25	75	100

Prerequisite:

Basic knowledge of environmental science and waste management concepts.

Learning Objectives

1. To provide students with an understanding of the principles and practices of solid waste management.
2. To explore the various types of solid waste, their sources, characteristics, etc.

Course Outcomes

On completion of this course, students will be able to:		
1.	define solid waste and classify different types of solid waste.	**K1**
2.	understand the legal and regulatory frameworks governing solid waste management	**K2**
3.	assess the environmental and public health impacts of improper solid waste management practices.	**K3**
4.	analyze the various methods of solid waste collection, transportation, treatment, and disposal.	**K4**
5.	evaluate the feasibility and effectiveness of different solid waste management**.**	**K5**

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

Units	Contents
I	**Introduction to Solid Waste Management:** Definition and classification of solid waste, historical evolution and global trends in solid waste generation and management, importance of proper waste management for environmental protection, public health, and sustainable development, regulations, and policies governing solid waste management at international, national, and local levels. Case studies highlighting successful and unsuccessful approaches to solid waste management worldwide.
II	**Solid Waste Generation and Characterization:** Sources and factors influencing solid waste generation, classification and characterization of solid waste based on composition, physical properties, and hazardousness, methods for quantifying and analyzing solid waste streams, including waste audits, sampling techniques, and data analysis. Case studies illustrating waste generation patterns and trends in urban, peri-urban, and rural areas.
III	**Solid Waste Collection, Transportation, and Disposal:** Collection methods and technologies for gathering solid waste, transportation logistics and strategies, landfill design, operation, and closure techniques, Incineration and thermal treatment. Environmental and social considerations on land use planning and community engagement.

IV	**Waste Minimization and Resource Recovery:** Waste minimization strategies to reduce the generation of solid waste, source separation and recycling initiatives, composting and organic waste management techniques, recovery of energy and materials from solid waste through advanced technologies. Economic, environmental, and social benefits of waste minimization and resource recovery programs.
V	**Sustainable Solid Waste Management Practices:** Integrated solid waste management approaches, economy principles and their application to solid waste management, best practices for developing and implementing comprehensive solid waste management plans. Emerging trends and innovations in solid waste management, challenges and opportunities in achieving sustainable solid waste management goals,

Textbooks:

1. Bhatia, S. 2023. *Solid And Hazardous Waste Management.* Atlantic Publishers and Distributors (P) Ltd. New Delhi.
2. Ashok K Rathoure, 2021. *Sustainable Practices for Waste Management*. Discovery Publishing House Pvt Ltd., New Delhi.

Reference books:

1. Bhatia, H.S. 2019. *A Comprehensive Book on Solid Waste Management with Application*. Misha Books, India.
2. Ravichandran, T.R. 2009. *Management of Municipal Solid Waste.* The Energy and Resources Institute, TERI, India.
3. Himadri Panda, 2019. *Biomedical waste: management, recycling and applications*. Discovery publishing house Pvt Ltd; First Edition, India.
4. Rajan, N. 2023. ILBCO's *Waste Management Law with Guidelines*. ILBCO, India.
5. Sinha, G.N. 2024. *E-Waste Management: Governance and Policy Options*. M/s Bishen Singh Mahendra Pal Singh, Dehrdun, Urrakhand.

Web Resources:

1. https://byjus.com/biology/solid-waste-management/
2. https://www.vedantu.com/biology/solid-waste-management
3. https://ec.europa.eu/echo/files/evaluation/watsan2005/annex_files/WEDC/es/ES07CD.pdf
4. https://www.slideshare.net/slideshow/introduction-to-solid-waste-management-notes/264739191
5. https://www.youtube.com/watch?v=T_pIJiZ8JYI

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	2	2	2
CO2	3	3	2	2	3	3	3	2	2	2	3	3
CO3	3	2	3	3	3	2	2	2	2	3	3	2
CO4	3	3	3	3	3	3	3	3	3	3	2	3
CO5	3	3	2	2	3	2	3	2	3	3	2	3
Total	**15**	**14**	**13**	**13**	**15**	**12**	**14**	**12**	**13**	**13**	**12**	**13**
Average	**3**	**2.8**	**2.6**	**2.6**	**3**	**2.4**	**2.8**	**2.4**	**2.6**	**2.6**	**2.4**	**2.6**

3 -Strong; 2 -Medium; 1 -Low

SEMESTER IV

CORE COURSE VII: IMMUNOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP234CC1	3	2	-	1	5	6	90	25	75	100

Pre-requisite:

Students would have basic knowledge in animal science, particularly functional anatomy, cell biology and developmental biology.

Learning Objectives:

1. To impart conceptual understanding of functional organization of immune system and its responsiveness in health and disease.
2. To enable a successful performance in Immunology component of CSIR-UGC NET.

Course Outcomes

Upon completion of this course the students will be able to:		
1	recall the importance of immunity, immune response, MHC, BCR and TCR, antigen –antibody interaction.	**K1**
2	relate the evolution of immune molecules in different groups of animals, immunodeficiency diseases and immune-techniques.	**K2**
3	make use of immunization schedules, differentiate the types of hypersensitive allergic reactions and symptoms.	**K3**
4	analyse the immune response in relation to toxicants, vaccines, tumour, and infectious diseases.	**K4**
5	evaluate the role of immune cells and humoral factors in immune response	**K5**

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

Units	Contents	No. of Hours
I	**Immune system in invertebrates and vertebrates**: Immunity - Innate and acquired, Types. Lymphoid organs and immune cells. Antigens and Immunoglobulins – characteristics, haptens, types. Immune Response - Humoral and Cell-mediated. Immunological memory (Anamnesis). Immunization - immunization schedule and vaccines	**18**
II	**B and T cell**: B cells - Development, maturation, activation and differentiation - B cell receptor (BCR) - B cell co-receptor complex - signal transduction from B cell antigen receptor, major pathways of BCR signaling. T cells - maturation, activation and differentiation, T cell receptor (TCR), T cell co-receptor complex - formation of T and B cell conjugates, Costimulation in T cell response and signal transduction. Clonal anergy. Antigen processing and presentation – role of antigen presenting cells – cytosolic pathway and endocytic pathway	**18**
III	**Major and minor histocompatibility complex**: MHC class I and II molecules, cellular distribution and regulation of MHC expression, MHC in immune responsiveness, MHC and susceptibility to infectious diseases. Minor histocompatibility (H) antigens. Immune effectormechanisms: Cytokines and their functions, Complement system – classical and alternative pathways, biological functions	**18**
	Immune system in health and diseases: Tumour immunology - tumour antigens, immune response to tumour, immune surveillance, immune-diagnosis of tumour antigens, immune-therapy of tumors.	

