Holy Cross College (Autonomous), Nagercoil-629004

Kanyakumari District, TamilNadu.

Nationally Re-Accredited with A+ by NAAC IV cycle – CGPA 3.35

Affiliated to

Manonmaniam Sundaranar University, Tirunelveli

DEPARTMENT OF ZOOLOGY

SYLLABUS FOR UNDERGRADUATE PROGRAMME

Issued from the Deans Office

(With effect from the Academic year 2020– 2021)

Department of Zoology

Vision

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

Mission

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

Programme Educational Objectives (PEOs)

PEO - 1	The graduates will apply appropriate theory and scientific knowledge to participate in activities that support humanity and economic development nationally and globally, developing as leaders in their fields of expertise.
PEO - 2	The graduates will pursue lifelong learning and continuous improvement of the knowledge and skills with the highest professional and ethical standards.
PEO - 3	The graduates will inculcate practical knowledge for developing professional empowerment and entrepreneurship and societal services.

Programme Outcomes (POs)

PO	Upon completion of B.Sc. Degree Programme, the graduates will be able to:
PO - 1	utilize scientific knowledge to pursue higher studies in the relevant field.
PO - 2	create innovative ideas to enhance entrepreneurial skills for economic independence.
PO - 3	face challenging competitive examinations that offer rewarding careers.
PO - 4	reflect upon green initiatives and take responsible steps to build a sustainable environment.
PO - 5	handle ethical issues with social responsibility.
PO - 6	communicate effectively and collaborate successfully with peers to become competent professionals.

Programme Specific Outcomes (PSOs)

PSO	Upon completion, B.Sc. Zoology graduates will be able to:	PO addressed
PSO - 1	gain knowledge on animal diversity and basic concepts of Taxonomy, Cell biology, Genetics, Physiology, Immunology, Microbiology, Biotechnology, Ecology, Evolution, Embryology and Applied Zoology.	PO - 1, 3
PSO - 2	perform experiments as per laboratory standards in the areas of Taxonomy, Physiology, Cell Biology, Genetics, Applied Zoology, Ecology and Toxicology, Biochemistry, Biophysics, Biostatistics, Biotechnology, Immunology, Microbiology and Evolution.	PO - 2, 3
PSO - 3	apply the biological method by formulating a hypothesis, gathering relevant data and analyzing the data to address the problem effectively.	PO - 4, 5
PSO - 4	plan their career goals and pursue higher studies in different Zoological disciplines and develop entrepreneurship skills by applying the knowledge gained from courses like Aquaculture, Sericulture, Apiculture, Poultry, Vermitechnology and Clinical Laboratory Technology.	PO - 2, 6

Eligibility Norms for Admission: Those who seek admission to B.Sc. Zoology Programme must have passed the Higher Secondary Examinations conducted by the Board of Higher Secondary Examinations, Tamil Nadu with Zoology or Biology as one of the subjects in Part III or any other examination recognized and approved by the Syndicate of the ManonmaniamSundaranar University, Tirunelveli.

Duration of the programme: 3 years

Medium of instruction: English

Passing minimum: A minimum of 40% in the external examination and an aggregate of minimum 40% is required. There is no minimum pass mark for Continuous Internal Assessment (CIA).

Components of the B.Sc. Zoology programme

Part III (Major and Allied)

Major	Core - Theory papers	10 x 100	1000
	Practical (Core applied)	5 x 100	500
	Elective – Theory papers/ Project	4 x 100	400
	Major - Total marks		**1900**
Allied	Theory	4 x 100	400
(I & II)	Practical	2 x 100	200
	Allied - Total marks		**600**
	Part III - Total marks		**2500**

Course Structure

Distribution of Hours and Credits

Course	Sem. I	Sem. II	Sem. III	Sem. IV	Sem. V	Sem.VI	Total	
							Hours	Credits
Academic Courses								
Part I: Language	6 (4)	6 (4)	6 (4)	6 (4)	-	-	24	16
Part II: English	6 (4)	6 (4)	6 (4)	6 (4)	-	-	24	16
PartIII								
Major Core - Theory	4 (4)	4 (4)	4 (4)	4 (4)	6 (6) + 6 (6) + 6 (5)	6 (6) + 6 (6) + 6 (5)	52	50
Major Core - Practical	2	2 (2)	2	2 (2)	2 + 2 + 2	2 (2) + 2 (2) + 2 (2)	20	10
Major Elective/ Project	-	-	4 (3)	4 (3)	4 (3)	4 (3)	16	12
Allied – Theory	4 (3)	4 (3)	4 (3)	4 (3)	-	-	16	12
Allied – Practical	2	2 (2)	2	2 (2)	-	-	8	4
Part IV								
Add on Course (Professional English)	2 (2)	2 (2)	2 (2)	2 (2)	-	-	8	8
NMEC (Non-Major Elective Course)	2 (2)	2 (2)	-	-	-	-	4	4
SEC (Skill Enhancement Course)	2 (2)	2 (2)	-	-	-	2 (2)	6	6
AEC (Ability Enhancement Course)	-	-	-	-	2 (2)	-	2	2
Total	**30(21)**	**30(25)**	**30(20)**	**30(24)**	**30(22)**	**30 (28)**	**180**	**140**
Non Academic Courses								
Part V								
*FC I: Values for Life	-	(1)					-	1
*FC II: Personality Development			-	(1)			-	1
*FCIII: Human Rights Education					(1)		-	1
*FC IV: Gender Equity Studies						(1)	-	1
*SLP-Community Engagement Course		(1)	(1)				-	2
*SLP-Extension activity (RUN)			(1)	(1)			-	2
*STP - Clubs & Committees / NSS		(1)		(1)			-	2

Total number of Hours = 180

Total number of Compulsory Credits = 140+10

* Mandatory Courses conducted outside the regular working hours.

Skill Development Programme(Mandatory Certificate Course - 30 hours) offered for all first year students

Courses offered

Semester	Course Type	Course Code	Title of the Course	Hours /Week	Credits
I	**Part I**	TL2011/ FL2011	Language: Tamil / French	6	4
	Part II	GE2011	General English	6	4
	Part III	ZC2011	Major Core I: Invertebrate Zoology	4	4
		ZC20P1	Major Practical I	2	-
		CA2011	Allied I: Theory	4	3
		CA20P1	Allied I: Practical	2	-
	Part IV	ALS201	Add on course: Professional English for Life Sciences	2	2
		ZNM201	Non Major Elective: Public Health and Hygiene	2	2
		SEC201/ SEC202	Skill Enhancement Course (SEC): Meditation and Exercise/ Computer Literacy	2	2
	Part V	FCV201	Foundation Course I: Values for Life	-	-
		STP201	Student Training Programme (STP): Clubs & Committees / NSS	-	-
II	**Part I**	TL2021/ FL2021	Language: Tamil/French	6	4
	Part II	GE2022	General English	6	4
	Part III	ZC2021	Major Core II: Chordate Zoology	4	4
		ZC20P1	Major Practical I: Invertebrate Zoology &Chordate Zoology	2	2
		CA2021	Allied I: Theory	4	3
		CA20P1	Allied I: Practical	2	2
	Part IV	ALS202	Add on course: Professional English for Life Sciences	2	2
		ZNM202	Non Major Elective: Common Ailments and Simple Remedies	2	2
		SEC201/ SEC202	Skill Enhancement Course (SEC): Meditation and Exercise/ Computer Literacy	2	2
	Part V	FCV201	Foundation Course I: Values for Life	-	1
		SLP201	Service Learning Programme (SLP): Community Engagement Course	-	1
		STP201	Student Training Programme (STP): Clubs & Committees / NSS	-	1
	Part I	TL2031/	Language: Tamil / French	6	4

III		FL2031			
	Part II	GE2031	General English	6	4
	Part III	ZC2031	Major Core III: Cell Biology	4	4
		ZC2032 ZC2033 ZC2034	Major Elective I: (a) Biochemistry, Biophysics and Biostatistics/ (b) Bioinformatics/ (c) Wildlife Biology	4	3
		ZC20P2	Major Practical II	2	-
		BA2031	Allied II: Theory	4	3
		BA20P1	Allied II: Practical	2	-
	Part IV	ALS203	Add on course: Professional English for Life Sciences	2	2
	Part V	FCV202	Foundation Course II: Personality Development	-	-
		SLP201	Service Learning Programme (SLP): Community Engagement Course	-	1
		SLP202	Service Learning Programme (SLP): Extension Activity (RUN)	-	1
		STP201	Student Training Programme (STP): Clubs & Committees / NSS	-	-
IV	**Part I**	TL2041/ FL2041	Language: Tamil / French	6	4
	Part II	GE2041	General English	6	4
	Part III	ZC2041	Major Core IV: Genetics	4	4
		ZC2042 ZC2043 ZC2044	Major Elective II: (a) Clinical Laboratory Technology/ (b) Animal Care & Services/ (c) Entomology	4	3
		ZC20P2	Major Practical II: Cell BiologyandElective I &Genetics and Elective II	2	2
		BA2041	Allied II: Theory	4	3
		BA20P1	Allied II: Practical	2	2
	Part IV	ALS204	Add on course: Professional English for Life Sciences	2	2
	Part V	FCV202	Foundation Course II: Personality Development	-	1
		SLP202	Service Learning Programme (SLP): Extension Activity (RUN)	-	1
		STP201	Student Training Programme (STP): Clubs & Committees / NSS	-	1
	Part III	ZC2051	Major Core V: Physiology	6	6

V		ZC2052	Major Core VI: Biotechnology	6	6
		ZC2053	Major Core VII: Ecology and Toxicology	6	5
		ZC20PR	**Project	4	3
		ZC20P3	Major Practical III Physiology & Biotechnology	4	-
		ZC20P4	Major Practical IV Ecology and Toxicology& Organic Evolution	2	-
	Part IV	AEC201	Ability Enhancement Course (AEC):Environmental Studies	2	2
	Part V	FCV203	Foundation Course III: Human Rights Education	-	1
VI	**Part III**	ZC2061	Major Core VIII: Developmental Zoology	6	6
		ZC2062	Major Core IX: Immunology and Microbiology	6	6
		ZC2063	Major Core X: Organic Evolution	6	5
		ZC2064 ZC2065 ZC2066	Major Elective III: (a) Economic Zoology/ (b) Sericulture/ (c) Aquaculture	4	3
		ZC20P3	Major Practical III: Physiology & Biotechnology	-	2
		ZC20P4	Major Practical IV: Ecology and Toxicology& Organic Evolution	2	2
		ZC20P5	Major Practical V:Developmental Zoology & Immunology and Microbiology	4	2
	Part IV	ZSK206	*** Skill Enhancement Course (SEC): Vermitechnology	2	2
	Part V	FCV204	Foundation Course IV: Gender Equity Studies (GES)	-	1
			TOTAL	**180**	**150**

**Project of the fifth semester is a Subject based group project (5 students per group). Individual viva voce will be conducted for the group project.

*** SEC for the VI semester is offered by the department.

Self-Learning Courses - Extra Credit Courses

Semester	Course code	Title of the Course	Hours / Week	Credits
III / V	ZC20S1	Ornamental Fish Culture	-	2
IV / VI	ZC20S2	Nutrition and Dietetics	-	2
I/II/III/IV /V/VI	ZC20S3	Online Course (MOOC – Swayam/ NPTEL)	-	2

Value Added Courses

S.No.	Course code	Name of the course	Total hours
I	VAZ201	First Aid	30
II	VAZ202	Household Waste Management	30

Instruction for Course Transaction

Distribution of total Hours for Theory(Major Core)

Components	Sem. I	Sem. II	Sem. III	Sem. IV	Sem. V	Sem. VI
Lecture hours	45	45	45	45	60 / 75	60 / 75
Continuous Internal Assessment (CIA):						
Internal Test (2)	5	5	5	5	5	5
Quiz (2)	1	1	1	1	1	1
Class test (3) - Open book test (objective type questions)/ Slip test	3	3	3	3	3	3
Class assignment (Mind map / Flow chart)/ Group discussion/ Field assignment/ Problem solving	6	6	6	6	6	6
Total Hours	**60**	**60**	**60**	**60**	**75 / 90**	**75 / 90**

Distribution of total Hours for Theory(Elective/ Allied)

Components	Elective				Allied	
	Sem. III	Sem. IV	Sem. V	Sem. VI	Sem. I/III	Sem. II/ IV
Lecture hours	45	45	45	45	45	45
Continuous Internal Assessment (CIA):						
Internal Test (2)	5	5	5	5	5	5
Quiz (2)	1	1	1	1	1	1
Class test (3) - Open book test (Objective type questions)/ Slip test	3	3	3	3	3	3
Class assignment (Mind map / Flow chart)/ Group discussion/ Field assignment/ Problem solving	6	6	6	6	6	6
Total Hours	**60**	**60**	**60**	**60**	**60**	**60**

Distribution of total Hours for Practicals

Major	**Semester**	**Hours /Week**	**Total hours / semester**
	I / II / III / IV	2	30
	V / VI	2 + 2 + 2 = 6	90
Allied	**I / II / III / IV**	2	30

Examination Pattern

Ratio of Internal and External= 30:70

Continuous Internal Assessment (CIA)

i) Part III (Major/ Major Elective/ Allied)

Internal Components and Distribution of Marks

Component	**Marks**
Internal Test (2)	15
Quiz (2)	4
Class Test (3)	6
Class assignment/ Home assignment/ Field assignment/ Article review/ Group discussion/ Problem solving	5
Total	**30**

Question Pattern – Internal and External Examination

Internal Test	**Marks**	**External Exam**	**Marks**
Part A 4 x 1	4	Part A 10 x 1 (No choice)	10
Part B 3 x 4	12	Part B 5 x 4 (Internal choice)	20
Part C 3 x 8	24	Part C 5 x 8 (Internal choice)	40
Total	**40**	**Total**	**70**

Practical Examination Pattern

Major & Allied papers

Ratio of Internal and External =**40 : 60** marks

Total : 100 marks

Internal Components and Distribution of Marks

Internal Component	Marks
Performance of the experiments	10
Regularity in attending practical and submission of records	10
Record	5
Model exam	15
Total	**40**

Question pattern forExternal Examination

External Exam	Marks
Major Practical (2 x 20)	40
Spotters (6 x 2.5)	15
Record	5
Total	**60**

ii) Part IV

Ratio of Internal and External = 50: 50

a) Add-on Course: Professional English for Life Sciences

Internal Components and Distribution of Marks

Internal Component	Marks
Listening and Speaking	25
Reading and Writing	25
Total	**50**

Question pattern forExternal Examination

External Exam	Marks
Written Test : Open choice – 5 out of 7 questions (5 x 10)	50
Total	**50**

b) Non-major Elective Course (NMEC)

Continuous Internal Assessment (CIA)
Internal Components and Distribution of Marks

Internal Component	Marks
Internal Test (2)	20
Quiz (2 quizzes)	15
Class assignment/ Home assignment/ Project report	15
Total	**50**

Question Pattern for Internal & External Examination

Internal Test	Marks	External Exam	Marks
Part A 4 x 1 (No Choice)	4	Part A 5 x 1 (No Choice)	5
Part B 3 x 4 (Internal Choice)	12	Part B 5 x 3 (Internal Choice)	15
Part C 3 x 8 (Internal Choice)	24	Part C 5 x 6 (Internal Choice)	30
Total	**40**	**Total**	**50**

c) Skill Enhancement Course (SEC) Computer Literacy

Internal Components

Component	Marks
Objective type questions (30x1)	30
Exercise (Book) compulsory (2x10)	20
Total	**50**

External Components

Component	Marks
Exercise 1	20
Exercise 2	10
Procedures for both Exercises	20
Total	**50**

d) Meditation and Exercise
Internal Components

Component	Marks
Objective type questions (20x1)	20
Exercise (2x10)	20
Assignment	10
Total	**50**

External Components

Component	Marks
Quiz	20
Written assessment: open choice - 10 out of 15 questions (10x3)	30
Total	**50**

e) Ability Enhancement Course (AEC)
Environmental Studies
Internal Component

Component	Marks
Project Report	30
Viva voce	20
Total	**50**

External Component

Component	Marks
Quiz	20
Written Test(open choice - 10 out of 15 questions (10x3)	30
Total	**50**

iii) Part V: Foundation course (Values for life, Personality development, Human rights education and Gender equity studies)

Ratio of Internal and External = 50: 50

a) Foundation Course I: Values for Life

Internal Components

Component	Marks
Song, Mime, Skit	20
Book Activities	20
A Kind Action	10
Total	**50**

External Components

Component	Marks
Quiz	20
Written Test: Open choice – 5 out of 7 questions (5 x 6)	30
Total	**50**

b) Foundation Course II: Personality Development

Internal Components

Component	Marks
Exercise from book	20
Skit	10
Group Album	20
Total	**50**

External Components

Component	Marks
Quiz	20
Written Test: Open choice – 5 out of 7 questions (5 x 6)	30
Total	**50**

c) Foundation Course III: Human Rights Education

Internal Components

Component	Marks
Album on current issues	20
Group Song/ Mime/ Skit	10
Open book test (Objective type questions)	20
Total	**50**

External Components

Component	Marks
Quiz	20
Written Test: Open choice – 5 out of 7 questions (5 x 6)	30
Total	**50**

d) Foundation Course IV: Gender Equity Studies

Internal Components

Component	Marks
Album on current issues	20
Group Song/ Mime/ Skit	10
Open book test (Objective type questions)	20
Total	**50**

External Components

Component	Marks
Quiz	20
Written Test : Open choice – 5 out of 7 questions (5 x 6)	30
Total	**50**

e) SLP -Community Engagement Course (CEC)

(Field Work – 15 hours; Class Hours – 15 hours)

Internal Components

Component	Marks
Assignment	10
Group Discussion	10
Attendance (Field work)	30
Total	**50**

External Components

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

f) SLP – Service Learning Programme: Reaching the unreached Neighbourhood (RUN)

- 60 Hours mandatory programme included in the curriculum (2 credits)

g) STP – Student Training Programme

- Compulsory for all I & II year students (2 credits).
- Clubs and Committees – Eco Club, YRC, Rotaract Club, NSS/ RRC, AICUF, Consumer Club, Sports, Legal Literacy and Women's Cell.
- Each student can opt for any one of the clubs/ committees.

iv) SLC - Self learning course

Ratio of Internal and External = 30: 70

Internal Components: Internal Test (2)

Question Pattern – Internal and External Examination

Internal Test	Marks	External Exam	Marks
Part A 10 x 1(No choice)	10	Part A 20 x 1 (No choice)	20
Part B 3 x 4 (Internal choice)	12	Part B 5 x 4 (Internal choice)	20
Part C 3 x 6 (Open choice – any 3 out of 5)	18	Part C 3 x 10 (Open choice – any 3 out of 5)	30
Total	**40**	**Total**	**70**

Semester I
Major Core I: Invertebrate Zoology
Course Code: ZC2011

No. of Hours/ Week	No. of Credits	Total Hours	Marks
4	4	60	100

Objectives

1. To know the difference between protozoa and metazoa, and to study the structure, functional organization, adaptations of invertebrates.
2. To develop the skill of identification of invertebrates and to promote employability in museum, consultancy firms and educational institutions.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	identify the fundamental principles of systematics and classify according to their characters.	PSO - 1	R
CO - 2	compare functional organization and their relationship with the environment.	PSO - 2	U
CO - 3	apply and communicate the information about Invertebrates for life - long learning.	PSO - 4	Ap
CO - 4	analyse the ecological and economic importance of invertebrates.	PSO - 3	An
CO - 5	evaluate animal diversity and initiate their career opportunities.	PSO - 2	E
CO - 6	observe, draw and synthesize information about invertebrates in laboratory and field conditions to enhance research.	PSO - 4	C

Unit I **(12 hrs.)**

Zoological nomenclature – Rules and regulations, Classification of Animal Kingdom. Levels of organization: Grades of organization, symmetry and coelom. **Protozoa**: General characters and classification up to classes with names of examples only. Type study: *Paramecium* – Structure, osmo-regulation and reproduction (binary fission and conjugation). Locomotion and Nutrition in Protozoa.Malaria and Amoebiasis (causes, symptoms, prevention and control).

Unit II **(12 hrs.)**

Porifera: General characters and classification up to classes with names of examples. Type study: *Leucosolenia* – external morphology – body wall - reproduction. Canal system in

sponges.**Coelenterata:** General characters and classification up to classes with names of examples only. Type study: *Obelia*- Polymorphism and metagenesis. Corals, Coral reefs and their significance.

Unit III **(12 hrs.)**

Platyhelminthes: General characters and classification up to classes with names of examples only. Type study: Liver fluke (structure and life cycle), Tape worm (structure). **Aschelminthes:** General characters and classification up to classes with names of examples only. Pathogenicity and control measures of *Ascarislumbricoides, Wuchereriabancrofti, Enterobiusvermicularis, Ancylostomaduodenale* and *Dracunculusmedinensis*.Parasitic adaptations of Helminthes.

Unit IV **(12 hrs.)**

Annelida: General characters and classification up to classes with names of examples only. Type study: Earthworm (structure and nephridia). Metamerism in Annelida.**Arthropoda:** General characters and classification up to classes with names of examples. Type study: *Penaeus*- external characters, appendages, compound eye, reproductive system and life cycle. Mouthparts of insects.Pest of Paddy (*Leptocorisavaricornis*), Coconut (*Oryctes rhinoceros*).

Unit V **(12 hrs.)**

Mollusca: General characters and classification up to classes with names of examples only. Type study: Pila - external characters – shell - pallial complex - digestive system - respiratory system. Cephalopods as advanced molluscs.**Echinodermata:** General characters and classification with names of examples only. Type study: Star fish – external characters and water vascular system. Larval forms of Echinoderms and their phylogenetic significance.

Textbook

Jordan, E.L. and Verma, P.S. (2010).*Invertebrate Zoology*. New Delhi: S. Chand & Co. Ltd.

Reference Books

1. Kotpal, R.L. (2004). *Modern Textbook of Zoology- Invertebrates* **(**9th ed.). Meerut: Rastogi Publications.
2. Ayyar, E.K. and Ananthakrishnan, T.N. (1995). *Manual of Zoology, Vol. I (Invertebrata), Part I & II.* Madras: S. Viswanathan Printers and Publishers Pvt. Ltd.
3. Dhami, P.S. and Dhami, J.K. (1979). *Invertebrate Zoology.* Ram Nagar, New Delhi: S. Chand & Co. Ltd.
4. Jain, A.P. (2002). *Biology of Invertebrates* (4th ed.). New Delhi: Tata McGraw-Hill Publishing Company Ltd.
5. George Gaylord Simpson (2018). *Principles of Animal Taxonomy*. India: Scientific Publishers.
6. Lal, S.S. (2004). *A Text Book of Practical Invertebrate Zoology*. Meerut: Rastogi Publications.

Semester I
Major Practical I: Invertebrate Zoology & Chordate Zoology
Course Code: ZC20P1
(Conducted during Semester I & II)

No. of Hours/ Week	No. of Credits	Total Hours	Marks
2 + 2	2	60	100

Objectives

1. To impart practical knowledge on morphology and anatomy of invertebrates and chordates.
2. To reinforce the basic laboratory skills including microscopy, dissection and observation of animal diversity.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	identify the systematic position of selected invertebrates and chordates through observation of live and preserved specimens.	PSO - 1	R
CO - 2	describe the external morphology and biological significance of invertebrates and chordates.	PSO - 4	U
CO - 3	apply technical and creative skills through teamwork.	PSO - 3	Ap
CO - 4	analyse the different taxonomic groups based on anatomy and structural arrangements.	PSO - 2	An

Invertebrate Zoology

Observation

1. Observation of live *Paramecium* – Hay culture
2. Observation of spicules – Sponge

Mounting

3. Mouthparts – cockroach and mosquito
4. Cockroach - salivary gland apparatus
5. Cockroach – trachea
6. Appendages of prawn.

Dissection

7. Cockroach - Digestive system
8. Cockroach - Nervous system

Taxonomic study

9. Grouping of given Invertebrates as per their systematic position.
10.Taxonomic study of insectsupto class giving key identification, selecting any 5 locally available common examples and recording them.

Spotters

Amoeba, *Euglena*, *Spongilla*, Sponge gemmule, *Obelia*, Coral (Fungia), Liver fluke, Tapeworm, *Ascaris* (Male and Female), Nereis, Leech, *Penaeus*, *Oryctes rhinoceros*, *Leptocorisavaricornis*, Pila, *Lamellidens*, *Pinctada*, Sepia, Octopus, Chiton, Starfish, Sea urchin, Sea Cucumber. Larval forms:Cercaria, Trochophore, Nauplius, Zoea, Bipinnaria.

Semester I
Add on Course: Professional English for Life Sciences
Course Code: ALS201

No. of Hours/ Week	No. of Credits	Total Hours	Marks
2	2	30	100

Objectives

1. To enhance the lexical, grammatical and socio-linguistic and communicative competence in an increasingly complex, interdependent world.
2. To develop intellectual flexibility, creativity and critical thinking skills of students by offering adequate practice in professional contexts.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	recognise the words used in life science and improve their competence in using the language.	1	R
CO - 2	Comprehend unfamiliar texts and describe biological processes.	2	U
CO - 3	apply language for speaking and writing with confidence in an intelligible and acceptable manner.	3	Ap
CO - 4	apply critical and theoretical approaches to the reading and analysis of various texts in life sciences.	3	Ap
CO - 4	analyze critically, negotiate and present without committing errors and develop entrepreneurship skills.	4	An

Unit I **(6 hrs.)**

Communication

1. Listening to Audio Text & answering Questions
2. Pair Walk
3. Comprehension passage
4. Developing a story with pictures
5. Vocabulary

Unit II **(6 hrs.)**

Description

1. Listening to Process Description – Online shopping
2. Speaking – Role play – sample 1
3. Reading Passages on Products
4. Process Description – Compare & Contrast
5. Vocabulary

Unit III **(6 hrs.)**

Negotiation Strategies

1. Listening to interviews of specialists
2. Brainstorming (Mind mapping)
3. Economic System (Longer Reading Text)
4. Why learn the skill of writing an essay
5. Vocabulary

Unit IV **(6 hrs.)**

Presentation Skill

1. Listening to Lecture – I
2. Short Talks – I
3. Reading comprehension – passage I
4. Writing Recommendations
5. Vocabulary

Unit V **(6 hrs.)**

Critical Thinking Skills

1. Listening Comprehension
2. Speaking – Making Presentation – Task 1 & 2
3. Reading – Comprehension Passages, Note making
4. Writing - Problem & Solution Essays, Creative writing
5. Vocabulary

Textbook

Tamil Nadu State Council for Higher Education (TANSCHE).*Professional English for Life Sciences – I.*

Semester I
NME I: Public Health and Hygiene
Course Code: ZNM201

No. of Hours/ Week	No. of Credits	Total Hours	Marks
2	2	30	100

Objectives

1. To understand the various aspects of health and hygiene and to practice a healthy life.
2. To develop skill for personal care and maternal health for the betterment of society.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	describe personal health with respect to skin, hair, eye, ear and teeth.	PSO - 1	R
CO - 2	explain the concepts of health and nutrition in relation to physical, mental, social and spiritual fitness.	PSO - 1	U
CO - 3	analyse BMI and personal hygiene.	PSO - 3	An
CO - 4	evaluate food quality, housing standards and good sanitation.	PSO - 2	E
CO - 5	apply the knowledge of maternity, child health and Swachh Bharat Mission.	PSO - 4	Ap

Unit I **(6 hrs.)**

Nutrition and health: Concept of health. Food pyramid.Snacking and Fast food. BMI - obesity - malnutrition (Kwashiorkor and Marasmus). Food hygiene, food toxicants and adulterants.

Unit II **(6 hrs.)**

Personal health care: General care of skin, hair, teeth, eye and ear. Personal hygiene.

Unit III **(6 hrs.)**

Maternal and Child health: Motherhood -pregnancy confirmation - common problems during pregnancy - labour and delivery - postnatal care. Vaccination schedule in India. Family planning.

Unit IV **(6 hrs.)**

Environment and Health: Standards of housing. Sanitary health measures during fairs and festivals. Swachh Bharat Mission and Swachhata Hi Seva. Precautions during pandemic situations.

Unit V **(6 hrs.)**

First aid: First aid procedures for dehydration, heart attack, poisoning, electric shocks, drowning, snake bite, road accidents and fire accidents.

Textbook

Sorna Raj, R., Kumaresan, V. (2012). *Public Health and Hygiene***.**Nagercoil: Saras Publication.

Reference Books

1. Park, K. (2005). *Park's Textbook of Preventive and Social Medicine* (18th ed.). Jabalpur: M/S. BanarsidasBhanot Publishers.
2. LakshmanaSarma, K. &Swaminathan, S. (2011). *Speaking of Nature Cure*. New Delhi: Sterling Publications Pvt. Ltd.
3. Hoon, R.S. (1983). *First aid to the Injured*. New Delhi: Published by St. John Ambulance Association, Printed at The Statesman's Press.
4. Rae Bains (1984). *Health and Hygiene.* USA: Troll Associates Publisher.

Semester I/II
Skill Enhancement Course (SEC): Meditation and Exercise
Course Code: SEC 201

No. of hours per week	Credit	Total No. of hours	Marks
2	2	30	100

Objectives

1. To promote good - health and emotional stability among students.
2. To increase relaxation of body and mind.
3. To equip the students with traditional understanding of yogasanas and meditation.
4. To prevent stress-related health problems.

Unit I: Physical Health

Physical Structure of Human Body- Five Factors to Balance in Life- Nadisuthi- Neuro-Muscular Breathing Exercises - Eye exercises - Kapalabathi.

Unit II: Yogasanas

Surya Namaskar- Eka Pada Asana **(**Viruchchasana**) -** Chakrasana (sideways) - Uthkadasana - Padmasana- Vajrasana- PachiMothasana- Navasana- PavanaMukthasana- Salabhasana- Dhanurasana- Makkarasana.

Unit III: Mind

Mind-Mental frequency- Meditation- Benefits of Meditation.

Unit IV: Personality Development

Analysis of Thought - Six roots for thought – Introspection for analysis of thought - Practical technique for analysis of thought - Moralization of desire - Analysis of desire - Practical technique for moralization of desire

Unit V: Human Resources Development

Eradication of worries- Analyse your problems and eradicate worry - Practical exercise to eradicate worries- Benefits of Blessings - Effect of good vibrations - practicing blessing a daily habit.

Text Book:

Value Education - Vision for Wisdom World Community Service Centre ,Aliyar.

Reference books:

1. Handbook on Yoga-N.C. Narayanan
2. Simplified Physical Exercises - ThathuvagnaniVethathiri Maharishi
3. Mind - ThathuvagnaniVethathiri Maharishi
4. Yoga for modern age - ThathuvagnaniVethathiri Maharishi.
5. Yogasanas-- Vision for Wisdom World Community Service centre ,Aliyar.

Value Added Course

First Aid
Course Code: VAZ201

Total Number of Hours	Theory Hours	Training Hours
30	15	15

Learning Objectives

1. To give initial care to a person in distress to save from casualty.
2. To deal with first aid emergencies in any situation.
3. To understand and demonstrate lifesaving skills.

Course outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	identify the responsibilities of a First Aider.	PSO - 4	R
CO - 2	assess the incident and manage responsive and unresponsive causality.	PSO - 3	U
CO - 3	administer first aid to a casualty with injuries, burns, poisoning, bleeding and cardiac arrest.	PSO - 4	Ap
CO - 4	gain employability as a first aider in institutions.	PSO - 4	Ap

Unit I

Care of the unconscious: Causes of unconsciousness: Diabetes, Epileptic seizures, head injury, Fainting, heart attack, Cardiac Pulmonary Resuscitation (CPR), electric injury, choking, stroke - principles of treatment - patient approach - call for emergency.

Unit II

Bleeding: Hemorrhage - internal, external. Wounds - Amputation-nose bleeds. Principles of treatment - patient approach- call for emergency.

Unit III

Burns and extremes of temperature: Burns- Causes, signs and symptoms. Hypothermia-hyperthermia.Heat stroke. Principles of treatment- patient approach - call for emergency.

Unit IV

Bites and stings: Types of bites and stings- treatment. Patient approach- call for emergency. Foreign body in eye, ear and nose: Type of foreign body-treatment. Patient approach - call for emergency.

Unit V

Injuries and Poisoning: Fractures and injuries: Bone and joint injury- head injury- dislocations-treatment. Patient approach- call for emergency.Poisoning: Chemicals - noxious gasses and food poisoning - treatment.Patient approach- call for emergency.

Reference Books

1. Hoon, R.S. (1983). *First aid to the Injured*. New Delhi: Published by St. John Ambulance Association, Printed at The Statesman's Press, New Delhi.
2. Norman G. Kirby and Stephen J. Mather (2005).*Bailliere's Handbook of First Aid* (7^{th}ed.). Delhi: I.T.B.S. Publishers and Distributers.
3. Eva Roman (2008). *First aid*. New Delhi: Indiana Publishing House.