IV	Hypersensitivity- factors causing hypersensitivity, Type I, II, III, and IV reactions. Immunodeficiency - primary and secondary. Autoimmune diseases - characteristics, causes, classification, localized - Diabetes mellitus and systemic - rheumatoid arthritis. Immune response to infectious diseases and treatment - Protozoan disease - Malaria, Bacterial disease - Tuberculosis, Viral disease – AIDS	**18**
V	**Antigen-antibody interaction**: Complement fixation test - precipitation reaction in fluids and precipitin curve. Radial immunodiffusion and double immunodiffusion. Agglutination reaction - hemagglutination, bacterial agglutination, coated particle agglutination, agglutination inhibition. Radio immuno assay - ELISA - Immunofluorescence - Flow cytometry. Transplantation: classification of grafts, mechanism of graft rejection, graft versus host reaction, immunosuppressive therapy during transplantation	**18**
	Total	**90**

Self-study	immune system: cellular and humoral immune components- distribution

Textbooks:

1. Kuby, J. 1997. *Immunology*. W. H. Freeman & Co., New York.
2. Rao, C.V. 2006. *Immunology* (2th ed.): Narosa Publishing House, Chennai

Reference Books:

1. Goldsby, R.A., Kindt, T.J. & Osborne, B.A. 2007. *Kuby's Immunology* (6thed.). W.H. Freeman and Company, New York.
2. Deves, P., Martin, S., Burton, D. &Roitt I.M. (2017). *Roitt's Essential Immunology*. (13thed.).: Wiley-Blackwell Scientific Publication, Oxford.
3. Ashim, K., Chakravarthy 2007. *Immunology and Immunotechnology* (2th ed.). Saurabh Printers Pvt. Ltd., Delhi
4. Gupta, S.K. (1991). *Immunology perspectives in Reproduction and Infection.* Oxford and IBH publication Co. Pvt. Ltd., New Delhi
5. Abbas, A. K and A. H. Lichtman. 2007. Cellular and Molecular Immunology (6th edition), W. B. Saunders, Philadelphia.

Web Resources:

1. http://www.elsevier.com/inca/publications/store/7/3/6/
2. https://immunologylink.com/#
3. https://en.wikipedia.org/wiki/Outline_of_immunology
4. http://www.elsevier.com/inca/publications/store/3/0/5/2/1/
5. http://www.immunity.com/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER IV
CORE COURSE VIII: MICROBIOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP234CC2	5	-	-	1	5	6	90	25	75	100

Pre-requisite:
Students should have fundamental knowledge of Microorganisms.

Learning Objectives:
1. To facilitate the students to understand the microbes and their significance.
2. To develop skills in microbial techniques relevant to industries, environment and disease management.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall the structure, distribution and life cycle of microorganisms and their role in human welfare.	**K1**
2.	explain culture techniques, growth, fermentation and microbial products.	**K2**
3.	apply the microbiological laboratory skills in clinical research, food industries and environmental management.	**K3**
4.	analyze beneficial and harmful microbes	**K4**
5.	evaluate the microbial importance and applications in various fields.	**K5**

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

Unit	Contents	No. of Hours
I	**Virus, Fungi and Protists:** History and scope of microbiology. Classification of microorganisms - Whittaker's five kingdoms and three domain classification. Virus - General properties, viral taxonomy. Bacteriophages – life cycle – Lytic and Lysogenic. Sub viral agents – viroid, virusoids, prions and satellite viruses. Cultivation of viruses and purification assays. Virus-host interactions. Fungi: classification – morphology - filamentous, non-filamentous and dimorphic fungus. *Apicomplexa – Toxoplasma.*	**18**
II	**Bacteria and culture techniques:** Bacteria - classification – Bergey's system, morphology, structure and functions of cell walls (Gram positive & Gram negative), flagella, fimbriae and pili. Fine structure of *Escherichia coli*. Bacterial nutrition - nutrient requirements, nutritional classes, uptake of nutrients. Bacterial growth and measurements. Types of culture media - pure culture and isolation techniques - streak plate and pour-plate technique.	**18**
III	**Industrial Microbiology**: Fermentation - production of microbial products - alcohol (ethanol), antibiotics (penicillin), vitamin B2 and Vitamin B12. Biofertilizers - steps for preparing bacterial biofertilizers, Mass cultivation of *Cyanobacteria*, *Azolla* and *Trichoderma*. Production of mycorrhizal fungi– Vesicular Arbuscular Mycorrhiza (VAM) and yeast. Industrial uses of yeast and moulds. Probiotics- *Lactobacillus* and *Saccharomyces*. Bacterial insecticides – *Bacillus* species.	**18**
IV	**Environmental Microbiology:** Microbiological analysis of water - Coliform test, Most Probable Number (MPN) test, and Membrane Filter (MF) test. Sewage treatment – small scale and large-scale treatment. Biogas production	**18**

	– solubilization, acetogenesis and methanogenesis. Microbial leaching – copper and Uranium leaching. Biodegradation of petroleum and Xenobiotics, bioremediation and biosorption. Microbes as biofilms, biosensors, nanomaterials.	
V	**Medical Microbiology:** Gnotobiotic animals, distribution of normal microbiotaof the human body. Nosocomial infections. Fungal diseases - Candidiasis and Aspergillosis. Bacterial diseases - Streptococcal pneumonia, Tetanus. Viral diseases – Covid-19, Ebola, Hepatitis-B, Rabies. Sexually transmitted diseases – Gonorrhea, Syphilis. Microbial drugs - determination of antimicrobial activity, antimicrobial agents – mode of action. Assay of microbial analysis – Disc diffusion and Tube dilution method. Microbial drug resistance, Multidrug resistance.	**18**
	Total	**90**

Self-study	Industrial uses of yeast and moulds.

Textbooks:

1. Dubey R.C., Maheswari, D.K. 2010. *A textbook of Microbiology*, 3rd ed., New Delhi: S. Chand and Co.
2. John L. Ingraham, Catherine A. 2004. *Introduction to Microbiology*. UK: Ingraham Thomson Brooks /Cole.

Reference Books:

1. Joanne, M., Wiley Linda M., Sherwood Christopher J., Woolverton. 2013. *Prescott's Microbiology*, McGraw-Hill International, America.
2. Arti Kapil. 2013. *Anandanarayan and Panicker's textbook of Microbiology*, Universal Press, Hyderabad.
3. Vijaya Ramesh, K. 2004. *Environmental Microbiology*. MJP Publishers, Chennai.
4. Powar, C.B. and Daginawala, H.F. 2008. *General Microbiology*, Vol. 2, Himalaya Publishing House, Chennai.
5. Singh, R.P. 2007. *General Microbiology*, Kalyani Publishers, New Delhi.

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

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

3 – Strong, 2- Medium, 1- Low

SEMESTER IV

CORE LAB COURSE IV: LAB ON IMMUNOLOGY AND MICROBIOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP234CP1	-	2	4	-	**5**	**6**	**90**	**25**	**75**	**100**

Pre-requisite:

Students should have knowledge relevant to Immunology and Microbiology.

Learning Objectives:

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

Course Outcomes

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

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

Units	Contents	No. of Hours
	IMMUNOLOGY	
1	Identification of Lymphoid organs in rat	**45**
2	Identification of various types of immune cells in peripheral blood smear	
3	Separation of RBC as intact cellular antigen	
4	Agglutination reaction: Qualitative analysis of antigen-antibody reaction using human blood group system	
5	Agglutination reaction: Determination of hemagglutination titer	
6	Single Radial Immuno-diffusion	
7	Double Immuno-diffusion	
8	Detection of IgG by precipitation Ring test	
9	Separation of T cells	
10	Separation of B cells	
Charts/ Slides/ Models/ Bookplates/ Instruments: Agglutination, Precipitation, Immune response curve, Haemagglutination, HIV, Malaria, Tuberculosis, Vaccination chart – human, ELISA		
	MICROBIOLOGY	
1	Preparation of culture media.	
2	Isolation of bacteria from soil and water (Streak plate method).	
3	Serial dilution technique and bacterial count by plate count method.	
4	Measurement of growth of bacteria (turbidimetric method).	