Semester II
Major core II: Chordate Zoology
Course Code: ZC2021

No. of Hours/ Week	No. of Credits	Total Hours	Marks
4	4	60	100

Objectives

1. To impart knowledge on the systematic position, structure, functional organization, adaptation and the economic importance of chordates.
2. To develop real time skills on identification of major groups of chordates to gain employment in academic and research institutions.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	identify the systematic position and describe the biological significance of chordates.	PSO - 1	R
CO - 2	recognize different chordates based on their salient features.	PSO - 1	U
CO - 3	compare the morphology and anatomy of selected chordates.	PSO - 3	An
CO - 4	assess the structural, physiological, ecological and behavioural adaptations pertaining to their mode of life.	PSO - 2	E
CO - 5	design experiments to relate chordates with their environment.	PSO - 2	C
CO - 6	disseminate knowledge on chordates to excel in research and entrepreneurship initiatives.	PSO - 4	Ap

Unit I **(12hrs.)**

Introduction to Chordata: General characters of chordates and classification up to classes with names of examples. **Prochordata**: General characters and classification up to classes with examples. Type study: *Amphioxus* - external features, digestive system and excretory system. External features and biological significance of the following: *Ascidian, Balanoglossus*, *Salpa*. Agnatha: *Petromyzon* - externalmorphology, Ammocoeteslarva.

Unit II **(12 hrs.)**

Pisces: General characters and classification up to subclasses with names of the examples. Type study: *Scoliodon*- external characters, placoid scales, digestive system, respiratory system, circulatory system, nervous system, receptor organs, urino-genital system. Accessory respiratory organs in fishes, Migration of fishes, Lungfishes - Dipnoi.

Unit III (12 hrs.)

Amphibia: General characters and classification up to orders with names of the examples. Type study: Frog – external characters, endoskeleton: skull, typical vertebra, atlas, girdles and limbs. Biological significance of Axolotl larva, *Ichthyophis*.Parental care in Amphibia.**Reptilia:** General characters and classification up to orders with names of the examples only. Type study: *Calotes* – external characters, circulatory system and excretory system. Identification and study of poisonous snakes in India - first aid for snake bite and anti-venom.

Unit IV (12 hrs.)

Aves: General characters and classification up to sub classes with names of the examples. Type study: *Columba livia* - external characters, exoskeleton, flight muscles, digestive system, respiratory system and urino-genital system. Migration of birds, flight adaptation in birds, flightless birds (Ratitae): general characters and examples.

Unit V

(12hrs.)Mammalia: General characters and classification up to subclasses with names of the examples. Type study: Rabbit - external morphology, structure of skin, dentition, digestive system, respiratory system, urinogenital system. Structure of heart and brain.Egg laying mammals.Pouchedmammals.Adaptations of aquatic mammals.

Textbook

Jordan, E.L. and Verma, P.S. (2010). *Chordate Zoology*(11th ed.). New Delhi: S. Chand and Company Ltd.

Reference Books

1. EkambaranathaAyyar, M. and Ananthakrishnan, T.N. (1995).*A Manual of Zoology, Volume II (PartI& II).*Chennai: S. Viswanathan Pvt. Ltd.
2. Kotpal, R. L. (2014). *Modern text book of Zoology – Vertebrates* **(**3rd ed.). Meerut: Rastogi Publications.
3. Dhami P.S and Dhami J.K. (1972).*Chordate Zoology.* New Delhi: S. Chand and Company Ltd.
4. Kardong, K. (2002). *Vertebrates: Comparative Anatomy, Function and Evolution.* Chennai: Tata McGraw Hill Publishing Company Ltd.
5. Young, J. Z. (2004). *The Life of Vertebrates* (3rd ed.). London: Oxford University Press.
6. Verma P.S. (2010).*A manual of Practical Zoology* (*Chordates*).New Delhi: S. Chand & Co. Ltd.

Semester II
Major Practical I: Invertebrate Zoology & Chordate Zoology
Course Code: ZC20P1
(Conducted during Semester I & II)

No. of Hours/ Week	No. of Credits	Total Hours	Marks
2 + 2	2	60	100

Objectives

1. To impart practical knowledge on morphology and anatomy of invertebrates and chordates.
2. To reinforce the basic laboratory skills including microscopy, dissection and observation of animal diversity.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	identify the systematic position of selected invertebrates and chordates through observation of live and preserved specimens.	PSO - 1	R
CO - 2	describe the external morphology and biological significance of invertebrates and chordates.	PSO - 4	U
CO - 3	apply technical and creative skills through teamwork.	PSO - 3	Ap
CO - 4	analyse the different taxonomic groups based on anatomy and structural arrangements.	PSO - 2	An

Chordate Zoology

1. Mounting: Placoid, Cycloid and Ctenoid scales.
2. Fish: Digestive system
3. Frog: Arterial system*.
4. Frog: Brain*.
5. Frog: Urinogenital system*
5. Reptiles: Key for identification of poisonous and non-poisonous snakes.
6. Pigeon:

i. Identification of feathers.
ii. Digestive system*
iii. Respiratory system*

7. Submission of "Animal Album" containing photographs or paper cuttings of locally available chordates of different taxa with brief write-up.

8. Maintenance of campus Bird-watcher's Diary (group work).

9. Field visit to places of Zoological importance.

10. Grouping of given chordate as per their systematic position.

* Models/ Chart/ CD can be used. Students have to draw the diagram and write detailed account in the observation notebook.

Museum specimens / slides / charts:

Amphioxus, *Balanoglossus*, *Ascidian*, *Petromyzon*, Ammocoetes larva, *Narcine*, *Hippocampus*, *Anguilla*, *Rhacophorus*, Axolotl larva, *Ichthyophis*, Salamander, *Chamaeleon*, *Draco*, *Chelone*, Cobra, Woodpecker, Pelican, Penguin, Pangolin, Kangaroo, Bat, Loris, Whale. Endoskeleton of Frog - typical vertebra, atlas, pectoral girdle, pelvic girdle, forelimb skeleton and hind limb skeleton.

Virtual laboratory / CD can be used as and when necessary.

Semester II
Part IV
Add on Course- Professional English for Physical Sciences-II
Course Code: APS202

Hours/ Week	Credit	Total Hours	Marks
2	2	30	100

Objectives

1.To develop the language skills of students by offering adequate practice in professional contexts

2.To develop strategic competence that will help in efficient communication

Course Outcomes

CO	Upon completion of this course, students will be able to:	PSO addressed	CL
CO - 1	recognise their own ability to improve their own competence in using the language	**PSO - 1**	U
CO - 2	use language for speaking with confidence in an intelligible and acceptable manner	**PSO - 6**	Ap
CO - 3	understand the importance of reading for life	**PSO - 1**	U
CO - 4	Understand the importance of writing in academic life	**PSO - 1**	U
CO - 5	Write simple sentences without committing error of spelling or grammar	**PSO - 7**	An

Unit I
Communication:

1.Listening to instruction

2.Small Group Work

3.Comprehension- Difference between facts & opinions

4.Developing a short poem with pictures

5.Vocabulary

Unit II
Description:

1.Listening to Process Description - Cartographic Process

2.Speaking – Role play – sample 2

3.Reading Passages on Equipments& gadgets
4.Paragraph: Sentence Definition & Extended Definition, Free writing
5.Vocabulary

Unit III

Negotiation Strategies:

1.Listening to interviews of inventors in fields
2.Small Group Discussion – Specific
3.Longer reading text –The Art of Loving
4.Essay Writing – Solidarity
5.Vocabulary

Unit IV

Presentation Skill:

1.Listening to Lecture – 2
2.Short Talks – Poverty and the need to alleviate it
3.Reading comprehension – passage 2
4.Interpreting Visual Inputs
5.Vocabulary

Unit V

Critical Thinking Skills:

1.Listening for Information
2.Making Presentation task 3& 4
3.Motivational Articles on Professional Competence, Professional Ethics & Life Skill
4.Problem & Solution Essays, Summary Writing
5.Vocabulary

Reference Book

1. TANSCHE (2020).Professional English for Physical Sciences, *First* edition

Semester II
NMEC II: Common Ailments and Simple Remedies
Course Code: ZNM202

No. of Hours/ Week	No. of Credits	Total Hours	Marks
2	2	30	100

Objectives

1. To create awareness on the changing lifestyle and its impact on human health.
2. To develop skills on disease management to form a healthy society.

Course outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	enumerate the symptoms of common diseases.	PSO - 1	R
CO - 2	summarise common health problems like anaemia, diabetes, skin and dental problems and old age ailments.	PSO - 1	U
CO - 3	apply preventive strategies to develop healthy society.	PSO - 3	Ap
CO - 4	analyse the problems of changing lifestyle and its impact on human health.	PSO - 4	An
CO - 5	evaluate the simple remedies for common ailments.	PSO - 2	E

Unit I **(6 hrs.)**

Blood related ailments: causes, symptoms and control of anaemia, blood pressure, diabetes and jaundice.

Unit II **(6 hrs.)**

Digestive disorders: causes, symptoms and control of dental caries and pyorrhea, typhoid, diarrhea and chronic constipation.

Unit III **(6 hrs.)**

Respiratory diseases: causes, symptoms and control of common cold, cough, primary complex, asthma and headache.

Unit IV **(6 hrs.)**

Vector borne diseases: causes, symptoms and control of dengue fever, malaria and epidemic conjunctivitis.

Unit V **(6 hrs.)**

Old age related ailments: causes, symptoms and treatments of osteoporosis, Parkinson's disease, Alzheimer's disease and arthritis.

Textbook

John M. Fowler (1970). *Radiant Living*. Pune: Oriental Watchman Publishing House.

Reference Books

1. Chugh, S.N. (2006). *Emergency Medicine* (2nd ed.). India: PeePee Publishers and Distributors Pvt. Ltd.
2. Clifford R. Anderson (1999). *Your Guide to Health*. Pune: Oriental Watchman Publishing House.
3. Chawla, N.P.S. (1994). *Penguin India Family Medical Encyclopaedia.*New Delhi: Penguin Book Publication.
4. ValantineFuster, R. & Wayne Alexander (2001). *The Heart* (10th ed.). USA: McGraw-Hill Publications.
5. Anne McIntyre (1994). *Simple Home Remedies for Common Ailments*. USA: Gaia Books Publisher.

Semester I / II
Skill Enhancement Course (SEC): Computer Literacy
Course Code: SEC202

Hours/Week	Credits	Total no. of hours	Total marks
2	2	30	100

Objective
To enable students to understand the basic working of ms office which includes ms word, excel and powerpoint.

Unit I
Microsoft Word: Starting MS-Word – Introduction to word 2007 user interface – Understanding document views – Creating a new document – Saving a file – Printing a document – Opening an existing file – Microsoft word 2007 basic features.

Unit II
Formatting text – Formatting paragraphs – Graphics – Tables – Page Setup – Bullets and Numbering – Columns and Ordering – Text Boxes – Mail Merge.

Unit III
Microsoft Excel: Starting MS- Excel – Introduction to Excel 2007 user interface – Creating a New workbook – Saving a workbook – Opening an Existing workbook – Entering data into a cell – Selecting cells – Entering data using autofill – Using merge & center – Sorting data – Creating a table – Formatting a table.

Unit IV
Adjusting cell data alignment – Changing cell data orientation - Adding borders to cell – Basic operations on worksheet – Advanced operations on worksheets – Resizing columns and rows in a worksheet – Using formulas and functions – Charts.

Unit V
Microsoft PowerPoint: The PowerPoint window – PowerPoint views – Create a new presentation - Changing a slide layout – Inserting text on a new slide – Inserting a new slide –
Rearrange the order of slides – Delete a slide – Save a presentation – Applying themes to a presentation – Change background style – Creating a textbox – Format textboxes – Add an image – Format an image – WordArt – Slide transitions – Slide animation - Setup slide show.

Text Book
1.J. AntoHepzie Bai & S. J. Jenepha Mary, “Step Into Microsoft Office 2007”.

LAB EXERCISES

MS WORD

1. Design an Invitation
2. Design a Book Cover
3. Prepare a Calender
4. Mail Merge

MS EXCEL

1. Mark Sheet Preparation
2. Chart
3. Macro
4. Built-in Functions

MS POWERPOINT

1. Creating Resume
2. Birthday Greeting Card

Semester I & II
Foundation Course I - Values for Life
Course Code: FCV201

No. of hours per week	Credit	Total no. of hours	Marks
1	1	30	100

Objectives:

1. To inculcate the importance of values among the students.
2. To instill personal, family, social and religious values among the learners.
3. To equip them as responsible human beings.

Course Outcomes (COs)

CO No.	*Upon completion of this course, the students will be able to:*	PSO Addressed	Cognitive Level
CO-1	understand the human values, its importance and components	PSO-	U
CO-2	applythe values learnt in real life situation	PSO-	Ap
CO-3	comprehend the different personal values and its components	PSO-	U
CO-4	realize the personal values and to practice them	PSO -	Ap
CO - 5	understand the family values	PSO -	U

Unit I

Values – meaning- definition –value education - importance – objectives – essence – components- process - issues to be taught – benefits – significance of values in the present scenario - core value concerns – role of educators

Unit II

Personal Values – importance – purpose – factors that form personal values – components - assistance, truth, hard work, perseverance, respect for elders and teachers.

Unit III

Family Values - types – selfless love and service, sacrifice, Affection, gratitude, sharing humanity, kindness, peace, obedience

Infatuation – love – marriage – relationship

Familial love – brotherly love – sisterly love – parental love – definition – quotes from title

Unit IV

Social values – function – benefits - Components – honesty, integrity, compassion, empathy, commitment, responsibility, discipline, punctuality, respect, courtesy, dedication, attitude.

Unit V

Religious values – faith, belief, forgiveness, surrender.
Prayer – definition – components – types, benefits
God's love and protection – relevant quotes and reflections.

Text Book

Ed. Jansi, Mary, Jeyaseeli, Mary Helen Stella and AnithaMalby.Values for Life.SarasPublication.Nagercoil.

Semester II & III
Service Learning Programme (SLP): Community Engagement Course
Course Code: SLP201

Credits	Total no. of hours	Total marks
2	30 (15 classroom + 15 field)	100 (50 + 50)

Objectives

- To develop an appreciation of rural culture, life-style and wisdom among students
- To learn about the status of various agricultural and rural development programme
- To understand causes for rural distress and poverty and explore solutions for the same
- To apply classroom knowledge of courses to field realities and there by improve quality of learning

Learning Outcomes

After completing this course, student will be able to

- Gain an understanding of rural life, culture and social realities
- Develop a sense of empathy and bond so mutuality with local community
- Appreciate significant contributions of local communities to Indian society and economy
- Learn to value the local knowledge and wisdom of the community
- Identify opportunities for contributing to community's socio-economic improvements

Credit: 2credits, 30hours, atleast 50% in field, compulsory for all students.

Contents:

Course Structure:

2 Credits Course (1Credit for Classroom and Tutorials and 1 Credit for Field Engagement)

S. No.	Module Title	Module Content	Assignment	Teaching/ Learning Methodology	No.of Classes
1	**Appreciation of Rural Society**	Rural lifestyle, rural society, caste and gender relations, rural values with respect to community, nature and resources, elaboration of "soul of India lies in	Prepare a map (physical, visual or digital) of the village you visited and write an essay about inter-family relations in that village.	- Class room discussions - Field visit** - Assignment Map	2 4 2

		villages'(Gandhi), rural infrastructure			
2	**Understanding rural economy & livelihood**	Agriculture, farming, land ownership, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural markets	Rural household economy, its challenges and possible pathways to address them	- Field visit** - Group discussions in class -Assignment	3 4 1
3	**Rural Institutions**	Traditional rural organisations, Self-help Groups, Panchayatiraj institutions (GramSabha, GramPanchayat, Standing Committees), local civil society, local administration	How effectively are Panchayatiraj institutions functioning in the village? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual)	Classroom - Field visit** - Group presentation of assignment	2 4 2
4	**Rural Development Programmes**	History of rural development in India, current national programmes: Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awaas Yojana ,Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA etc.	Describe the benefits received and challenges faced in the delivery of one of these programmes in the rural community; give suggestions about improving implementation of the programme for the rural poor.	- Classroom - Each studentselect soneprogram for fieldvisit** Written assignment	2 4 2

****Recommended** field-based practical activities:

- Interaction with SHG women members, and study of their functions and challenges; planning for their skill building and livelihood activities
- Visit MGNREGS project sites, interact with beneficiaries and interview functionaries at the worksite
- Field visit to Swachh Bharat project sites, conduct analysis and initiate problem solving measures

- Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan(GPDP)
- Interactive community exercise with local leaders, panchayat functionaries, grass-root officials and local institutions regarding village development plan preparation and resource mobilization
- Visit Rural Schools/ mid-day meal centres, study Academic and infrastructural resources and gaps
- Participate in Gram Sabha meetings, and study community participation
- Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries
- Attend Parent Teacher Association meetings and interview school dropouts
- Visit local Anganwadi Centre and observe the services being provided
- Visit local NGOs, civil society organisations and interact with their staff and beneficiaries,
- Organize awareness programmes, health camps, Disability camps and cleanliness camps
- Conducts oil health test, drinking water analysis, energy use and fuel efficiency surveys
- Raise understanding of people's impacts of climate change, building up community's disaster preparedness
- Organise orientation programmes for farmers regarding organic cultivation,rational use of irrigation and fertilizers and promotion of traditional species of crops and plants
- Formation of committees for common property resource management, village pond maintenance and fishing

Teaching & Learning Methods

A large variety of methods of teaching must be deployed:
UGC will prepare an ICT based MOOC for self-paced learning by students for the1 credit to be conducted in the classroom.
Reading & classroom discussions, Participatory Research Methods & Tools, Community dialogues, Oral history, social and institutional mapping, interactions with elected panchayat leaders and government functionaries, Observation of Gram Sabha, Field visits to various village institutions.

Recommended Readings

Books:

1. Singh, Katar, Rural Development: Principles, Policies and Management, Sage Publications, NewDelhi,2015.
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002.
3. United Nations, Sustainable Development Goals, 2015 un.org/sdgs/
4. M.P. Boraian, Best Practices in Rural Development**,** Shanlax Publishers, 2016.

Journals:

1. Journals of Rural development, (published by NIRD & PR Hyderabad)
2. Indian Journal of Social Work, (byTISS,Bombay)
3. Indian Journal of Extension Education (by Indian Society of Extension Education)
4. Journal of Extension Education (by Extension Education Society)
5. Kurukshetra (Ministry of Rural Development, GoI)
6. Yojana (Ministry of Information and Broadcasting, GoI)

Value Added Courses

Household Waste Management
Course Code: VAZ202

Total Number of Hours	Theory Hours	Training Hours
30	10	20

Learning Objectives

1. To encourage healthy waste management strategies at home and the environment.
2. To promote technological methods to enhance effective bio-composting at home.

Course outcomes

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	identify the sources, composition, collection methods, disposal methods and management of wastes.	PSO - 1	U
CO - 2	analyse the types, means of transport and disposal, methods of composting and management of wastes.	PSO - 3	An
CO - 3	apply vermicomposting technique and biogas production for biodegradable wastes and documentation ofwaste management strategies.	PSO - 4	Ap
CO - 4	apply waste management strategies in household and locality to create kitchen gardenand healthy society.	PSO - 3	Ap

Unit I

Ecosystem and Solid waste: Introduction to Environment - Ecosystem - meaning- types - components- structure. Types of waste - Definition – Solid and Liquid waste; Biodegradable and Non-biodegradable wastes; Sources of waste - Composition and determinants of waste.

Unit II

Generation and Collection of wastes: Factors influencing generation- Assessment of solid wastes-Methods of sampling and characterization. Collection and Transfer - Collection of Solid waste - Collection system - Time and frequency of collection - Factors affecting collection.

Unit III

Waste Disposal: Disposal of Solid Wastes - Refuse disposal - Various methods - Incinerations - Sanitary landfills - Gas and leachate movement and control. Bio-composting methods for Kitchen waste management.

Unit IV

Composting Methods: Vermitechnology for decomposition of House hold wastes. Biogas preparation in house hold waste management systems.

Unit V

Kitchen garden and waste management strategies: Kitchen garden as a means of liquid and biodegradable waste management. Documentation of waste management strategies implemented in their household and locality.

Reference Books

1. Sharma, P.D. (1999). *Ecology and Environment.* Meerut: Rastogi Publications.
2.Bhatt, M. S. and AsherefIlliyan (2012). *Solid Waste Management: An Indian Perspective*.New Delhi: Synergy Books India.
3. Frank Kreith and George Tchobanoplous (1994).*Handbook of Solid Waste Management.* USA: McGraw-Hill Publications.

Semester III
Major core III: Cell Biology
Course Code: ZC2031

No. of Hours/ Week	No. of Credits	Total Hours	Marks
4	4	60	100

Objectives

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

Course outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	identify the types of microscope, cell, cell organelles and cell division.	PSO - 1	R
CO - 2	outline the role of cell organelles, nucleic acid and their interactions.	PSO - 4	U
CO - 3	apply knowledge in cellular research using cytological and modern techniques.	PSO - 3	Ap
CO - 4	differentiate cell types, chromosomes, cell stages, normal and abnormal cells.	PSO - 2	An

Unit I **(12 hrs.)**

Cell, Microscope and microtechniques: Cell theory. Prokaryotic and eukaryotic cells. Cytological techniques - Fixation, sectioning and staining. Microscopy – Resolving power and uses of Compound, Phase contrast and electron microscope. Micrometry.

Unit II **(12 hrs.)**

Plasma membrane & Cell organelles: Ultrastructure and functions of Plasma membrane, mitochondria, Ribosomes, Endoplasmic reticulum, Golgi complex, lysosomes, centrosomes.

Unit III **(12 hrs.)**

Nucleus and nucleic acids: Ultrastructure and functions of nucleus and nucleolus. Chromosomes - types, structure, giant chromosomes. Nucleic acids – structure, types and functions. Nucleosomes.DNA replication in prokaryotes.

Unit IV **(12 hrs.)**

Gene expression and regulation: Characteristics of Genetic code. Fine structure of gene. Protein synthesis in prokaryotes - transcription and translation. Regulation of gene expression - *Lac* operon.

Unit V **(12 hrs.)**

Cell division and significance: Cell cycle, Mitosis, Meiosis, Regulation of cell cyclecdk dependent. Cancer - properties, types, diagnosis and treatment. Proto-oncogenes, Oncogenes, tumour suppressor genes. Ageing and apoptosis.

Textbook

Powar, C.B. (2013). *Cell Biology*. Bombay: Himalaya Publishing House.

Reference Books

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

2. De Robertis, E. M. F. (2011). *Cell Biology* (8th ed.). New York: Lippincott Williams & Wilkins Publication.

3. Arumugam, N. (2015). *Cell Biology*.Nagercoil: Saras Publications.

4. Singh, S.P. &Tomar, B.S. (2014). *Cell Biology* (10th ed.). New Delhi: Rastogi Publications.

5. Rastogi, S.C. (2008). *Cell Biology* (2nd ed.). New Delhi: New Age International (P) Limited Publishers.

6. Prakash S. Lohar (2009). *Cell and Molecular Biology*, (5th ed.). Chennai: MJP Publishers.

Semester III

Major Elective I: (a) Biochemistry, Biophysics and Biostatistics

Course Code: ZC2032

No. of Hours/ Week	No. of Credits	Total Hours	Marks
4	3	60	100

Objectives

1. To enrich the knowledge of students on the structure, classification andmetabolism of biomolecules and to learn the principle and functions of specified bio-instruments.
2. To enlighten students on the nature of life and basic methods in statistics to be used in future biological research.

Course outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	recall the structure of atoms, biomolecules, bioinstruments, and biological data.	PSO - 1	R
CO - 2	describe the interactions of biomolecules; importance of buffer systems, enzymes, light, bioinstrumentation and collection of biological data.	PSO - 2	U
CO - 3	apply basic scientific methods and analysis in the fields of biochemistry, biophysics and biostatistics.	PSO - 3	Ap
CO - 4	classify biological macromolecules, the techniques used in biological study, and analyse biological data using appropriate statistical methods.	PSO - 3	An
CO - 5	evaluate the significance of biomolecules, principle of bioinstruments, statistical concepts.	PSO - 4	E

Unit I **(12 hrs.)**

Bonds, Buffers and Protein: Atoms - Isotopes- Chemical bonds - Hydrogen ion concentration – pH and its measurement. Acids and bases – Acidosis and alkalosis. Buffers - Biological buffer systems - Significance of buffers. Proteins – Classification, structure and biologicalfunctions.Enzymes - Classification and properties.

Unit II **(12 hrs.)**

Carbohydrates andLipids: Carbohydrates - classification, Monosaccharaides –

glucose, Disaccharides - lactose, Polysaccharides - glycogen, biological functions of carbohydrates. Lipids - classification, simple lipids - waxes, Compound lipids – lecithin, Derived lipids - cholesterol, biological functions of lipids.

Unit III **(12 hrs.)**

Light and Separation Techniques: Nature and properties - electromagnetic spectrum - Absorption and Emission spectrum, Fluorescence and Phosphorescence.Colorimeter and spectrophotometer - principle, instrumentation and application. Centrifuge -principles, types and applications. Chromatography - principle and applications of paper and column chromatography.

Unit IV **(12 hrs.)**

Introduction to Biostatistics: Population, Data, Sample and variable. Collection of data - sampling methods. Processing of data - classification and tabulation. Presentation of data - Diagrams and graphs.

Unit V **(12 hrs.)**

Statistical Methods: Measures of central tendency -Mean, Median, Mode, Dispersion -standard deviation and standard error. Probability - apriori and aposteriori. Test of significance: Chi square test and Student's '*t*' - test.

Textbooks

1. Annie &Arumugam, N. (2015). *Biochemistry and Biophysics*.Nagercoil: Saras Publications.
2. Arumugam, N. (2011). *Basic concepts of Biostatistics*.Nagercoil: Saras Publications.

Reference Books

1. Jain J.L., Sunjay Jain &Nitin Jain (2007). *Fundamentals of Biochemistry* (6th ed.). New Delhi: S. Chand and Company Ltd.
2. Satyanarayana, V. (2005). *Essentials of Biochemistry*. Calcutta: Books and Allied (P) Ltd.
3. Narayanan, P. (2000). *Essentials of Biophysics.*New Delhi: New Age International Publishers.
4. Daniel, M. (2000). *Biophysics for Biologists.*New Delhi: Agrobios.
5. Pranav Kumar (2016). *Fundamentals and Techniques of Biophysics and Molecular Biology.*New Delhi: Pathfinder Publications.
6. VasanthaPattabhi& N. Gautham (2002).*Biophysics*. New Delhi: Narosa Publishing House.
7. Ramakrishnan, P. (2015). *Biostatistics.*Nagercoil: Saras Publications. 8. Pranab Kumar Banerjee (2005). *An Introduction to Biostatistics.*New Delhi: S. Chand and Company Ltd.

9. Gurumani, N. (2005). *An Introduction to Biostatistics.*Chennai: MJP Publishers.

Semester III
Major Elective I: (b) Bioinformatics
Course code: ZC2033

No. of Hours/ Week	No. of Credits	Total Hours	Marks
4	3	60	100

Objectives

1. To create awareness about bioinformatics databases, databanks and data format, data retrieval from the online sources.
2. To develop the basic skills of data browsing as a strong foundation for performing research**.**

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	describe the computer programming languages, biological databases, search engines, sequence alignment.	PSO - 1	R
CO - 2	differentiate internet, World Wide Web, search engines, databases and bioinformatics search engines.	PSO - 2	U
CO - 3	retrieve nucleotide, protein sequences using bioinformatics tools.	PSO - 3	Ap
CO - 4	analyse the similarity between different sequences using pairwise and multiple alignment tools.	PSO - 4	An
CO - 5	evaluate the phylogeny of organisms using bioinformatics tools.	PSO - 3	E
CO - 6	design drugs through data mining.	PSO - 2	C

Unit I **(12 hrs.)**

Introduction to bioinformatics: Bioinformatics – Scope and applications. Biological Databases - Nucleic acid databases - NCBI, EMBL. Protein databases – Primary and

Secondary. Specialized Genome databases – SGD and TIGR. Structure databases - CATH, SCOP and PDBsum. File Format - Genbank, DDBJ, FASTA, and SwissProt.

Unit II **(12 hrs.)**

Sequence Alignments: Multiple alignment programs.Pairwise alignment - BLAST and FASTA Algorithm. Gene identification - sequence based gene prediction and molecular pathways.

Unit III **(12 hrs.)**

Multiple Sequence Alignment: Programs, Phylogenetic Analysis - Concept of dendrograms, Strings and Evolutionary trees, Methods of Construction of Phylogenetic trees-Maximum Parsimony Method, Maximum likelihood method and Distance Methods, Reliability of trees.

Unit IV **(12 hrs.)**

Genomics and proteomics: Introduction to Medline, PubMed, OMIM. Basic concepts of Genomics and proteomics, Data mining, 3D structure viewers - Rasmol, SPDBv, Chime, Cn3D, PyMol and Anatomical visualization.

Unit V **(12 hrs.)**

Gene mapping and applications: Genome assembly and annotation - Prediction of Genes, Promoters, Splice sites, Next Generation Sequencing.

Textbook

Rastogi, S. C. Mendiratta, N. &Rastogi, P. (2011).*Bioinformatics*.New Delhi: PHI Learning Private Limited.

Reference Books

1.Stuart M. Brown (2013). *Next-Generation DNA Sequencing Informatics.* New York: CSHL Press.

2.Martina Bremer and Rebecca W. Doerge (2015).*Using R at the Bench: Step-by-Step Data Analytics for Biologists*. New York:CSHL Press.

3.David Mount (2004). *Bioinformatics: Sequence and Genome Analysis* (2nded.). New York: CSHL Press.

4. Attwood, T.K. & Parry-Smith, D.J. (2006). *Introduction to Bioinformatics*. Delhi: Dorling Kindersley Publication.

5. Gladis Helen Hepsyba, S. &Hemalatha, C.R. (2009).*Basic Bioinformatics.* Chennai: MJP Publishers.

6. John De Britto, A. (2011).*Bioinformatics.*Sivakasi: Anto Art Craft Printers.

7. Sundaralingam, R. &Kumaresan, V. (2008). *Bioinformatics.*Nagercoil: Saras Publication.

8. Jin Xiong (2006). *Essential Bioinformatics.* UK: Cambridge University Press.

9. Hooman H. Rashidi& Lukas K. Buehler (2000).*Bioinformatics Basics: Application in Biological Science and Medicine.* New York: CRC Press.
10. Mohan Bansal, A.S. (2003). *Medical Informatics – A primer.* New Delhi: Tata McGraw- Hill Publishing Company Ltd.

Semester III

Major Elective I: (c) Wildlife Biology

Course Code: ZC2034

No. of Hours/ Week	No. of Credits	Total Hours	Marks
4	3	60	100

Objectives

1. To familiarize the behaviour and conservation of wild animals and techniques of census.
2. To develop skills for pursuing higher studies and competence in wildlife conservation strategies.

Course outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	identify wild life, their habitat, behavior and conflict with man.	PSO - 1	R
CO - 2	interrelate human-wildlife conflict and its conservation.	PSO - 2	U
CO - 3	apply census techniques and conservation methods.	PSO - 3	Ap
CO - 4	survey wildlife and related natural resources.	PSO - 4	An

Unit I **(12 hrs.)**

Importance of wildlife and Forestry: Wildlife: Scope - Causes of wildlife depletion, Economic importance and conservation. Forest types in India- identification, deforestation and impacts, afforestation - agro- and social forestry. Seed technology - collection, storage, pretreatment and germination.

Unit II **(12 hrs.)**

Behaviour of wildlife: Instinctive behaviour – learning – imprinting - habituation. Analysis of behaviour pattern - taxis, kinesis and reflexes - types of animal

communications - courtship, display, sexual selection and parental care in mammals and birds- Social behaviour in animals –elephants, monkeys, hyenas and wild buffalo.

Unit III **(12 hrs.)**

Wildlife census techniques: Planning census – sample counts – direct count - total counts, drive count, roadside count, transect methods, Point counts, pellet count, camera trap, visual encounter survey, waterhole survey. Indirect count - call count, track and signs, pugmark, The king strip method, sight and resight method. Identifying animals based on indirect signs, Capture-recapture techniques.

Unit IV **(12 hrs.)**

Human-wildlife conflicts: Human-elephant, bear, tiger, bison, monkey and crocodile conflict, reasons for conflicts, Identification of damages and control measures. Translocation of wild animals – principles, methods and applications.Wildlife crimes- Wildlife forensics and its applications in detecting wildlife crimes.

Unit V **(12 hrs.)**

Conservation of wildlife: *in-situ* and *ex-situ* conservation. Zoos and Zoological Parks - formation and management - Central Zoo Authority of India, Captive breeding - aims, principles, methods - role of Government and Non-Government organizations in conservation. Wildlife Projects - Tiger, Elephant, Lion and Kashmir stag.

Textbooks

Goutam Kumar Saha &SubhenduMazumdar (2017). *Wildlife Biology: An Indian Perspective*. New Delhi: PHI Learning Pvt. Ltd.

Singh, S.K (2015). *Textbook of wildlife management* (2nd ed.). Delhi: CBS Publishers and Distributors Pvt. Ltd.