5	Observation of bacterial motility by Hanging Drop method.	**45**
6	Gram staining and negative staining of bacteria	
7	Methylene blue reduction test to assess the quality of milk.	
8	Antibiotic susceptibility test by disc-diffusion method.	
9	Bacterial count by Most Probable method.	
10	Identification of coli form in the sample.	
Charts/ Slides/ Models/ Bookplates/ Instruments: Salmonella, Clostridium, Rabies virus, hepatitis – B, Entamoeba, Azolla, ocular and stage micrometer, inoculation loop, autoclave, laminar airflow chamber.		

Textbooks:

1. Talwar, G.P., Gupta, S.K. 2017. *A Handbook of Practical and Clinical Immunology*, Vol. 1, 2nd Ed, CBS Publishers, New Delhi.
2. Shukla Das and Rumpa Saha. 2024. *Microbiological Practical Manua*l, 3 rd Ed., CBS Publishers, New Delhi.

Reference Books:

1. Ankitha Joshi, Chaukan, R.S. 2022. *Immunological Techniques: Interpretations, Validation and Safety Measures*, IP Innovative Publications, New Delhi.
2. Arora, D.R. 2023. *Practical Microbiology*, 3rd Ed., CBS Publishers, New Delhi.
3. Apurba, S Sastry, Sandhya Bhat. 2021. *Essentials of Practical Microbiology*, 2nd Ed., Jaypee Brothers Medical Publishers, Haryana.
4. Barbara Detrick, John L. Schmitz, Robert G. Hamilton. 2016. Manual of Molecular and Clinical Laboratory Immunology. Wiley, New York, USA.
5. Tobili Y. Sam-Yellowe, 2018. *Immunology: overview and laboratory manual.* Cham, Switzerland

Web Resources:

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER IV

ELECTIVE COURSE VI: a) AQUACULTURE

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP234EC1	3	-	1	-	3	4	60	25	75	100

Pre-requisite:

Students should be aware of economic and cultural importance of aquaculture**.**

Learning Objectives:

1. To know the needs for aquaculture and the status in global market.
2. Acquire the skills to apply the techniques and practices needed or aquaculture.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall the basic principles and concepts of aquaculture, as well as the primary species of aquatic organisms cultivated in this field.	**K1**
2.	understand various aquaculture systems and their practical applications in water quality management essential for successful aquaculture operations.	**K2**
3.	utilize diverse aquaculture techniques to propagate and culture aquatic organisms effectively.	**K3**
4.	apply the knowledge about different culture methods in aquaculture	**K4**
5.	asses the different fish's diseases, diagnosis, and their management strategies.	**K5**

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

Units	Contents	No. of Hours
I	**Aquaculture systems:** Aquaculture concept, Culture systems: Freshwater fishes, prawn culture, fish culture in paddy fields. Brackish water culture. Mariculture: Oyster culture, Crab culture, Lobster culture, mussel culture, Culture of aquatic weeds. Mixed fish farming in India. Techniques of composite culture. Culture of buffalo fish. Culture of Catfishes. Cray fish culture.	**12**
II	**Preparation and management of fish culture ponds:** Culture Types: Nursery ponds, Rearing ponds, Stocking ponds. Fish breeding: Natural and artificial. Predatory and Weed fishes and their control. Fish toxicants. Fertilization. Aquatic insects and their control. Fish food organisms: probiotics, prebiotics & gnotobiotics, artificial feed.	**12**
III	**Transport of fishes:** Transport of fish seed and Brood fish. Causes of mortality in transport. Methods for packaging and transport. Open systems. Closed systems. Use of chemicals in live fish transport. Anesthetic drugs. Antiseptics and Antibiotics.	**12**
IV	**Technologies in Fisheries development:** Role of hard water in culture of *Macrobrachium* species. Fertilization & feeds. Pearl culture: collection of oysters, rearing of oysters, insertion of nucleus, harvesting of pearls, composition & quality of pearl. Recirculation technology, Geographic Information System (GIS) technology, passive Acoustics in fisheries, Use of Information Communication Technology (lCT) in fishes: production aspects, marketing aspects.	**12**
V	**Fish pathology:** Parasitic infections. Fungus infections. Protozoan diseases. suryodata; Worm diseases. Non parasitic diseases. Harvesting: Fishing techniques, preservation & processing of fish.	**12**

	Fresh water prawn culture. Breeding characteristics. Juvenile prawn migration. Seasonal & regional distribution of seeds. Identification of juveniles. Controlled breeding. Culture: Ponds, Monoculture. Mixed culture.	
	Total	**60**

Self-study	Freshwater fishes, Predatory and Weed fishes and their control.

Textbooks:

1. Srinivasulu, M., Reddy, K.R.S., Rao, S. 1999. *Text book of Aquaculture*, Discovery Publishing House, New Delhi.
2. Hute, M. and Kahn, H. 2000. *Textbook of fish culture*, Blackwell Scientific Publication, Australia.

Reference Books:

1. Debnath, H. S., 2020. *Principles of Aquaculture*, 1st Edition, ABD Publishers, Jaipur.
2. Jena, J. K., 2019. *Aquaculture Engineering*, 2nd Edition, Daya Publishing House, New Delhi.
3. Gupta, M. V., and Acosta, B. O., 2018. *Aquaculture in India: Recent Advances*, 1st Edition, ICAR- Central Institute of Freshwater Aquaculture, Bhubaneswar.
4. Pillai, B. R., 2021. Modern Aquaculture Practices, 3rd Edition, New Age International Publishers, New Delhi.
5. Jingran, V. G. 1983. *Fish and fisheries of India*, Hindustan pub. corp. New Delhi.

Web Resources:

1. https://www.ciba.res.in/
2. (https://www.ciba.res.in/)
3. https://www.cmfri.org.in/
4. http://nfdb.gov.in/
5. https://www.icar.org.in/] (https://www.icar.org.in/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	2	2	1	2	2	1	2	3	3	3	1	3
CO 2	2	2	2	3	1	2	3	2	3	3	2	2
CO 3	3	2	3	3	3	3	2	2	2	3	3	2
CO 4	3	3	3	2	3	2	3	3	2	3	3	3
CO 5	3	3	2	3	2	3	2	3	3	2	3	2
TOTAL	**13**	**12**	**11**	**13**	**11**	**11**	**12**	**13**	**13**	**14**	**12**	**12**
AVERAGE	**2.6**	**2.4**	**2.2**	**2.6**	**2.2**	**2.2**	**2.4**	**2.6**	**2.6**	**2.8**	**2.4**	**2.4**

3 - Strong; 2 - Medium; 1-Low

SEMESTER IV

ELECTIVE COURSE VI: b) FORENSIC BIOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP234EC2	3	-	-	1	3	4	60	25	75	100

Pre-requisite:

Students should know the fundamentals of natural science and have a curiosity of criminology.

Learning Objectives:

1. Students should emphasize the importance of scientific methods in crime detection and disseminate information on the advancements in the field of forensic science.
2. Derive skills to identify crime through various forensic techniques

Course Outcomes

On the successful completion of the course, student will be able to		
1	recall the fundamentals of forensic biology, psychology, and criminal profiling.	**K1**
2	outline the use of scientific evidence in a legal context using basic facts, fundamental principles, and functions of forensic science.	**K2**
3	apply the knowledge to render forensic service during real-time crime scenes.	**K3**
4	analyze fingerprints, personal identification evidence, bite marks and pug marks.	**K4**
5	evaluate information to find strategies to resolve problems in forensic biology.	**K5**

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

Units	Contents	No. of Hours
I	Concepts and scope, functions, and historical aspects of forensic science. Importance, nature, location, collection and preservation of biological exhibits and crime scene investigation of biological evidence. Forensic dermatoglyphics - biological basis of fingerprints, formation of ridges, fundamental principles of fingerprinting, types of fingerprints, fingerprint patterns, automated fingerprint identification system.	**12**
II	Forensic examination of hair - importance, nature, location, structure, growth phases of hair, collection, evaluation, and tests for their identification. Forensic Serology - identification of body fluids, collection and preservation of blood evidence, distinction between human and non-human blood, semen - forensic significance, forensic significance of saliva, sweat, milk and urine.	**12**
III	Structural variation, types of teeth - human and non-human teeth, determination of age from teeth, eruption sequence, dental anomalies, their significance in personal identification. Bite marks - forensic significance, collection and preservation of bite marks, photography and evaluation of bite marks, lip prints in forensic investigations.	**12**

IV	Forensic Entomology - insects of forensic importance, collection of entomological evidence during death investigations. The role of aquatic insects in forensic investigations, insect succession on carrion and its relationship to determine time since death, factors influencing insect succession on carrion, its application to forensic entomology. Forensic Microbiology - types and identification of microbial organisms of forensic significance.	**12**
V	Importance of Wildlife Protection Act-1972- Schedules in the protection of endangered species of flora and fauna. Identification of wildlife materials such as skin, fur, bones, nails, horn, teeth, plants, plant parts and products by conventional and modern methods. Identification of pug marks of various animals, DNA techniques in wildlife investigations.	**12**
	Total	**60**

Self-study	Historical aspects of fingerprints, Collection, and preservation of blood Types of teeth, Forensic microbiology, DNA techniques

Textbooks:

1. Harsh Sharma, Kusum Singal, Rakesh Mia, Vijay Panchal. 2022. *Handbook of forensic biology & forensic serology*. India.
2. Jalindar S. Ambhore Arun D. Ghuge Sandeep G. Sangle . 2021. *Arenas in Forensic Biology.* Walnut Publication, Bhubeshwar, Odisha.

References

1. Shadma Siddiqui Chandra Bahadur Singh Dangi, 2020. *Handbook For Forensic Biology: A Science for Solving Crime Part 1*. Notion Press, Chennai, India.
2. Ramotowski. R.S. 2013. *Advances in Fingerprint Technology*. (3rd ed.). CRC Press, Boca Raton.
3. Bernstein, M. 1997. *Forensic odontology in, Introduction to Forensic Sciences* (2nd ed.), W.G. Eckert (Editor). CRC Press, Boca Raton
4. Geberth, V.J. 2006. *Practical Homicide Investigation*. CRC Press, Boca Raton.
5. Chowdhuri, S. 1971. *Forensic Biology*. BPRD, New Delhi.

Web Resources:

1. http://www.dnaftb.org/
2. https://forensicdental.wordpress.com/
3. https://www.forensicsciencesimplified.org/
4. http://www.istl.org/03-spring/internet.html
5. https://www.youtube.com/watch?v=V_P0U29Ndvs

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	1	2	3	1	3	3	3	3	3	3
CO 2	3	2	2	2	2	1	3	2	3	2	2	3
CO 3	3	3	2	2	3	2	3	2	2	3	2	2
CO 4	3	2	1	1	3	2	2	3	3	3	3	3
CO 5	2	2	3	3	2	3	3	3	2	2	3	3
TOTAL	**14**	**12**	**9**	**10**	**13**	**9**	**14**	**13**	**13**	**13**	**13**	**14**
AVERAGE	**2.8**	**2.4**	**1.8**	**2**	**2.6**	**1.8**	**2.8**	**2.8**	**2.6**	**2.6**	**2.6**	**2.8**

3 - Strong; 2 - Medium; 1-Low

SEMESTER IV
ELECTIVE COURSE VI: c) ECOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP234EC3	3	-	-	1	3	4	60	25	75	100

Prerequisite:

Basic knowledge in biology and environmental science.

Learning Objectives:

1. To gain knowledge into the interactions between organisms and their environment.
2. To analyze the environmental impacts of human population growth and assess the significance of biodiversity.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	relate the evolutionary and functional basis of animal ecology.	**K1**
2.	comprehend how organisms interact with their environment.	**K2**
3.	engage in field-based research activities for gathering data in the field.	**K3**
4.	analyse a biological problem, derive testable hypotheses and then design experiments and put the tests into practice.	**K4**
5.	solve the environmental problems involving interaction of humans and natural systems at local or global level.	**K5**

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

Units	Contents	No. of Hours
I	**An Overview of Ecology:** Introduction and scope of Ecology. Multidisciplinary relevance in the current perspective. Structure and function of ecosystem. Abiotic factors affecting survival and sustenance of organisms. Role of limiting factors in survival of biotic components.	**12**
II	**Ecosystems and Biomes:** Major ecosystems of the world. Ecological features, limiting factors, zonation, and classification of organisms of fresh water and marine ecosystems. Biome, Biotic community, characteristics, and attributes. Ecological features of Tundra, Desert, Savannah, and Tropical Rain Forest. Energy flow in ecosystems, food chains, and food webs. Recycling of nutrients: C, N, & P.	**12**
III	**Community Ecology:** Community characteristics: stratification. Dominance, diversity, species richness, abundance, Evenness, Similarity. Diversity and food-web indices. Ecotone and edge effect. Ecological Succession: Definition, Process, types, theories of succession. Niche overlap and segregation. Gause's Principle with laboratory and field examples.	**12**
IV	**Population Ecology:** Ecology of populations: Unitary and Modular populations. Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves. Mortality, age ratio, sex ratio, dispersal. Factors regulating population dispersal and growth: Exponential and logistic growth. Population regulation: density-dependent and independent factors; r and K strategies. Metapopulations, demes and interdemic extinction. Ecological efficiencies.	**12**

V	**Environmental Conservation and Human Impact**: Human population growth-Impacts on environment, carrying capacity, human health, and welfare. Environmental ethics. Natural resources: Mineral, water, and forest, their significance, and conservation. Types of biodiversity, Hotspots, benefit, and threat of conservation strategies. Biodiversity: status, monitoring, and documentation. Major drivers of biodiversity change. Biodiversity mapping using GPS, GIS, and remote sensing. Environmental movements: Bishnois, Chipko, Silent valley, big dam movements. Environmental education and public awareness.	**12**
	Total	**60**

Self-study	Structure and function of ecosystem, Recycling of nutrients

Textbooks:

1. Odum, E.P. 2008. *Fundamentals of Ecology*. Brooks/Cole., Indian Edition
2. Sharma, P.D. 2011. *Ecology and Environment*. Rastogi Publications, Meerut, Uttar Pradesh.