Reference Books/ Website

1. TajRawat (2012). *Biodiversity Conservation and Wildlife Tourism*. Delhi: Discovery Publishing House Pvt. Ltd.
2. Kumar, U. &Asija, M.J. (2007). *Biodiversity - Principle and Conservation* (2nd ed.). Jodhpur: Student Editors.
3. SeshadiriBalakrishnan, (1969). *The Twilight of India's Wildlife*. Chennai: Oxford University Press.
4. Gee, E.P. (1969). *Wildlife in India* (1sted.). London: Collins Foundation Books.
5. Anthony R.E. Sinclair, John M. Fryxell& Graeme Caughley (2006). *Wildlife Ecology, Conservation, and Management* (2nd ed.). USA: Blackwell Publishing.
6. https://www.iaszoology.com/wildlife-management-conservation/

7. http://web.mnstate.edu/stockram/WildlifeEcol/wildlife_ecology.htm

Semester IV
Major Practical II
III & IV Semester Major Core & Electives
Course Code: ZC20P2
(Conducted during III & IV Semester)

No. of Hours/ Week	No. of Credits	Total Hours	Marks
2 + 2	2	60	100

Objectives

1. To impart practical skills in selected fields of biology.
2. To develop skills to apply the principles of biological techniques.

Course outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	Identify biomolecules, cells, chromosomes, genetic disorders and animals.	PSO - 1	**R**
CO - 2	illustrate cells and its structure, biomolecules and theprinciples of biotechniques.	PSO - 2	U
CO - 3	handle analytical instruments and biological samples.	PSO - 3	Ap
CO - 4	analyse biochemical constituents, biological sequences and disorders.	PSO - 4	An

Cell Biology

1. Observation of mitosis in onion root tip.
2. Observation of giant chromosomes in *Chironomus*larva.
3. Measurement of cells using stage and ocular micrometer.
4. Drawing of a cell/ organism by using Camera Lucida.
5. Smear preparation of squamous epithelium.

Charts/ Models/ Bookplates: Compound microscope, Camera Lucida, Mitochondria, Golgi complex, Endoplasmic reticulum, Ribosomes, Lysosomes (polymorphism), Interphase nucleus, DNA (Watson & Crick model), tRNA.

Biochemistry, Biophysics and Biostatistics

1. Preparation of standard acid and alkali (normal, molar and percent).
2. Quantitative estimation of protein by Biuret method.
3. Determination of pH using pH meter.
4. Separation of amino acids using ascending paper chromatography.
5. Demonstration of osmosis using raisins.
6. Analysis of data (ungrouped) - mean, median, mode, standard deviation.

Charts/ Models/ Bookplates: Glucose, Amino acid, Cholesterol, ATP, EM

spectrum, Centrifuge, Colorimeter, pH meter, Bardiagram, Histogram, Pie diagram.

Bioinformatics

1. Retrieval of human hemoglobin Protein sequences- NCBI
2. Sequence similarity of retrieved protein sequences - FASTA format
3. Insulin and growth hormone 3D Structure Database - PDB
4. Nucleotide Sequence Database - BLAST
5. Construction of Phylogenetic tree (Cytochrome oxidase- 5 mammals) -Clustal W

Charts/ Models/ Bookplates: DDBJ, EMBL, SwissProt, PROSITE, PDB

Wildlife Biology

1. Data collection (wildlife) – transect method
2. Report on behaviour of birds
3. Demonstration of equipment used in capturing and handling of wild animals.
4. Pugmark identification and characterization of common large animals.
5. Use of different techniques in identification of different parts and products of fauna reported in wildlife trade.
6. Wildlife animal identification: hair and pellet.

Charts/ Models/ Bookplates: Tags, Collars, Cage Trap, Sambar deer, Hangul, Civet cat, Malabar squirrel, NilgiriTahr.

Semester III
Allied Zoology: General Zoology
Course Code: ZA2031

No. of Hours/ Week	No. of Credits	Total Hours	Marks
4	3	60	100

Objectives

3. To impart knowledge on Animal diversity, Cell Biology, Genetics, Developmental Biology, Evolution and Physiology.
4. To instill interdisciplinary skills for availing employment opportunities.

Course outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO – 1	recall the classification of animals, cells, genetic disorders in man, development of frog, structure and function of vital organs.	PSO – 1	R
CO – 2	outline the diversity of animal forms and their cellular organization, genetic makeup, evolution and physiology.	PSO – 1	U
CO – 3	correlate the physiological processes of animals and relationship of organs system, inheritance of characters.	PSO - 3	Ap
CO – 4	recognize the major functions of organ systems in the human body and the role played by animals and evolution of animal life.	PSO – 2	An
CO – 5	evaluate the characters, functions and genetics of diverse animals.	PSO – 4	E

Unit I **(12 hrs.)**

Invertebrate Zoology: General characters of Invertebrates – classification up to phylum with two examples for each. *Paramecium* – external features, conjugation. *Obelia* – external features, polymorphism. *Ascaris*- external features, parasitic adaptations. *Penaeus* – external features. Starfish – external features, water vascular system.

Unit II **(12 hrs.)**

Chordate Zoology: General characters of chordates - outline classification up to classes with one example. Migration of fishes.Identification of poisonous and non-

poisonous snakes, first-aid for snake bite.Flight adaptations in birds. Rabbit – external characters. Dentition in human.

Unit III **(12 hrs.)**

Cytogenetics: Difference between plant and animal cells. Chromosomes - structure - types and function. Human - Simple Mendelian traits, Genetics of blood groups, sex linked inheritance - colour blindness and haemophilia, Non-disjunction - Klinefelter's, Turner's and Down's syndrome.

Unit IV **(12 hrs.)**

Developmental Zoology and Evolution: Frog - structure of sperm and ovum - fertilization. Early development in frog - cleavage, blastulation and gastrulation.Biochemical origin of life - Urey Miller Experiment, Natural selection theory and Modern synthetic theory of evolution.

Unit V **(12 hrs.)**

Human Physiology: Digestion – structure and functions of the digestive system. Respiration - structure and functions of lungs. Circulation - structure and function of the heart. Excretion - structure and functions of kidney.

Textbook

Arumugam, N. (2011). Allied Zoology, Vol.I to III.Nagercoil: Saras Publications.

Reference Books

1. EkambaranathaAyyer, M.A. (1986).*Manual of Zoology*Vol.I& II. Chennai: S. Viswanathan Printers and Publishers Pvt. Ltd.
2. Jordan, E.L. and Verma, P.S. (1988). *Chordate Zoology* New Delhi: S. Chand and Co. Ltd.
3. Kotpal, R.L. (2004). *Modern Text Book of Zoology – Invertebrates* (9th ed.). Meerut: Rastogi Publications.
4. Kotpal, R.L. (2004). *Vertebrates.* Meerut: Rastogi Publications.
5. Nagabhushanam, R., Kodarkar, M.S. and Sarogini, R. (1982). *Textbook of Animal Physiology* (2nd ed.). New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.
6. Verma, P.S. &Agarwal, V.K. (2003). *Chordate embryology* (10th ed.). New Delhi: S. Chand and Co. Ltd.
7. Rastogi, V.B. &Jayaraj, M.S. (2000). *Textbook of Genetics*. Meerut: KedarnathRamnath Publishers.
8. Verma, P.S. &Agarwal, V.K. (2010). *Cell Biology, Genetics, Molecular Biology, Physiology, Evolution and Ecology.* New Delhi: S. Chand & Co.

Semester III &IV
Allied Zoology Practical: General Zoology & Applied Zoology
Course code: ZA20P1
(Conducted during Semester III & IV)

No. of Hours/ Week	No. of Credits	Total Hours	Marks
2 + 2	2	60	100

Objectives

1. To develop practical skills in basic concepts of biology.
2. To enhance practical skills on agro-based animal farms.

Course outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	recognize museum specimens, stages of cleavage, vital organs, genetic diseases of human and culturable organisms.	PSO - 1	R
CO - 2	explain the economic importance of animals, clinical procedures, dominant and recessive characters of humans.	PSO - 2	U
CO - 3	use the skills relevant to general and applied Zoology.	PSO - 3	Ap
CO - 4	analyse the clinical samples, nutritive value farms products and water quality parameters.	PSO - 4	An

General Zoology

1. Dissection: Cockroach – Nervous system.
2. Mounting: Prawn appendages.
3. Culture of Paramecium.
4. Mounting: Shark – Placoid scale.
5. Observation of simple Mendelian traits in man.
6. Observation of a frog's egg.
7. Identification of stages of cleavage in frog.
8. Analysis of glucose in Urine.
9. Observation of colour vision test using Ishihara chart.
10. Observation of blood groups in human.

Museum specimens/ Slides/Charts/Models/Bookplates

Paramecium, *Obelia*, *Ascaris*- male and female, *Penaeus*, Starfish - oral and aboral, Eel, *Najanaja*, Human karyosome, Down’s syndrome, Human Kidney, Human Heart, Ancon Sheep.

Semester III
Add on Course: Professional English for Life Sciences
Course Code: ALS203

No. of Hours/ Week	No. of Credits	Total Hours	Marks
2	2	30	100

Objectives

1. To enhance the creative and academic writing skills and workplace communication.
2. To develop competence and competitiveness and thereby improve the employability skills and life-long learning.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	define concepts related to communicative and digital competence.	1	R
CO - 2	illustrate academic writing and creativity in digital media.	2	U
CO - 3	apply communicative skills with digital competence in the workplace.	3	Ap
CO - 4	analyse a variety of formats, including essays, research papers, reflective writing, and critical reviews of life sciences.	4	An
CO - 5	analyze lectures, scripts, blogs, e-content and short films related to biology.	4	An

Unit I **(6 hrs.)**

Communicative Competence

Listening – Answering comprehension exercises

Speaking – Reading passages – open ended questions

Reading – One subject based reading of text followed by comprehension activities / exercises

Writing – Summary writing based on the reading passages (semi-guided)

Unit II **(6 hrs.)**

Persuasive Communication

Listening – Announcement

Speaking – Just a minute activities

Reading – Analyzing Ads

Writing – Dialogue writing

Unit III **(6 hrs.)**

Digital Competence

Listening – Listening to interviews (subject based)

Speaking – Interview with subject teachers / professionals (using video conferencing skills)

Reading – Selected sample of web page

Writing – Creating web pages

Reading Comprehension – Essay on Digital competence for academic and professional life

Unit IV **(6 hrs.)**

Creativity and Imagination

Listening – General videos (lifestyle and values)

Speaking – Movie review, book review

Writing – Poster making – writing slogans / captions (subject based)

Reading – Essay on creativity and imagination

Unit V **(6 hrs.)**

Workplace Communication & Basics of Academic Writing

Speaking – Presentation using PowerPoint

Reading / Writing – Circulars, minutes of meeting, paraphrasing

Textbook

Tamil Nadu State Council for Higher Education (TANSCHE).*Professional English for Life Sciences – II*.

Semester III & IV
Foundation Course II - Personality Development
Course Code: FCV202

No. of hours per week	Credit	Total no. of hours	Marks
1	1	30	100

Objectives

1. To practice personal and professional responsibility.
2. To develop and nurture a deep understanding of personal motivation.

Course Outcome

CO No.	*Upon completion of this course, the students will be able to:*	PSO Addressed	Cognitive Level
CO-1	identify various dimensions and importance of effective personality	PSO-	A
CO-2	apply the models of positive thinking in real life situations	PSO-	A
CO-3	To overcome shyness and loneliness and cope up with the society.	PSO-	Y

Unit I

Personality – Factors influencing personality – Theories on personality – Types of personality. Self acceptance – self awareness–self concept – elements - self esteem – types of self esteem – impact of self esteem – importance – low self esteem.

Unit II

Self actualization– characteristics – Positive thinking – The profile of a positive thinker – Positive attitude – Models of positive thinking. Worry – Why to worry – ways to overcome – ways to turn negative thinking into positive.

Unit III

Motivation – Sources of motivation – Types of motivation – Factors determining motivation – characteristics of motivation. Goal setting – Types of goals – ways to achieve goals. Decision making – Steps for decision making.

Unit IV

Time Management – Definition – Controversies regarding time management – importance – Ways to manage time – controlling interruption – Leisure. Leadership and team building – types –qualities of a good leader – group formation – types- responsibilities of group members – instructions to form groups. Communication – classification – verbal and non verbal – rules – hindrance to communication.

Unit V

Process of coping or adjustments – coping – mal adjustment – frustration – types – techniques to overcome frustration. Mental stress – types – mechanism of coping – positive and negative mechanism –steps for adjustment in life – coping with shyness – loneliness – techniques to overcome shyness and loneliness.

Textbook

AazhumaiVazhampera– Dr. Sr. Mary Jhonsy, Dr. M. Mary Helen Stella and Dr.AnithaMalbi

Reference books

1. Personality Development (1999). Selvaraj, Palayamkottai Community College, V.M. Chattram, Tirunelveli.
2. Resource book for Value Education (2002). Mani Jacob, Institute of Value Education, New Delhi
3. You can win (1998).Shiv Kheera, published by Rajive Beri, Macmillan India Ltd, New Delhi.
4. The seven habits of highly effective people (1990). Covey Stephen, R. Simon and Schuster, New York.
5. Change or be changed (2008). Dr. Xavier Alphonse, S. published by ICRDCE, Chennai.

Semester III / V
UG Self Learning Course: Ornamental Fish Culture
Course Code: ZC20S1

No. of Credits	Marks
2	100

Objectives

1. To learn the culture techniques of aquarium fishes.
2. To develop skills in ornamental fish culture so as to enable the students to become an entrepreneur.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	choose materials necessary for setting an aquarium, accessories, popular ornamental fishes, feed, anesthetics and diseases.	PSO - 1	R
CO - 2	demonstrate the construction of fish tanks, culture techniques and feed preparation.	PSO - 2	U
CO - 3	establish and maintain an aquarium for commercialization.	PSO - 4	Ap
CO - 4	analyse the types of tanks, physico-chemical parameters and feed relevant for ornamental fishes.	PSO - 3	An

Unit I

Construction of fish tanks: Scope of ornamental fish culture. Fish tanks - Seating the tank – ornamental fish tank as a biological filter.Setting up of tanks - bottom gravel, planting with plants, filling with water, maintenance of water quality, stocking of fishes.

Unit II

Accessories for fish tanks: hood and light source – nets – suction tube – scraper tool – aerator – lights – filters – Underwater bottom filter - Under gravel filter – Poly foam filter – Overhead trickle purification system (OTP) - Filter with activated charcoal (Carbon filter) - filtration. Aquarium plants - Floating, rooted and submerged.

Unit III

Popular ornamental fishes: Ornamental fishes - Egg laying fishes (Zebra fish, Gold fish, Barbs, Gourami, Fighter), Live bearing fishes (Guppies, Mollies, Platys and Swordtails). Breeding methods in egg layers - Breeding of live bearing ornamental fishes - Culture techniques – Stocking tank.

Unit IV

Food and feeding: Live feed organisms and culture – Cyclops, Tubifex, Brine shrimp (*Artemia*), Cladoceran (*Daphnia*), Blood worm (*Chironomus* larva). Artificial feeds - feed ingredients and feed formulations, Feeding, Balanced diet for aquarium fishes, Holiday or vacation feed.

Unit V

Transport and diseases management: Transport of fishes - Oxygen packing, Anesthetics used in fish transport, Mechanism of action of anesthetics, Transport of export consignment, Preparing of fishes, Methods of sedation, Role of Carbonic acid and Tertiary butyl alcohol. Diseases and treatment methods – Protozoan, Fungal, Bacterial, Viral, Ectoparasites and endoparasites.Economics of commercial farming.

Textbook

Jameson, J.D. &Santhanam, R. (1996).*Manual of Ornamental fishes and Farming Technologies.*Thoothukudi: Fisheries College and Research Institute.

Reference Books

1. Butcher, L. (1992).*Manual of Ornamental Fish.* Gloucestershire: British Small Animal Veterinary Association Publications.
2. Jameson, J.D., Srinivasan, A. &Venkataramanujam (1995). *Ornamental Fish Culture Technology.* Chennai: TANUVAS Publications.
3. Hawkins, A.D. (1981). *Aquarium Systems*. New York: Academic Press.
4. KishoriLalTekriwal& Andrew ArunavaRao (1999).*Ornamental Aquarium Fish of India*. England: Kingdom Books.
5. Dawes, J.A. (1984). *The Freshwater Aquarium.* London: Roberts Royee Ltd.

Semester IV
Major Core IV: Genetics
Course Code: ZC2041

No. of Hours/ Week	No. of Credits	Total Hours	Marks
4	4	60	100

Objectives

1. To enable the students to understand the basic principles of inheritance and population genetics.
2. To enhance skills to interpret hereditary, mutation and syndromes and extend genetic counseling to society.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	recallthe key concepts of heredity, population genetics, karyotyping and genetic counselling.	PSO - 1	R
CO - 2	describeMendelian, polygenic and cytoplasmic inheritance, chromosome mapping, nondisjunction, gene frequency and eugenics.	PSO - 1	U
CO - 3	apply the principles of heredity to real life situations.	PSO - 2	Ap
CO - 4	execute and analyze the results of genetic experimentation in animal and plant models.	PSO - 3	An
CO - 5	evaluate the genetic data of a population.	PSO - 4	E

Unit I **(12 hrs.)**

Mendelian inheritance - Monohybrid and dihybrid - back cross and test cross. Complete, incomplete and codominance. Interactions of genes: Complementary genes – flower colour in sweet pea, Supplementary genes – inheritance of comb in fowl, Epistasis – inheritance of colour pattern in poultry and coat colour in mice, Lethal genes – sickle cell anemia. Polygenic inheritance - Skin colour in man, Multiple alleles: ABO blood group in man, Rh factor in man, coat colour in rabbit.

Unit II **(12 hrs.)**

Chromosome mapping and Syndromes: Linkage – types, groups and theories. Crossing over - mechanism, theories, cytological evidence - Stern's experiment and

Tetrad analysis, significance. Chromosome map - two point and three point cross, construction of chromosome map.Sex determination in man and Drosophila.Nondisjunction - Primary and secondary nondisjunction in *Drosophila*. Syndromes in man: Turner's, Klinefelter's and Down syndrome.

Unit III **(12 hrs.)**

Cytoplasmic inheritance and Mutation: Cytoplasmic inheritance - Kappa particles in *Paramecium,* milk factor in mice, shell coiling in *Limnaea*. DNA as genetic material - Bacterial transformation, conjugation, F- factor and transduction. Mutation: Chromosomal mutation - changes in structure and number, aneuploidy and euploidy, Gene mutation - mutagens. DNA repair mechanisms.

Unit IV **(12 hrs.)**

Human chromosomes and genetic diseases: autosomes and allosomes – Karyotype and idiogram. Simple Mendelian traits in man. Twins - types, development and application. Inborn errors of metabolism - Phenylketonuria, Alkaptonuria, Albinism. Sex-linked genes and their inheritance - X-linked genes - Colour blindness and Haemophilia, Y-linked genes - holandric genes.

Unit V **(12 hrs.)**

Population genetics: Hardy Weinberg equilibrium – calculation of gene frequency – factors affecting gene frequency – selection, mutation, genetic drift and migration. Inbreeding, out breeding and heterosis.Eugenics, Euthenics and Euphenics.Pedigree analysis. Genetic prognosis - Genetic counselling.

Textbook

Meyyan, R. P. (2011). *Genetics.*Nagercoil: Saras Publications.

Reference Books

1. Verma, P.S. &Agarwal, V.K. (2009). *Genetics,* Revised ed. New Delhi: S. Chand & Co.
2. Peter Snustad, D. & Michael J. Simmons (2010). *Principles of Genetics* (2nd ed.). USA: John Wiley and Sons.
3. Chatterjee, S. (2009).*Genetics.* New Delhi: APH Publishing Corporation.
4. Singh, B.D. (2008). *Fundamentals of Genetics* (4th ed.). Ludhiana: Kalyani Publishers.
5. Gardner, Simmons &Snustad (2006). *Principles of Genetics* (8th ed.). USA: John Wiley & Sons.
6. Ahluwalia, K.B. (2009). *Genetics* (2nd ed.). New Delhi: New Age International.

Semester IV
Major Elective II: (a) Clinical Laboratory Technology
Course Code: ZC2042

No. of Hours/ Week	No. of Credits	Total Hours	Marks
4	3	60	100

Objectives

1. To impart knowledge on the laboratory techniques adopted in clinical laboratories.
2. To develop skills for gaining employability in hospitals and research laboratories.

Course outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	describe the laboratory principles applied in diagnosis of disease.	PSO - 1	R
CO - 2	classify the clinical specimens and use appropriate laboratory protocol.	PSO - 2	U
CO - 3	prepare reagents, handle instruments, perform clinical analysis and validate the results.	PSO - 3	Ap
CO - 4	develop skills necessary for higher studies or placement in clinical laboratories.	PSO - 4	An

Unit I **(12 hrs.)**

Essential pre-requisites of a Clinical Laboratory: Safety measures and first aid in the laboratory. Sterilization – physical and chemical methods. Preparation of Normal, Molar and Percentage solution.Biomedical waste management.

Unit II **(12 hrs.)**

Laboratory Instruments and their applications: Microscope, Balance, pH meter, Colorimeter, Autoanalyser, Centrifuge, Incubator, Water bath, Haemocytometer, Sahli'shaemoglobinometer.

Unit III **(12 hrs.)**

Clinical Haematology: Collection of blood - Venous and capillary, Blood grouping, Separation of plasma and serum, Blood cell count – Total count and differential count, Haemoglobin estimation by Sahli's method, Erythrocyte sedimentation rate (ESR). Analysis of blood glucose, serum creatinine, alkaline phosphatase, cholesterol, High density lipid (HDL) and low density lipid (LDL), Triglycerides.

Unit IV **(12 hrs.)**

Examination of sputum and body fluids: Collection, Physical, chemical and microscopic examination of cerebrospinal fluid and sputum. Serous fluid - pleural, pericardial and peritoneal, Synovial fluid.

Unit V **(12 hrs.)**

Urine and Stool Analysis: Urine – collection, composition, volume, colour and transparency. Analysis of urine for glucose, albumin, bilirubin, urobilinogen and ketone.Microscopic examination for bacteria, organized and unorganized deposits and blood.Pregnancytest.Stool - collection, types, microscopic examination - identification of intestinal parasites using saline wet mount - faecal occult blood.

Textbook

Rajan, S. (2012).*Manual for Medical Laboratory and Technology* (1st ed.). Chennai: Anjanaa Book House.

Reference Books

1. Kanai, L. Mukherjee (2005). *Medical Laboratory Technology, A procedure manual for routine diagnostic tests*, Vol I, II & III (19th ed.). New Delhi: Tata McGraw - Hill Publishing Company Ltd.
2. John Bernard Henry (2001). *Clinical diagnosis and management by laboratory Methods*(20th ed.). Philadelphia: Saunders & Co.
3. RamnikSood, M.D. (2003). *Medical Laboratory Technology, Methods and Interpretation* (4th ed.). New Delhi: Jaypee Brothers Medical Publishers (P) Ltd.
4. Mary Vijaya, T., Mini, M.L., SunithaKumari, K., Asha, K.R.T. (2003).*Practical Clinical Biochemistry Manual.*Kaliakkavilai: Rishi Publications.
5. Himadri Panda (2019). *Biomedical Waste Management, Recycling and Applications* (1st ed.). India: Discovery Publishing house Pvt. Ltd.

Semester IV
Major Elective: (b) - Animal Care and Services
Course Code: ZC2043

No. of Hours/ Week	No. of Credits	Total Hours	Marks
4	3	60	100

Objectives

1. To impart knowledge on care and management of domestic, pet and laboratory animals.
2. To develop skills on animal care services.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	recall animal breeds and their management practices.	PSO - 1	R
CO - 2	explain the nutritional requirement and maintenance of domestic, laboratory and pet animals.	PSO - 1	U
CO - 3	apply animal care skills in farm practices and research laboratories.	PSO - 2	Ap
CO - 4	analyze the general management of domestic, pet and laboratory animals.	PSO - 3	An
CO - 5	assess the prophylactic measures against common disease of domestic, pet and laboratory animals.	PSO - 4	E

Unit I **(12 hrs.)**

Animal care: Care of common breeds of cattle – cow, goat, domestic animals – hen and duck, pet animals - dog and love birds, laboratory animals – rabbit and guinea pig.

Unit II **(12 hrs.)**

Nutrition: Feeds and fodders - livestock, pet, laboratory animals - feeding schedule - feed additives, silage making. Diet formulation for newborn, growing, pregnant, lactating and sick animals.

Unit III **(12 hrs.)**

Reproduction: Domestic animals – pregnancy diagnosis, gestation, functional infertility, anestrous, repeat breeding in farm animals. Parturition, Care and management of newborn. Routine management practices for calves, heifers, pregnant and lactating animals.

Unit IV **(12 hrs.)**

Epidemiology and Public Health: Common zoonoses and their management. Disposal of cadaver and clinical waste.Guidelines for control of contagious diseases and infectious diseases.Notifiable diseases and disease outbreaks.Prevention of cruelty to animals.

Unit V **(12 hrs.)**

Wounds Management and Care Services: Wound - causes, classification, drainage - wound dressings and wound protection. Clinical use of antiseptics, fly repellents and anti-maggot. First aid - sick animals and fracture cases.

Textbook

Sastry, NSR and Thomas, (2017).*Livestock Production Management*, Chennai: Kalyani Publisher

Reference Books

1. William C. Skelley (2011). *Beef Cattle Management - With Information on Selection, Care, feeding and Fattening of Beef Cows and Bulls.*England: Cooper Press
2. Roberts Morris H Jr. (2013). *Feeding and Management of Dairy Cattle for Official Production.*New York: Franklin Classics.
3. John Webster. (2013). *Animal Husbandry Regained: The Place of Farm Animals in Sustainable Agriculture.*New York: Routledge.
4. Richard O. Kellems& David C. Church (2002).*Livestock Feeds and Feeding.* N.J.: Prentice Hall.
5. JannHau, Steven J. Schapiro & Boca Raton (2010). *Handbook of Laboratory Animal Science*. FL: CRC Press.
6. Wilson G. Pond & Kevin R. Pond (2000).*Introduction to Animal Science*. New York: Wiley.
7. Mathialagan. P. (2007).*Textbook of Animal Husbandry & Livestock Extension*. Lucknow: International Book Distributing Co.

Semester IV
Major Elective II: (c) - Entomology
Course code: ZC2044

No. of Hours/ Week	No. of Credits	Total Hours	Marks
4	3	60	100

Objectives

1. To enable the students to gain knowledge about insect diversity, structure and functions of organ system, importance of beneficial insects, pest of cultivable crops and their control measures.
2. To develop skills to identify and differentiate crop pests, productive insects, and their management.

Course Outcome

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	identify locally available insects, the pests of crops, stored products and medical importance.	PSO - 1	R
CO - 2	interrelate the salient features of insect orders and utility value of various productive and beneficial insects.	PSO - 1	U
CO - 3	apply various methods of pest management in the fields of agriculture and research.	PSO - 4	Ap
CO - 4	analyse the morphology and physiology of insect pests and suggest appropriate control measures .	PSO - 2	An
CO - 5	appraise the culture of productive and beneficial insects.	PSO - 3	E

Unit I **(12 hrs.)**

Classification and morphology of Insects: Outline classification of class Insecta up to orders. Morphology - **s**tructure and modification – head, types of mouthparts and antennae; thorax and its appendages; abdomen, segmentation of appendages and genitalia.

Unit II **(12 hrs.)**

Anatomy and physiology: Integument, digestive, circulatory, respiratory, excretory, nervous and reproductive system. Special organs.Endocrine gland, Role of hormones - moulting, growth, metamorphosis and diapause.

Unit III **(12 hrs.)**

Pest of agriculture and Insects of medical important: Symptoms and management of pests of rice –*Nilaparvatalugens* and *Leptocorisaacuta*, brinjal–*Leucinodesorbonalis*, tomato–*Helicoverpaarmigera*and *Spodopteralitur*a, banana - *Cosmopolites sordidus.* Pest of stored grains –*Callosobruchuschinensis*and*Sitophilusoryzae.*Pest of medical importance – mosquitoes and head louse.

Unit IV **(12 hrs.)**

Productive and Beneficial insects: Bionomics and economic importance of Silkworms, Honeybee and Lac insects; Biological control agents - Lacewings, ladybird beetles, *Trichogramma*; Pollinators, weed killers, scavengers, insects as food and feed.

Unit V **(12 hrs.)**

Crop pests and management: Physical, chemical, cultural, biological, genetic control of pests. Classification of insecticides - chemical nature, mode of entry and mode of action.Pesticide poisoning and first aid. Integrated Pest Management and biopesticides, *Bt* - concepts and application.

Textbooks

1. David, B.V. &Ananthakrishnan, T.N. (2016). *General and Applied Entomology*. New Delhi: Tata-McGraw Hill Publishing Company.
2. Kalyanasundaram, S. &Kalyanasundaram, M. (2003). *Pest management in field Crops / Horticultural Crops*. Vellore: KeranDeskTop Publisher.
3. Mike W. Service (2004). *Medical entomology for students* (3rded.). USA: Cambridge University Press.

Reference Books

1. Ambrose, D.P. (2017). *The Insects: Structure, Function and Biodiversity* (2nded.). Ludhiana: Kalyani Publishers,
2. David, B.V. &Ramamoorthy, V.V. (2011). *Elements of economic entomology*. Chennai: NP Namrata Publications.
3. Pedigo, L.P. (2002). *Entomology and pest Management*. Singapore: Pearson Education.
4. Robert F. Morris, Edward P. Caswell-Chen & Marcos Kogan (2002). *Concept in Integrated Pest Management*. New Delhi: Prentice-Hall of India P. Ltd.
5. Chapman R.F. (1998). *The Insects: Structure and Function*. Cambridge: Cambridge Univ. Press.
6. Romoser, W.S &Stoffolano, J.G. (1998). *The Science of Entomology*. New York: McGraw-Hill Company.
7. Wigglesworth V.B.(1984). *Insect Physiology* (8thed.). New York: Chapman & Hall.

Semester IV

Major Practical II
III & IV Semester Major Core & Electives
Course Code: ZC20P2
(Conducted during III & IV Semester)

No. of Hours/ Week	No. of Credits	Total Hours	Marks
2 + 2	2	60	100

Objectives

1. To impart practical skills in selected fields of biology.
2. To develop skills to apply the principles of biological techniques.

Course outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	Identify biomolecules, cells, chromosomes, genetic disorders and animals.	PSO - 1	**R**
CO - 2	illustrate cells and its structure, biomolecules and theprinciples of biotechniques.	PSO - 2	U
CO - 3	handle analytical instruments and biological samples.	PSO - 3	Ap
CO - 4	analyse biochemical constituents, biological sequences and disorders.	PSO - 4	An

Genetics

1. Observation of simple Mendelian traits in man.
2. Verification of monohybrid and dihybrid ratio using beads.
3. Observation of mutant forms of *Drosophila*.
4. Observation of polygenic inheritance (length of shell/ height of students)
5. Blood group identification.

Charts / Models / Bookplates: Syndromes - Klinefelter's, Turner's and Down's, Sex-linked inheritance - Colour blindness, Haemophilia, Hypertrichosis.

Clinical Laboratory Technology

1. Collection of blood and separation of serum and plasma
2. Estimation of blood glucose using glucometer.
3. Routine examination of urine: Urine sugar determination by Benedict's method.
4. Protein byheat and acetic method, Urobilinogen and Ketone bodies.
5. Microscopic examination of urine.
6. Pregnancy test (kit method).

Spotters: Water bath, Balance, Autoanalyser, Incubator, Renal calculi, *Entamoebahistolytica*, *Enterobiusvermicularis*, Biomedical waste bags.

Animal Care and Services

1. Silage making.
2. Analysis of artificial feed – cattle feed, grower mash.
3. Identification of different breeds of cow.
4. Identification of different breeds of dogs
5. Dressing of the wound of an animal model.

Charts / Models / Bookplates: Jamunapuri, Love birds, Groundnut cake, Commercial Cattle feed, Repellents, Food and mouth disease, Rabies, Animal cruelty.

Entomology

1. Observation of hemolymph of cockroach and identification of haemocytes - types.
2. Observation of life stages of mosquitoes.
3. Observation of life stages of stored product pests.
4. Collection, preservation and submission of one agriculture, storage, public health and 5. beneficial and harmful insects from different orders.
6. Repellent activity – Petri Plate assay

Charts / Models / Bookplates: *Epilachnavigintioctopunctata, Nilaparvatalugens, Helicoverpaarmigera, Spodopteralitura, Odoiporuslongicollis, Cosmopolites sordidus, Callosobruchuschinensis,* Honey bee, Scarabs - Dung beetle, plant protecting equipments.

Semester IV

Allied Zoology: Applied Zoology
Course Code: ZA2041

No. of Hours/ Week	No. of Credits	Total Hours	Marks
4	3	60	100

Objectives

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

Course Outcome

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	recall the principles of api-, seri-, and aquaculture, poultry and dairy farming.	PSO - 1	R
CO - 2	explain the tools and techniques used in rearing practices.	PSO - 3	U
CO - 3	practice the fundamental concepts of applied zoology in research and animal farms.	PSO - 3	Ap
CO - 4	inspect the quality of honey, silk, egg, milk and fish.	PSO - 2	An
CO - 5	evaluate the profitability of animal farms.	PSO - 4	E
CO - 6	extend the entrepreneurial skills in establishing animal farms.	PSO - 4	C

Unit I **(12 hrs.)**

Apiculture: Classification and kinds of bees, bees and their society - caste distinction and their functions. Food of honey bees.Beekeeping methods - primitive and modern. Honey bee products - honey, bee wax, bee venom. Common diseases -nosemosis, acariasis, bee septicemia and management.