Reference Books:

1. Southwood, T.R.E. and Henderson, P.A. 2000. *Ecological Methods* (3rd edition). Blackwell Sci. USA.
2. Stiling, P. D. 2012. *Ecology Companion Site: Global Insights and Investigations*. McGraw Hill Education, New York, USA.
3. Frances H, 2012. *Global Environmental Issues* (2nd edition) Willey-Blackwell, USA.
4. Mahesh R, 2006. *Environmental Issues in India*: 1st Edn. Pearson, London, UK.
5. Bill Adams, 2021. *Green Development: Environment And Sustainability in A Developing World*, 4th Edn. Routledge Publishers, USA.

Web Resources:

1. https://avniet.ac.in/wp-content/uploads/2020/06/EST.pdf
2. https://teresas.ac.in/wp-content/uploads/2020/06/CHAPTER-1-7-MULTIDISCIPLINARY-NATURE-OF-ENVIRONMENTAL-STUDIES.pdf
3. https://vardhaman.org/wp-content/uploads/2021/03/ENVIRONMENTAL-SCIENCE-1.pdf
4. https://byjus.com/biology/biodiversity-conservation/
5. https://www.ndvsu.org/images/StudyMaterials/VPH/topic-2-biodiversity.pdf

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	3	2	1	3	3	3	2	3	3
CO2	2	2	3	3	3	3	3	3	3	2	2	3
CO3	2	3	2	3	2	2	3	2	3	3	2	3
CO4	2	2	3	3	3	3	3	1	3	2	2	2
CO5	2	2	3	3	3	3	3	2	2	2	3	3
TOTAL	**12**	**13**	**14**	**15**	**13**	**12**	**3**	**11**	**14**	**11**	**12**	**14**
AVERAGE	**2.4**	**2.6**	**2.8**	**3.0**	**2.6**	**2.4**	**3.0**	**2.2**	**2.8**	**2.2**	**2.4**	**2.8**

3 – Strong, 2- Medium, 1- Low

SEMESTER IV

ELECTIVE COURSE VII: a) ORNAMENTAL FRESHWATER FISH PRODUCTION

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP234EC4	2	-	1	1	3	4	60	25	75	100

Pre-requisite:

Students should be aware of importance of aquarium fish keeping, culture, breeding and marketing techniques of ornamental fishes.

Learning Objectives:

1. To learn the scientific method of setting an aquarium.
2. To learn the culture breeding and marketing techniques of common indigenous ornamental fishes.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	identify the commonly cultured key species of ornamental freshwater fish.	**K1**
2.	explain the various culture and the factors that influence the growth and development of these fish.	**K2**
3.	utilize different breeding methods to raise freshwater fish and keep the water clean for their health and growth.	**K3**
4.	examine the economic feasibility of various production methods in ornamental freshwater fish farming.	**K4**
5.	assess the sustainability of ornamental freshwater fish production systems in meeting market demand while minimizing ecological pollution.	**K5**

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

Units	Contents	No. of Hours
I	**Designing and preparation of aquaria with all accessories:** Importance and history of aquarium fish keeping. Design and construction of aquaria: aquarium fabrication- preparation of glass tank, aquarium floor setting – type and size of pebbles, gravels, granites used for bed setting and its advantages. Filters- biological, chemical and mechanical. Aquarium accessories like aerators, decorative, lighting, heating and feeding trays.	**12**
II	**Water quality management**: Sources of water, containers, storage, temperature, pH, dissolved carbon dioxide, ammonia, hardness, turbidity and ozone in aquarium. Aquarium plants: Uses of aquarium plants, different varieties of plants like submerged plants (tubers, rooted plants, cutting plants) and emerged plants.	**12**
III	**Common fresh water ornamental fishes.** Fresh water ornamental fishes: Common ornamental fishes- indigenous and exotic species; Identification and biology of the common ornamental fishes. Live bearers and egg layers. Sexual dimorphism in ornamental fishes. Indigenous ornamental fishes - Common indigenous ornamental fishes. Identification and biology of the common ornamental fishes. Cyprinids - torpedo fish, barb, shark), Loaches: Cichlids: and Catfishes	**12**
IV	**Brood stock management:** Breeding and rearing of common ornamental fishes. Conditions for breeding- pH, temperature, and sex ratio. - selection of	**12**

	brooders, maintenance and management of brood stocks. Selective breeding and hybridization techniques. Induced breeding. Colour enhancement techniques. Food and feeding - live feed and formulated feed. Preparation and culture of live feed (Artemia and Spirulina).	
V	**Diseases and Pest of ornamental aquarium fishes:** Common disease of ornamental aquarium fishes - their causative agents - virus, bacteria, fungi, protozoa and nematode; symptoms, treatment and prophylactic measures. Control of algal growth, snails and other predators.	**12**
	Total	**60**

Self-study	Aquarium accessories, Control of algal growth, snails and other predators.

Textbooks:

1. Sen, A. K., 2020. *Ornamental Fish Breeding and Culture*, 1st Edition, Daya Publishing House, New Delhi.
2. Mandal, B. N., and Roy, S. K., 2019. *Ornamental Fish Culture and Aquarium Management*, 2nd Edition, New Vishal Publications, Delhi.

Reference Books:

1. Gupta, A., and Banerjee, S., 2018. *Advances in Ornamental Fish Culture*, 3rd Edition, Agrotech Publications, Jodhpur.
2. Nandi, N. C., 2021. *Ornamental Fish Culture: Biology, Breeding, and Management*, 1st Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Mills, D. (1981). *Aquarium Fishes*, Arco publishing, New York.
4. Mills, D. and Vevers, G. (1982). *The Practical encyclopedia of fresh water, Tropical Aquarium fishes, Salamander* Books limited, London.
5. Gupta, R. 2007. *Manual of experimental Ichthyology*, Daya publishing House, Delhi.

Web Resources:

1. https://www.aquaticcommunity.com/
2. https://www.practicalfishkeeping.co.uk/
3. https://www.ornamentalfish.org/
4. https://www.fisheriesjournal.com/
5. https://www.youtube.com/watch?v=nH4Rji7F9W0

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	2	3	2	3	2	3	3	2	2	3
CO3	3	2	2	2	2	2	2	2	2	3	2	2
CO4	3	1	2	3	1	3	2	3	3	3	3	3
CO5	3	2	3	2	3	3	2	2	3	2	2	2
Total	**15**	**8**	**10**	**13**	**10**	**14**	**10**	**13**	**14**	**12**	**12**	**12**
Average	**3**	**1.6**	**2**	**2.6**	**2**	**2.8**	**2**	**2.6**	**2.8**	**2.4**	**2.4**	**2.4**

3 -Strong; 2 -Medium; 1 -Low

SEMESTER IV

ELECTIVE COURSE VII: b) BIODIVERSITY CONSERVATION AND SUSTAINABLE DEVELOPMENT

Course Code	L	T	P	S	Credits	Inst. Hours	Total hours	Marks		
								CIA	External	Total
ZP234EC5	3			1	3	4	60	25	75	100

Prerequisite

Students should have basic knowledge on biodiversity, conservation, and sustainable development.