Unit II **(12 hrs.)**

Sericulture: Moriculture - methods of propagation - Common species of Silkworm - Life cycle of mulberry silkworm - egg, larva, pupa and adult. Rearing of silkworm -

mounting, spinning, harvesting of cocoons, silk reeling and marketing. Common diseases - pebrine, grasserie, muscardine, flacherie and management.

Unit III **(12 hrs.)**

Aquaculture: Aquaculture in India - Important cultivable organisms and their qualities, culture of Indian major carps, Marine prawn culture, Pearl culture. Integrated fish culture - Paddy cum fish culture.Ornamental fish culture.Common diseases - Ichtyophthirius, Dropsy, Fin Rot soft shell syndrome and management.

Unit IV **(12 hrs.)**

Poultry Farming: Poultry housing - types of poultry houses - management of chick, growers, layers and broilers. Sexing in chicks, Nutritive value of egg and flesh.Diseases of poultry – Ranikhet, Fowl pox, Coryza, Coccidiosis, Polyneuritis and management.

Unit V **(12 hrs.)**

Dairy Farming: Breeds of Dairy animals - Establishment of a typical Dairy farm - Management of cow - Newborn, calf, Heifer, milking cow. Diseases - Mastitis, RinderPest, Foot and Mouth Disease and management. Nutritive value of milk.Pasteurization. Dairy products - Standard milk, skimmed milk, toned milk and fermented milk - curd, ghee, cheese.

Textbook

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

Reference Books

1. Johnson, J. &Jeya Chandra, I. (2005). *Apiculture.*Marthandam: Olympic Grafix.
2. Ganga, G. &SulochanaChetty (1997). *An Introduction to Sericulture.* New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.
3. Gnanamani, M.R. (2005). *Profitable Poultry Farming*. Madurai: J. Hitone Publications.
4. Santhanakumar, G. &Selvaraj, A.M. (2002). *Concepts of Aquaculture.*Nagercoil: Meenam Publications.
5. John Moran (2005). *Tropical Dairy Farming.* Australia: Landlinks Press.
6. Uma Shankar Singh (2008). *Dairy Farming.* New Delhi: Anmol Publishers.
7. Shukla, G.S. &Upadhyay, V.B. (1998). *Economic Zoology.* Jaipur: Rastogi Publications.

Semester III &IV
Allied Zoology Practical: General Zoology & Applied Zoology
Course code: ZA20P1
(Conducted during Semester III & IV)

No. of Hours/ Week	No. of Credits	Total Hours	Marks
2 + 2	2	60	100

Objectives

1. To develop practical skills in basic concepts of biology.
2. To enhance practical skills on agro-based animal farms.

Course outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	recognize museum specimens, stages of cleavage, vital organs, genetic diseases of human and culturable organisms.	PSO - 1	R
CO - 2	explain the economic importance of animals, clinical procedures, dominant and recessive characters of humans.	PSO - 2	U
CO - 3	use the skills relevant to general and applied Zoology.	PSO - 3	Ap
CO - 4	analyse the clinical samples, nutritive value farms products and water quality parameters.	PSO - 4	An

Applied Zoology

1. Identification of cells in the honey bee comb.
2. Mounting mouthparts of a mosquito.
3. Testing of purity of Honey in three different samples.
4. Dissection of silk gland of *Bombyxmori* (virtual).
5. Measurement of shell ratio of mulberry silk cocoon.
6. Testing milk using a lactometer.
7. Qualitative analysis of milk - Methylene reductase test.
8. Estimation of protein in hen's egg.
9. Estimation of oxygen in water samples.
10. Estimation of salinity in water samples.

Spotters / Models / Charts / Bookplates

Honey bee - worker, queen and drone, Newton’s bee-hive, silkworm - egg, larva, pupa and adult, Chandrika, Rearing stand, Poultry feeders, Fowl pox, Coccidiosis, dairy products – skimmed milk, curd, cheese, ghee, *Catla*, *Rohu*, *Mrigal*.

Virtual laboratory / CD can be used as and when necessary.

Semester IV
Add on Course: Professional English for Life Sciences
Course Code: ALS204

No. of Hours/ Week	No. of Credits	Total Hours	Marks
2	2	30	100

Objectives

1. To enhance the creative and academic writing skills and workplace communication.
2. To develop competence and competitiveness and thereby improve the employability skills and life-long learning.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	define concepts related to communicative and digital competence.	1	R
CO - 2	illustrate academic writing and creativity in digital media.	2	U
CO - 3	apply communicative skills with digital competence in the workplace.	3	Ap
CO - 4	analyse a variety of formats, including essays, research papers, reflective writing, and critical reviews of life sciences.	4	An
CO - 5	analyze lectures, scripts, blogs, e-content and short films related to biology.	4	An

Unit I **(6 hrs.)**

Communicative Competence

Listening – Listening to two talks / Lectures by specialists on selected subjects
Speaking – Small Group Discussions
Reading – One Subject Based Reading text followed by comprehension activities / exercises
Writing – Summary writing based on the reading passages (Free Writing)

Unit II **(6 hrs.)**

Persuasive Communication

Listening – Product Launch

Speaking – Debates

Reading – Reading Texts on advertisements (On products relevant to the subject areas) and answering inferential questions

Writing – Writing an argumentative / persuasive essay

Unit III **(6 hrs.)**

Digital Competence

Listening – Interview by a famous celebrity

Speaking –Interviewing any professional / Creating Vlogs (How to become vlogger and use vloging to nurture interest – subject related)

Reading – Blog

Writing – Blog Creation

Unit IV **(6 hrs.)**

Creativity and Imagination

Listening – Listening academic videos (Prepared by EMRC Other MOOC videos on Indian academic sites)

Speaking – Making oral presentations through short films – subject based

Reading – How is creativity possible in Science (Continuation of essay in semester III)

Writing – Creating flyers and Brochures (Subject Based)

Unit V **(6 hrs.)**

Workplace Communication & Basics of Academic Writing

Speaking – Presentation (Without Aids)

Reading & Writing – Product Profiles / Writing an Introduction.

Textbook

Tamil Nadu State Council for Higher Education (TANSCHE).*Professional English for Life Sciences – II*.

Semester V
Major Core V - Physiology
Course Code: ZC2051

No. of hours/week	No. of credits	Total number of hours	Marks
6	6	90	100

Learning Objectives

1. To enable the students to gain insight knowledge on the functional significance of the different organs and organ systems.
2. To develop skills to relate the normal and abnormal functions of vital organs.
3. To train future researchers academically and intellectually in the area of physiology.
4. Enable to perform, analyse and report on experiments and observations in physiology;

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	recall the basic anatomy of digestive, respiratory, excretory, homeostatic, neuromuscular, endocrine and reproductive system.	PSO - 1	R
CO - 2	describe the important physiological systems and internal regulation.	PSO - 1	U
CO - 3	compare various organ systems and adaptations exhibited by animals.	PSO - 2	Ap
CO - 4	infer the integration of activities of different organ and organ system.	PSO - 3	An
CO - 5	interrelate different organ systems to diseases for a holistic approach to human health.	PSO - 2	E

Unit I

Nutrition and Digestion: Nutrition - types, composition of food - importance of nutrients**.** Balanced diet. Basal Metabolic Rate (BMR) and Body Mass Index (BMI), Malnutrition - Marasmus, Kwashiorkor, Obesity. Mechanical& chemical digestion and absorption–system of man, digestion of carbohydrate, protein and fat - absorption and assimilation of digested food materials.Physiology of ruminating stomach.

Unit II

Respiration, Osmo- and thermoregulation: Respiration - respiratory organs, respiratory pigments. Respiratory system of man - transport of O_2 and CO_2,oxygen dissociation curve, Bohr's effect, chloride shift.Anaerobiosis, Respiratory Quotient.Osmoregulation - osmoconformers and osmoregulators, osmoregulation in crustaceans, fishes and mammals. Thermoregulation - poikilotherms and homeotherms, thermoregulatory mechanisms.

Unit III

Circulation and Excretion: Circulation - composition of blood and lymph, myogenic and neurogenic heart, structure of human heart, heart beat - origin and conduction, pace maker, cardiac cycle and ECG, blood pressure. Heart diseases - atherosclerosis, acute coronary occlusion, myocardial infarction. Excretion -patterns of excretion, excretory organs in invertebrates, structure of kidney in man, nephron, counter current mechanism of urine formation, composition of urine. Nephritis and dialysis.

Unit IV

Muscle and Neuro-physiology: Muscle physiology - types of muscles, ultrastructure and properties of skeletal muscle, mechanism of muscle contraction and Rigor mortis. Neurophysiology - structure and types of neurons, neurotransmitters, conduction of nerve impulse through non-myelinated nerve and synapse. Reflex action. Receptors - types, physiology of phonoreception.

Unit V

Endocrine and Reproductive Physiology: Endocrine physiology - hormones and pheromones, hypothalamus and endocrine glands – pituitary, thyroid, parathyroid, adrenal, islets of Langerhans. Biological clock and rhythms.Reproductive physiology - male reproductive system – female reproductive system, structure of graffianfollicle.Menstrual cycle and menopause.Hormonal regulation of menstruation, pregnancy and lactation.

Textbook

Arora, M.P. (2007). *Animal Physiology* (6th ed.). Mumbai: Himalayan Publishing House.

Reference Books – update latest

1. Goel, K. A. and K.V. Sastry (2016).*A Text Book of Animal Physiology* (7thed.). Meerut: Rastogi Publications.
2. Singh, H.R. ShobanLalNagin (2017). *Animal Physiology and Related Biochemistry.* New Delhi: S. Chand and Co.
3. Agarwal R.A., Srivastava, A.K. and Kaushal Kumar (2015). *Animal Physiology and Biochemistry* (5thed.). New Delhi: S. Chand and Company Ltd.
4. William S. Hoar (1999). *General and Comparative Physiology.* (3rded.). New Delhi: Prentice Hall of India Publications.
5. Nagabhushan, R. Kodarkar, M.S. and Sarojini, R. (1982). *Text book of Animal Physiology* (2nded.). New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.

Semester V
Major Core VI - Biotechnology
Course Code: ZC2052

No. of hours/week	No. of credits	Total number of hours	Marks
6	6	90	100

Objectives

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

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	explain the basic concepts of biotechnology and nanotechnology.	PSO - 1	R
CO - 2	reciterDNA, hybridoma technology, tissue engineering and applications of nanotechnology.	PSO - 1	U
CO - 3	apply appropriate tools and techniques in biotechnological manipulation and problems ethically.	PSO - 2	Ap
CO - 4	examine the transgenic animals, microbial and biotechnological products.	PSO - 3	An
CO - 5	priorities biotechnological techniques for the welfare of environment and society.	PSO - 4	E

Unit I

Introduction to Biotechnology: Scope of biotechnology,Genetic Engineering – Enzymes for cutting and joining DNAs, cloning vectors - pBR322, SV40, Ti plasmid. *In vitro* construction of rDNA, Introduction of rDNA into host cell - selection of recombinants.DNA library.Molecular markers - RAPD and RFLP.Polymerase Chain Reaction (PCR).Southern blotting.DNA sequencing - Maxam and Gilbert's method – Sanger's .

Unit II

Cell culture: Culture media - cell culture technique - establishment of cell culture – primary and sub-culture - explant culture, callus culture, somatic hybridization and micro-propagation. Cell lines - large scale culture of cell lines -organ culture - artificial skin and cartilage–3D culture – *Invitro* organ development - embryo culture. Stem cells - characteristics, types and applications.

Unit III

Transgenic animal technology: Transgenesis – methods of transgenesis, knock out gene, applications of transgenic animals.Bioethics - ethical implications of transgenic

animals.Hybridoma technology -production of hybridoma, monoclonal antibodies - production and applications.Bioreactors - stirred tank and air–lift bioreactor.

Unit IV

Metabolite production and Bioremediation: Production - primary metabolite –L. glutamic acid and L. glutamine,secondary metabolite –penicillin, Biofuel- ethanol. Immobilization ofenzymes and their applications. Biosensors – types and applications. Bacterial SCP and its applications.Sewage and waste water treatment. Bioremediation - types, degradation of xenobiotics (hydrocarbon, pesticide), super bug – construction and application.Biomining and bioleaching**.**Biocontrol – *Bacillus thuringiensis.*Biosafety: Possible dangers of Genetically Engineered Organisms (GEOs) and biohazards of rDNA technology.

Unit V

DNA applications: Disease diagnosis – DNA probes, disease treatment – production of human insulin. Gene therapy – types and methods.Finger printing and its application in forensic medicine.Human Genome Project.Nanobiotechnology **–**Nano drug, Drug delivery system, DNA microarray, gene chip, Diagnosis and screening.

Textbook

Dubey, R.C. (2014). *A Text book of Biotechnology*(6thed.). New Delhi: S. Chand and Co. Ltd.

Reference Books

1. Dubey, R.C. (2006). *A Text book of Biotechnology*(4thed.). New Delhi: S. Chand and Co.Ltd.
2. Satyanarayana, V. (2005). *Biotechnology*. Kolkata: Books and Allied (P) Ltd.
3. Rema L.P. (2006). *Applied Biotechnology*. Chennai: MJP Publishers.
4. Prakash S. Lohar (2005). *Biotechnology*. Chennai: Kalyani Publishers.
5. Gupta P.K. (2004). *Elements of Biotechnology.* Meerut: Rastogi Publications.
6. Singh B.D. (2007). *Biotechnology - Expanding Horizon*, Chennai: Kalyani Publishers.
7. Trevan, M.D. Boffey, S., Goulding, K.H. and Stanbury, P. (2004). *Biotechnology - The Biological Principles*. New Delhi: Tata McGraw - Hill Publishing Company Limited.

Semester V
Major Core VII - Ecology and Toxicology
Course Code: ZC2053

No. of hours/ week	No. of credits	Total number of hours	Marks
6	5	90	100

Objectives

1. To develop a deep understanding on the interaction between the environment and the living organisms.
2. To develop skills to assess the toxicants and its impacts, environmental standards and apply that knowledge to current environmental issues for wise environmental management.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	define abiotic, biotic and limiting factors, community structure, ecological succession, wild life conservation and toxicants.	PSO - 1	R
CO - 2	comprehend the physical and chemical properties of environment, biological effects, biogeochemical cycles, wild life conservation, environmental pollution and toxicology.	PSO - 1	U
CO - 3	identify the biotic factors, characteristics of communities, endangered species and causes for environmental problems.	PSO - 2	Ap
CO - 4	assess the structure and function of ecosystem, community, habitat for sustainable management of environmental system and for the remediation.	PSO - 3	An
CO - 5	evaluate the impact of environment changes on the biosphere.	PSO - 4	E
CO - 6	design and execute independent research in environmental science.	PSO - 4	C

Unit I

Introduction to ecology: Scope-Branches of ecology. Autecology and synecology.Environment – atmosphere, lithosphere, hydrosphere and biosphere.Biological effects of temperature and light.Concept of limiting factors - Liebig's law of minimum, Shelford's law of tolerance.Interspecificrelationship - mutualism, commensalism, antagonism - antibiosis, parasitism, predation and competition. Habitat ecology- adaptations of deep sea and desert living animals.

Unit II

Ecosystem and Population ecology: Ecosystem –Structure, abiotic and biotic factors. Functions - Detritus and grazing food chains, food web, trophic levels, energyflow - Linear and Y-shaped,

ecological pyramids. Biogeochemical cycle – types, nitrogen and phosphorous cycle. Population ecology - density, natality, mortality, age distribution, population growth, population equilibrium, population fluctuations, biotic potential, population dispersal and dispersion, regulation of population - density independent and density dependent factors, population interaction.

Unit III

Community Ecology: Concept of community, Community- structure, composition and stratification. Ecological niche, Ecotone and Edge effect, Ecotype, Ecological indicators. Ecological succession - types, general process, Concepts of climax- theories of climax, patterns of succession. Ecological effects of dams, hydroelectric projects.Animal distribution – continuousand discontinuous.Parallelism, Endemism.Zoogeographical regions of world.Remote sensing and its applications in agriculture, fisheries, forest management and food management.

Unit IV

Toxicology: Scope and sub-divisions of toxicology.Toxicants – classification, toxicity - lethal, sublethal, LC_{50}, and LD_{50}.Toxic agents and their mode of action – toxicokinetics –toxicodynamics – toxic responses - ADME.Toxic effects of heavy metals, pesticides, carcinogens, food additives, cosmetics, micro plastics and radiations.Factors affecting toxicity.Dose-effect and dose-response relationship - acute toxicity, chronic toxicity reversible and irreversible effects.Toxicity bioassay – *invivo* experiments – determination of LC_{50} and LD_{50}, *exvivo* experiments – haematological and biochemical parameters.Application of toxicology.