Learning Objectives:

1. To develop an awareness of basic environmental concepts and their importance.
2. To apply the concepts of ecosystems and their significance for biodiversity conservation.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall the impact of the degraded environment and the importance of biodiversity	**K1**
2.	explain the consequences of biodiversity loss and the judicious utilization of natural resources.	**K2**
3.	apply green technology, eco-friendly practices, and prospects of environmental protection in daily practices.	**K3**
4.	analyse legal and ethical issues in the work environment.	**K4**
5.	evaluate environmental issues to propose solutions and advocate for sustainable practices.	**K5**

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

Unit	Contents	No. of hours
I	**Understanding Anthropogenic Impact and Resource Depletion:** Man as an integral part of ecosystems, Population dynamics and carrying capacity, Urbanization, industrialization, and agricultural practices: impacts on resource exploitation. Generation and types of waste: agricultural, municipal, industrial. Pollution types: air, water, soil, noise, and radioactive pollution. Eutrophication: causes, consequences, and control measures. Deforestation: implications for biodiversity and species extinction.	**12**
II	**Resource Depletion and Sustainable Energy Alternatives:** Overview of natural resources: land, air, water, and bioresources. Traditional fuel sources versus non-conventional alternatives. Introduction to renewable energy sources: solar, wind, bioenergy, geothermal, ocean, nuclear. Understanding greenhouse effect, global warming, and climate change. Effects of resource depletion on sustainable development. Challenges and opportunities for transitioning to sustainable energy systems.	**12**
III	**Biodiversity Conservation and Waste Management:** Waste generation and management techniques. Implementation of reduce, reuse, recycle (3Rs) principles. Biodiversity conservation strategies: in-situ and ex-situ approaches. Examples of in-situ conservation: sanctuaries, national parks. Examples of ex-situ conservation: gene banks, cryopreservation. Sustainable farming practices: contour farming, reforestation. Water conservation techniques: rainwater harvesting, groundwater recharge.	**12**
IV	**Sustainable Development Principles and Policies:** Understanding sustainable development principles. Biosafety considerations for genetically modified	**12**

	organisms (GMOs) and living modified organisms (LMOs). Role of environmental movements and public awareness campaigns. Government and non-governmental organization (NGO) roles in environmental conservation. National Environmental Policy. Introduction to conservation organizations: NBPGR, BSI, ZSI, WWF, IUCN.	
V	**Implementation of Green Technologies and Sustainable Practices:** Application of green technologies in various sectors. Case studies of successful eco-friendly initiatives. Challenges and barriers to implementing sustainable practices. Role of communities and individuals in promoting sustainability. Evaluating the effectiveness of sustainability measures. Future prospects and advancements in green technology.	**12**
	Total	**60**

Self-study	Eutrophication: causes, consequences, and control measures. Water conservation techniques: rainwater harvesting, groundwater recharge.Role of environmental movements and public awareness campaigns.

Textbooks:

1. Snigdha Tripathi. 2019. *Sustainable Development and Environment*. Ankit Publications, New Delhi, India
2. Pushpendra Kumar Sharma and Anup Kumar Mishra. 2022. *Environmental Conservation and Sustainable Development,* JTS Publications, Delhi.

Recommended readings

1. Joseph, B. 2008. *Environmental studies*, Tata McGraw Hill, New York, USA.
2. Miller, G.T. 2002. *Sustaining the earth, an integrated approach*. (5th edition). Thompson Learning, Inc.
3. Chapman, J.L. and Reiss, M.J. 1999. *Ecology: Principles and applications* (2nd edition) Cambridge University Press, Cambridge, UK.
4. Ghosh, S.K. and Singh, R. 2003. *Social forestry and Forest Management*. Global Vision Pub.
5. Wagher, R.H. (1974*). Environment and Man*. (Second Edition), Norton, New York.

Web resources

1. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/anthropogenic-effect
2. https://fastercapital.com/content/Running-Out-of-Time--Non-Renewable-Resource-Depletion-and-Sustainability.html
3. https://www.academia.edu/102356449/BIODIVERSITY_CONSERVATION_AND_WASTE_MANAGEMENT
4. https://www.legalservicesindia.com/article/1641/Sustainable-Development,-Guiding-Principles-And-Values.html
5. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4581463

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	2	3	2	3	3	3	3	2
CO2	3	2	2	3	2	1	2	3	2	3	2	3
CO3	3	2	3	2	2	2	2	2	2	3	2	2
CO4	3	3	2	3	3	3	2	3	3	3	2	3
CO5	3	2	2	2	3	3	2	2	3	2	2	2
Total	**15**	**11**	**11**	**13**	**12**	**12**	**10**	**13**	**16**	**14**	**11**	**12**
Average	**3**	**1.8**	**2.2**	**2.1**	**2.3**	**2.4**	**2**	**2.6**	**2.6**	**2.3**	**2.2**	**2.4**

3 -Strong; 2 -Medium; 1 -Low

SEMESTER IV

ELECTIVE COURSE VII: c) MEDICAL LAB TECHNOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PZ234EC6	3	-	-	1	3	4	60	25	75	100

Pre-requisite:

Students should have fundamentals of medical lab technology.

Learning Objectives:

1. To impart knowledge on laboratory principles, clinical analysis and safety measures in handling samples.
2. To develop skills on laboratory investigations adopted in medical diagnostic laboratories.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	outline the laboratory principles applied in diagnosis of disease and methods of biomedical waste disposal.	**K1**
2.	explain the type of specimens, collection and use of appropriate diagnostic techniques.	**K2**
3.	prepare reagents, handle instruments and perform clinical analysis.	**K3**
4.	systematically analyze complex laboratory data, identifying patterns, trends, and anomalies	**K4**
5.	critically evaluate and assess various laboratory methodologies and techniques in medical diagnostics	**K5**

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

Units	Contents	No. of Hours
I	**Laboratory instruments and safety measures:** Scope of Medical laboratory technology. Laboratory principles – Organization of clinical laboratory – Role of medical laboratory technician. Laboratory instruments: Common glass wares in clinical laboratory -Water bath – Refrigerator – Hot air oven – Mixer – Microscope – Analyser – Spectrometer – Cell counter – Blood bank. Safety measures - Cleaning and sterilization methods – antiseptics and disinfectants –hospital and clinic borne infection and personnel hygiene.	**12**
II	**Clinical sample collection, processing and storage:** Specimen collection and processing of blood, urine and cerebro spinal fluid, separation of serum and plasma, Handling of specimens for testing, preservation and transport of specimen, fact or affecting the clinical results, effect of storage on sample. Anticoagulants: EDTA, Dipotassium salts of EDTA, oxalate, sodium citrate and sodium fluoride. Techniques of sample processing: Throat Swab, Sputum, blood, urine, stool, pus, CSF, other body fluids, other swabs like from wounds, spore strips.	**12**
III	**Body fluid analysis:** Physical, chemical and microscopical examination of cerebro-spinal fluid, pleural fluid, synovial fluid. Haematological techniques-Haemoglobin estimation, Erythrocyte Sedimentation Rate, Differential count, Total Red Blood cell count, Total White blood cell count, Platelet count. Blood banking technology, collection and storage and plasma separation. Diagnosis of Covid-19.	**12**

IV	**Histopathology**: Introduction of histopathology, labelling and transportation of tissue specimens, tissue processing- fixation, sectioning, staining and mounting, manual and automated method. Cryostat, frozen sections of fresh, fixed and unfixed tissue, freeze drying, rapid frozen sections and staining for emergency diagnosis.	**12**
V	**Clinical sample analysis and biomedical waste management:** Physical, chemical and microscopical examination of sputum, urine and stool. Routine examination of urine and their clinical significance. Pregnancy test. Semen: Sample collection and microscopic examination for count and morphology. Bio-medical waste generation, segregation, disposal, incineration. Legal Aspects and Environment Concern.	**12**
	Total	**60**

Self-study	Laboratory principles, Blood banking technology, Pregnancy test.

Textbooks:

1. Mukerjee, L. & S. Ghosh, 2010. *Medical Laboratory Technology*, Volume III, New Delhi: McGraw Hill.
2. John Bernard Henry, 2001. *Clinical diagnosis and management by laboratory Methods* (20thed.). Philadelphia: Saunders & Co.

Reference Books:

1. Sood, R. 2006. *Textbook of Medical Laboratory Technology*. New Delhi: Jaypee.
2. Rajan, S. 2012. *Manual for Medical Laboratory and Technology* (1sted.). Chennai: Anjanaa Book House.
3. John Bernard Henry 2001. *Clinical diagnosis and management by laboratory Methods* (20thed.). Philadelphia: Saunders & Co.
4. Mary Vijaya, T. Mini, M.L, Sunitha Kumari, K.& Asha, K.R.T. 2003. *Practical Clinical Biochemistry Manual.* Kaliakkavilai: Rishi Publications.
5. Himadri Panda 2019. *Biomedical Waste Management, Recycling and Applications* (1sted.). India: Discovery Publishing house Pvt. Ltd.

Web Resources:

1. https://www.youtube.com/watch?v=-et7jDXOLB4
2. https://www.slideshare.net/8056933252/organization-of-laboratory
3. https://med.uc.edu/docs/default-source/mmpc-docs/serum_plasma-preparation.pdf?sfvrsn=bbdec461_2
4. https://en.wikipedia.org/wiki/Histopathology
5. https://byjus.com/current-affairs/biomedical-waste/

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	3	3	3	2	3	3	2	3	2	3	2	3
CO3	3	2	2	3	2	2	2	3	3	2	3	2
CO4	2	2	3	2	2	2	2	2	3	3	2	2
CO5	1	3	1	2	3	3	3	3	3	2	2	2
TOTAL	**11**	**13**	**11**	**12**	**13**	**13**	**12**	**14**	**14**	**13**	**12**	**12**
AVERAGE	**2.2**	**2.6**	**2.2**	**2.4**	**2.6**	**2.6**	**2.4**	**2.8**	**2.8**	**2.6**	**2.4**	**2.4**

3 – Strong, 2- Medium, 1- Low

SEMESTER IV

SKILL ENHANCEMENT COURSE III: ANIMAL FOOD PROCESSING AND QUALITY CONTROL

Course Code	L	T	P	S	Credits	Inst. Hours	Total hours	Marks		
								CIA	External	Total
ZP234SE1	2	-	1	1	2	4	60	25	75	100

Prerequisite

Students should have a foundational understanding of basic nutrition principles and the nutritional composition of animal-derived food.

Learning Objectives:

1. To develop a skill on recognize different types of animal food and their nutritional importance.
2. To apply the principles of Good Manufacturing Practices (GMPs) and sanitation protocols to prevent contamination and ensure food safety.

Course Outcomes:

On the successful completion of the course, students will be able to:		
1.	recall different processing techniques used in the animal food industry.	K1
2.	explain the principles behind various processing methods used in animal food production.	K2
3.	demonstrate the use of quality control tools and techniques in monitoring and maintaining product quality.	K3
4.	analyze the impact of processing methods on the nutritional value of animal food products.	K4
5.	evaluate the effectiveness of quality control of processed foods.	K5

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

Unit	Contents	No. of hours
I	**Introduction to Animal Food Processing:** Overview of animal food processing industry. Importance of processing in animal food production. Basic principles of food preservation and processing. Regulations and standards in animal food processing.	12
II	**Raw Material Handling and Preparation:** Selection and sourcing of raw materials for animal food production. Cleaning, sorting, and grading of raw materials. Pre-processing techniques for different animal food products - meats, dairy, eggs.	12
III	**Processing Techniques for Animal Food Products:** Thermal processing methods - pasteurization, sterilization. Mechanical processing techniques - grinding, extrusion. Chemical processing methods - curing, fermentation. Novel processing technologies in animal food industry.	12
IV	**Quality Control and Assurance:** Principles of quality control in animal food processing. Testing methods for assessing quality attributes - texture, flavor, shelf-life. Monitoring and controlling factors affecting product quality. Implementation of HACCP (Hazard Analysis and Critical Control Points) in animal food processing.	12
V	**Packaging, Storage, and Distribution:** Packaging materials and	12

	techniques for animal food products. Storage conditions and facilities for maintaining product quality. Transportation and distribution considerations. Consumer awareness and labeling requirements.	
	Total	**60**

Self-study	Food Processing techniques

Textbook:

1. Gangly. S. 2014. *Food Processing and Quality Control.* Narendra Publishing House, Delhi.
2. Shafiur RahmanF, M. (2007). *Handbook of Food Preservation*. CRC Press. Florida, United States

Recommended readings

1. Hui, Y. H. 2016. *Handbook of Food Science, Technology, and Engineering*. CRC Press, Florida, United States
2. James G. Brennan, (2006). *Food Processing Handbook.* Wiley-VCH, Weinheim, Germany.
3. Alexandru Mihai Grumezescu. (2018). *Food Packaging and Preservation*. Academic Press.
4. Leo M. L. Nollet and Fidel Toldra. (2007). *Handbook of Meat, Poultry and Seafood Quality*. Wiley-Blackwell, New Jersey, United States.
5. Suzanne Nielsen, S. 2017. *Food Analysis Laboratory Manual*. Springer Cham, New York.

Web resources

1. https://ebooks.inflibnet.ac.in/ftp1/chapter/principles-of-food-processing-and-preservation/
2. https://www.fao.org/3/i1111e/i1111e.pdf
3. https://www.fao.org/3/ai407e/ai407e.pdf
4. https://application.wiley-vch.de/books/sample/3527324682_c01.pdf
5. https://nou.edu.ng/coursewarecontent/ANP303_0.pdf
6. https://www.ndvsu.org/images/StudyMaterials/Nutrition/Feed-Technology.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	1	3	2	3	2	3	3	2	3	2
CO2	3	2	2	3	2	1	2	3	2	2	2	3
CO3	3	3	2	2	2	2	2	2	2	3	3	3
CO4	3	3	3	3	3	3	2	3	3	3	2	3
CO5	3	2	3	2	3	3	2	2	3	2	3	3
Total	**15**	**12**	**11**	**13**	**12**	**12**	**10**	**13**	**16**	**12**	**13**	**14**
Average	**3**	**2.4**	**2.2**	**2.6**	**2.4**	**2.4**	**2**	**2.4**	**2.6**	**2.3**	**2.5**	**2.8**

3 -Strong; 2 -Medium; 1 -Low

SEMESTER III & IV

LIFE SKILL TRAINING II: VALUES

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PG23LST2	1	-	-	-	1	1	15	50	50	100

Pre-requisites: Value education-its purpose and significance in the present world

Learning Objectives

1. To guide students in making wise choices and decisions, and to help them discover the true purpose of their lives.
2. To ensure students not only grasp the concept of values but also incorporate them into their actions and attitudes.

Course Outcomes

On completion of this course the student will be able to		
1	recognize the perception of life and lead a positive life	K1
2	understand relationship with family, friends and the society	K2
3	develop as socially responsible citizens.	K3
4	assess goals, fix targets and value life	K4
5	create a peaceful, communal community and embrace unity.	K6

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

Units	Contents	No. of Hours
I	**Positive Thinking -** Why you should change your thinking? – How to became a better thinker- Putting yourself in the right place to think- Portrait of the good thinker. **Habits-** Habits vs. Addiction- Why are life styles changes so difficult to hold on to? - Habit Swapping.	3
II	**Art of Listening-** Many faces of speech- To be truly present- Valuing the other- Activating the subconscious. **Leadership**- Introduction- Who is a better leader? - Qualities of a Leader- You too can be a leader.	3
III	**Interpersonal Relationship**- Introduction - Factors that build trust- Steps to build a positive personality. **Managing Emotions**- 7 'Root' emotions- Importance of managing emotions- Why is it important to manage emotions?	3
IV	**Stress Management –** Highly effective tips for relieving stress- Fast-Acting Self Relief Strategies. **Anger Management:** Effects of anger – Tips to reduce anger – Anger warning signs – Identify your triggers – Ways to cool down your anger.	3
V	**Forgiveness-** What is forgiveness- Value of forgiveness- Benefits of forgiving- Self-forgiveness. **Gratitude –** What is gratitude? – How gratitude arises? –Features of gratitude – Gratitude is recognizing and acknowledging.	3
TOTAL		15

Self-Study Salient values for life, Human Rights, Social Evils and how to tackle them, Holistic living, Duties and responsibilities.

Textbooks

Life Skill Training – II, Holy Cross College (Autonomous), Nagercoil

Reference Books

1. Holy Cross College (Autonomous), Nagercoil (2007). Foundation Course Life's Challenges. Sipca Computers.
2. Mathew, Sam (2010). Self Help Life Book. Opus Press Publisher.
3. Romuald Andrade. (2015). *Habit Triggers: How To Create Better Routines And Success Rituals To Make Lasting Changes In Your Life*. Kindle Edition.
4. William Fergus Martin. (2014). *Four Steps to Forgiveness:* A *Powerful Way To Freedom, Happiness And Success*. Findhorn Press.
5. Robert A. Emmons and Joanna Hill (2001). *Words Of Gratitude for Mind, Body, and Soul*. USA: Templeton Foundation Press.

Web Resources

1. https://www.mayoclinic.org/healthy-lifestyle/stress-management/in-depth/positive-thinking/art-20043950
2. https://jamesclear.com/habits
3. https://www.skillsyouneed.com/ps/managing-emotions.html
4. https://emeritus.org/in/learn/what-is-leadership/
5. https://www.verywellmind.com/how-to-maintain-interpersonal-relationships-5204856

SEMESTER IV

SELF-LEARNING COURSE: ENVIRONMENTAL SUSTAINABILITY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP234SL1	-	-	-	-	1	-	-	25	75	100

Prerequisite:

Basic knowledge of environmental science or related disciplines is recommended.

Learning Objectives:

1. To explore key environmental issues and threats to sustainability.
2. To introduce sustainable development principles and strategies for achieving environmental sustainability at local, regional, and global scales.

Course Outcomes

On completion of this course, students will be able to:		
1.	define environmental sustainability and explain its significance.	**K1**
2.	identify key environmental issues and their interconnections.	**K2**
3.	infer the interdisciplinary approaches to practically address environmental sustainability challenges	**K3**
4.	analyze the various methods of solid waste collection, transportation, treatment, and disposal.	**K4**
5.	evaluate sustainability initiatives and strategies in various sectors.	**K5**

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

Units	Contents
I	**Introduction to Environmental Sustainability:** Definition and principles of environmental sustainability, Historical perspectives on human-environment interactions, Global environmental challenges: climate change, biodiversity loss, pollution, and resource depletion, The role of indigenous knowledge and traditional practices in sustainability, Sustainable development goals (SDGs) and international agreements for sustainability.
II	**Environmental Issues and Threats:** Climate change: science, impacts, adaptation, and mitigation strategies, Biodiversity conservation: threats to biodiversity, conservation biology principles, and protected area management, Pollution: sources, impacts, and management of air, water, and soil pollution, Resource depletion: sustainable management of water resources, forests, fisheries, and minerals. Environmental justice: inequities in environmental impacts and access to resources.
III	**Sustainable Development Principles:** Principles of sustainability: ecological integrity, social equity, economic viability, and cultural diversity, Circular economy: principles and practices for reducing waste and promoting resource efficiency, Sustainable consumption and production patterns, social entrepreneurship and sustainable business models, Ethics and values in sustainability decision-making

IV	**Strategies for Environmental Sustainability:** Renewable energy technologies: solar, wind, hydro, geothermal, and bioenergy, Energy efficiency measures and green building design. Sustainable transportation solutions: public transit, cycling, walking, and electric vehicles, Sustainable agriculture and agroecology: organic farming, permaculture, and regenerative practices, Waste management strategies: recycling, composting, anaerobic digestion, and waste-to-energy technologies.
V	**Promoting Environmental Sustainability:** Corporate sustainability practices: corporate social responsibility (CSR), green procurement, and sustainable supply chains, Environmental governance: policies, regulations, and institutions for environmental protection and management, Environmental education and public awareness campaigns, Community-based conservation initiatives and participatory approaches, Advocacy and activism for environmental justice and sustainability.

Textbooks:

1. Sharma, R.N. 2020. *Environmental Sustainability and Development (Recent Trends and Issues*). Books Treasure. Dehradun.
2. Arjun Gope, Abhijit Sarkar, Prasamita Sarkar, Santanu Majumder, Guldip Gosai. 2019. *Environmental issues and Sustainable Development*. Notion Press. Chennai, India.

Reference Books:

1. Utkarsh Sharma, 2018. *Environmental Sustainability***.** Jnanada Prakashan (P&D), Delhi.
2. Thankavel, P. and G. Sridevi. 2015. *Environmental Sustainability: Role of Green Technologies.* Springer, New Delhi.
3. Tripathi V. D. 2018. *Introduction To Environment Sustainability Environmental Science*. Shaswath Publications, Bilaspur, India.
4. Ba Srinivas, 2021. *Environmental Sustainability: A Text Book For 1 Sem Polytechnic Diploma Programmes & Degree*. Rasha Publications, Bengaluru, Karnataka
5. Bill Adams, 2020. *Green Development: Environment and Sustainability in a Developing World*. Edition: 4th Edition, Routledge, New York, USA.

Web Resources:

1. https://www.microsoft.com/en-us/sustainability/learn/environmental-sustainability
2. https://portals.iucn.org/library/sites/library/files/documents/Hlth-022.pdf
3. https://www.inspirecleanenergy.com/blog/sustainable-living/environmental-sustainability-definition
4. https://study.com/academy/lesson/video/environmental-sustainability-definition-and-application.html
5. https://www.youtube.com/watch?v=q9tFAAGFw6A

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	2	2	2	3	3	2	3	2	3
CO2	3	2	3	3	3	3	3	2	3	2	3	3
CO3	3	3	3	3	3	2	2	2	2	3	3	2
CO4	2	3	3	3	3	3	3	3	2	2	2	2
CO5	3	3	3	2	3	3	3	2	2	2	2	3
Total	**14**	**14**	**15**	**13**	**14**	**13**	**14**	**12**	**11**	**12**	**12**	**13**
Average	**2.8**	**2.8**	**3**	**2.6**	**2.8**	**2.6**	**2.8**	**2.6**	**2.2**	**2.4**	**2.4**	**2.6**

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