Unit V

Ecotoxicology: Types **–** measurement of ecotoxicological effects. Pollution - pollutants, xenobiotics, greenhouse effect, ozone depletion, acid rain, photochemical smog, Bhopal episode, Chernobyl disaster, BOD, Eutrophication, Red tide, Minamata disease, bioaccumulation, biomagnifications, biotransformation, biomonitoring. Waste water treatment and solid waste management. Environmental Auditing and Environmental Impact Assessment (EIA).

Text book

Mercy, P.D. and Basil Rose, M.R. (2003).*Ecology and Toxicology.*Nagercoil: Sathana Publications.

Arumugam, N. (2014). *Ecology and Toxicology.*Nagercoil: Saras Publications.

Reference Books

1. Sharma, P.D. (1999). *Ecology and Environment.* Meerut: Rastogi Publications.
2. Dash, M.L., Tata M.C. (1996). *Fundamentals of Ecology.* New Delhi: McGraw Hill Publishing Company Ltd.
3. Trivedi, R.N. (1993). *Textbook of Environmental Sciences.* New Delhi: Anmol Publications Pvt. Ltd.
4. Shukla, S.K. and Srivastava, P.R. (1992). *Water Pollution and Toxicology.* New Delhi: Common-Wealth Publishers.

5. Subramanian, M.A. (2004). *Toxicology: Principles and methods.* Chennai: M. J. P. Publishers.
6. Verma, P.S. and Agarwal V. K. (1986). *Principles of Ecology*. New Delhi: S. Chand & Co. Pvt. Ltd.
7. Bhattacharya, S. (2011). *Environmental Toxicology*. Kolkata: Books and Allied (P) Ltd.

Semester V

Project
Course Code: ZC20PR

Hours/ Week	Credits	Total Hours	Marks
4	3	60	100

Objectives

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

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	identify a research problem relevant to the subject or society.	PSO - 1	U
CO - 2	conduct an experiment and analyse the data.	PSO - 2	An
CO - 3	write research reports and present results in the scientific community.	PSO - 3	Ap
CO - 4	criticallyanalyse and interpret the results.	PSO - 3	E
CO - 5	design experiments to solve environmental and societal problems.	PSO - 4	C

Guidelines

- Submission of Project report is mandatory.
- Project is subject-based and in group (5-6 students per group).

Framework of Projectreport

Project report format

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

  The citation may assume any one of the following forms:

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

  ii) A paper, a monograph or a book with two authors may be designated by the name

of the first and second author followed by the year of publication, placed inside bracketsat the appropriate places in the text.

iii) A paper, a monograph or a book with more than two authors may be designated by the name of the first author followed by et al, and the year of publication, placed insidebrackets at the appropriate places in the text.

- Line space - 1.5
- Margin - 2" on the left and 1" on the right, Gutter -0.5.
- Page Numbering – Bottom middle alignment; excluding initial pages and references.
- Total number of pages - Minimum 20 - Maximum 30 (excluding initial pages and reference).
- The Tables and Figures should be included subsequently after referring them in the text.
- The content should be printed on single side.

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

III. Submission

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

The report contains three main parts:

A. Initial Pages - in the following sequence

i. Title Page

ii. Certificate from the Supervisor

iii. Declaration by the candidate endorsed by the Supervisor and HoD.

iv. Acknowledgement (within one page - signed by the candidate).

v. Table of Contents

B. Main body of the report

i) Introduction with Literature review and Objectives

ii) Materials and methods

iii) Results

iv) Discussion

v) Summary

vi) References(DOI number of the journals can be included)

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

1. Journal Article: with Single Author

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

2. Journal Article: with Two Authors

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

3. Journal Article: with more than two Authors

Alishahi, K, Marvasti, F, Aref, VA & Pad, P 2009, 'Bounds on the sum capacity

Of synchronous binary CDMA channels', Journal of Chemical Education, vol. 55, no. 8, 3577-3593.

4. Books

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

5. E-book

Aghion, P &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).

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

Semester V

Major Practical III – Physiology and Biotechnology
Course Code: ZC20P3

No. of hours/ week	No. of credits	Total number of hours	Marks
4	2	60	100

Objectives

1. To develop skills to perform physiological experiments and report the results.
2. To train the students to familiarize biotechnological experimental protocols.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	selectappropriate methods in physiology and biotechnology experiments.	PSO - 1	R
CO - 2	describe the principles of analytical instruments and its uses in physiology and biotechnology.	PSO - 2	U
CO - 3	demonstrate scientific experiments and interpret the biological data.	PSO - 3	Ap
CO - 4	estimate the effect of abiotic factors on physiological process and quantify genomic DNA.	PSO - 2	An
CO - 5	select appropriate physiological and biotechnological techniques to analyse the biological samples.	PSO - 4	E

Physiology

1. Rate of oxygen consumption in a fish.
2. Effect of temperature on the opercular movement of a fish and calculation of Q_{10}.
3. Estimation of salt loss and salt gain in a fresh water fish.
4. Identification of nitrogenous excretory products – ammonia, urea, uric acid
5. Action of salivary amylase in relation to pH.
6. Action of salivary amylase in relation to enzyme concentration.
7. Estimation of haemoglobin - demonstration.
8. Counting of blood cells using haemocytometer (Demonstration).
9. Determination of blood clotting time (Demonstration).
10. Determination of Body mass index of students.

Slides/ Models/ Charts

Haemoglobin, ECG,kwashiorkordisease,Obesity, Sphygmomanometer, Kymograph, Cardiac muscle, Striated and Non-striated muscle, Simple muscle curve.

Biotechnology

1. Isolation of genomic DNA from *E. coli.*
2. DNA – Agarose Gel Electrophoresis (Demonstration)
3. Estimation of DNA by Diphenylamine (DPA) Method.
4. Measurement of degradation: Estimation of COD in sewage.
5. Measurement of Bioremediation:Estimation of BOD in Sewage.
6. Immobilization of enzyme (Amylase/ Invertase/ Protease) using sodium alginate.
7. Polymerase Chain Reaction – Demonstration.
8. Production of Hybridoma and Monoclonal antibodies – Flow chart.
9. Isolation of B and T lymphocytes using kits.
10. Animal cell culture media preparation.

Models/ Charts/ Photos

pBR322, Recombinant DNA, Electroporation unit, Southern blotting, RFLP, Dolly, Fermenter, Human genome sequence, Penicillin, Biogas production.

Semester V
Foundation Course Ill - Human Rights Education (HRE)
Course. Code: FCV203

Objectives

1. Make them to identify issues, problems and violation of human rights.
2. Resolve the problems of human rights in their own life and society.

Course outcome

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	explains the historical growth of the idea of human rights.		U
CO - 2	interpret the problems of human rights and find solution.		A
CO - 3	analyze the importance of women and child rights		An
CO - 4	evaluate concepts and ideas of human rights		E

Unit I

Social Justice - Need for Social Justice, Parameters of Social justice. Untouchability - problems, causes, casteism. Social reformers - contributions of Dr. B.R. Ambedkar and E.V. Ramasamy. Role of Mandal commissions in Social justice - Social, educational, economic indicators and recommendations

Unit II

Human Rights - approaches and concept of human rights. United Nations - UN commission on Human rights, other UN bodieson Human rights. Fundamental rights of Indian Citizen.Fundamental duties of Indian Citizen. Political rights of Indian Citizen. Human rights concern in India.

Unit III

Women Rights - History and need of women rights. United Nation on women rights - issues by identified United Nation. Women and climate change. Women rights and problems.
Problem faced by women during medieval and modern India.

Unit IV

Gender inequality - seven types of inequality. Constitutional and legal provision for women in India. Special initiatives for women. Women struggle and reforms. Women today.

Unit V

Child Rights: History and declaration of rights of children. Convention on rights of child, Child rights in India. National commission on women rights. Issues faced by women.
Constitutional and Legal provision in India. Child rights in Indian Constitution.

Reference Book

Dr.Arymugam, N., Dr. Mohana., & Lr. Palkani. (2017). Value Based Education. (4th ed.). TamilNadu, Saras Publication

Semester III / V
UG Self Learning Course: Ornamental Fish Culture
Course Code: ZC20S1

No. of Credits	Marks
2	100

Objectives

1. To learn the culture techniques of aquarium fishes.
2. To develop skills in ornamental fish culture so as to enable the students to become an entrepreneur.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	choose materials necessary for setting an aquarium, accessories, popular ornamental fishes, feed, anesthetics and diseases.	PSO - 1	R
CO - 2	demonstrate the construction of fish tanks, culture techniques and feed preparation.	PSO - 2	U
CO - 3	establish and maintain an aquarium for commercialization.	PSO - 4	Ap
CO - 4	analyse the types of tanks, physico-chemical parameters and feed relevant for ornamental fishes.	PSO - 3	An

Unit I

Construction of fish tanks: Scope of ornamental fish culture. Fish tanks - Seating the tank – ornamental fish tank as a biological filter.Setting up of tanks - bottom gravel, planting with plants, filling with water, maintenance of water quality, stocking of fishes.

Unit II

Accessories for fish tanks: hood and light source – nets – suction tube – scraper tool – aerator – lights – filters – Underwater bottom filter - Under gravel filter – Poly foam filter – Overhead trickle purification system (OTP) - Filter with activated charcoal (Carbon filter) - filtration. Aquarium plants - Floating, rooted and submerged.

Unit III

Popular ornamental fishes: Ornamental fishes - Egg laying fishes (Zebra fish, Gold fish, Barbs, Gourami, Fighter), Live bearing fishes (Guppies, Mollies, Platys and Swordtails). Breeding methods in egg layers - Breeding of live bearing ornamental fishes - Culture techniques – Stocking tank.

Unit IV

Food and feeding: Live feed organisms and culture – Cyclops, Tubifex, Brine shrimp (*Artemia*), Cladoceran (*Daphnia*), Blood worm (*Chironomus* larva). Artificial feeds - feed ingredients and feed formulations, Feeding, Balanced diet for aquarium fishes, Holiday or vacation feed.

Unit V

Transport and diseases management: Transport of fishes - Oxygen packing, Anesthetics used in fish transport, Mechanism of action of anesthetics, Transport of export consignment, Preparing of fishes, Methods of sedation, Role of Carbonic acid and Tertiary butyl alcohol. Diseases and treatment methods – Protozoan, Fungal, Bacterial, Viral, Ectoparasites and endoparasites.Economics of commercial farming.

Textbook

Jameson, J.D. &Santhanam, R. (1996).*Manual of Ornamental fishes and Farming Technologies.*Thoothukudi: Fisheries College and Research Institute.

Reference Books

1. Butcher, L. (1992).*Manual of Ornamental Fish.* Gloucestershire: British Small Animal Veterinary Association Publications.
2. Jameson, J.D., Srinivasan, A. &Venkataramanujam (1995). *Ornamental Fish Culture Technology.* Chennai: TANUVAS Publications.
3. Hawkins, A.D. (1981). *Aquarium Systems*. New York: Academic Press.
4. KishoriLalTekriwal& Andrew ArunavaRao (1999).*Ornamental Aquarium Fish of India*. England: Kingdom Books.
5. Dawes, J.A. (1984). *The Freshwater Aquarium.* London: Roberts Royee Ltd.

Semester VI
Major Core VIII– Developmental Zoology
Course Code: ZC2061

No. of hours/week	No. of credits	Total number of hours	Marks
6	6	90	100

Objectives

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

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	define the concepts of reproduction, embryonic development, nuleo-cytoplasmic interaction and birth control.	PSO – 1	R
CO - 2	outline the patterns of cleavage, morphogenetic movements, fate map, the reproductive disorders and treatment.	PSO - 1	U
CO - 3	execute the principles of embryology in applied sciencesand birth control measures.	PSO – 3	Ap
CO - 4	analyze clinical implications of the development, gender based reproductive disorders and intervening mechanism.	PSO - 3	An

Unit I

Reproduction: Sexual reproduction - spermatogenesis, Structure and types of sperm. Oogenesis, types of egg, egg membranes, Structure of egg- frog, chick and human. Fertilization -types, chemical and cytological factors involved in fertilization, physiological changes in fertilization, significance, Prevention of polyspermy. Asexualreproduction. Parthenogenesis - types and significance.

Unit II

Cleavage and Gastrulation: Planes and patterns of cleavage, factors controlling cleavage,cleavage and blastulation in frog. Fate map of frog.Morphogeneticmovements.Gastrulation in frog. Organizer –Spemann's experiments - organizer in amphibian embryo, embryonic induction - neural induction. Competence. Gradient theory - gradient system - types, experimental evidences, mechanism.

Unit III

Organogenesis: Development of eye, heart, digestive system in frog. Extra embryonic membranes - development of fetalmembranes.Placenta in mammals - classification, functions and

developmentStem cells, Preservation of cord blood stem cells. Principles of collections of Umbilical cord, gametes and embryos.

Unit IV

Metamorphosis and Regeneration: Types, Insect and Amphibian metamorphosis - hormonal control.Regeneration - types, regeneration in Planaria, amphibia and human liver, factors influencing regeneration, physiological changes involved in regeneration. Nucleo-cytoplasmic interaction - Acetabularia.Ageing- concepts and theories.Synthetic biology – synthetic life.

Unit V

Embryological Techniques: Infertility – causes and diagnostic parameters – hormonal imbalance, Poly Cystic Ovarian Diseases (PCOD). Rh factors and incompatibility.*Invitro* fertilization, artificial insemination, cryopreservation of sperm and ovum - test tube babies – amniocentesis.Teratogenesis- agents and their effects.Birth control - physical barriers - contraceptive devices - IUCD, surgical method, hormonal therapeutic methods.

Textbook

Jain,P.C. (2013). *Elements of developmental biology*(7thed.). Jalandhar: Vishal publishing Co.

Reference Books

1. Verma, P.S. and Agarwal, V.K. (2010). *Chordate Embryology.* New Delhi: NarosaPublishing House.
2. Sastry, K.V. and Shukla, V. (2003). *Developmental Biology*. Meerut: Rastogi Publications.
3. Balinsky, B. I. and B.C. Fabian (1981). *An Introduction to Embryology* (5thed.).New York: Saunders Publishing College.
4. GayatriPrakash (2007). *Reproductive Biology*. New Delhi: Narosa Publishing House.
5. Gilbert S. F. (2010). *Developmental Biology*. IX Edition, Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts, USA.
6. **E-sources**

   https://cob.silverchair-cdn.com/cob/content_public/journal/dev/144/7/10.1242_dev.144196/8/dev144196.pdf?Expires=1641601205&Signature=shoDdF6R7ZwxxbizbO1uDjSwEstj3HxWUV2atgGOv1zQmsHzFSDPhlXmx~5vNjBlbSxgMsjDvF2SULZMbnkdcjRLNWjPV3rXWBW7wr1UJKtpRIFAPNBFSoHjeA2fp~DP4-2x1tSxMK13jnDReAOWPE4PSSZi5UumExHidN~N1gDdvDyUsj6IwKlGq6SE8h5SCclrt~QrZIh3sv8DbkKabgd4fb~v-WNLyPLxbbCfRoudpTfsJQsLLfkP1kWaMhs-G8kLQXRlteloX51~yWQYWBUUDsS6t62ak~q65wG6~KhC9YxXqWUdpXQHvwwFdzD4LYCsW5-s4vyfW005XTOH5g__&Key-Pair-Id=APKAIE5G5CRDK6RD3PGA

Semester VI
Major Core IX - Immunology and Microbiology
Course Code: ZC2062

No. of hours/week	No. of credits	Total number of hours	Marks
6	6	90	100

Objectives

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

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	define the components of the immune system, mechanisms of immune response, microbial diversity, infectious diseases and microbial application.	PSO - 1	R
CO - 2	discuss the types of immune cells, immune response, taxonomic classification of microbes and their role in industries.	PSO - 1	U
CO - 3	apply the concepts of Immunology and Microbiology forinterdisciplinary research and life-long learning.	PSO - 3	Ap
CO - 4	analyze the role of microbes in food, air, water, soil and immune response to infection.	PSO - 4	An

Unit I

Immunity and Lymphoid organs: History and scope. Types of immunity - Innate, acquired, passive and active.Cells of immune system (T cells and B cells, macrophages), Primary and Secondary lymphoidorgans - Thymus, Bone marrow, Bursa of Fabricius, Spleen, Lymph node, Mucosa Associated Lymphoid Tissue. Lymphoid and myeloid lineage.

Unit II

Antigen and Antibodies: Haemopoietic stem cells and haemopoiesis. Antigen, immunogens, hapten and adjuvants. Immunoglobulin - types, structure and functions of IgG. Antigen – Antibody reactions. Secondary antibody, purification of antibody.

Unit III

Immune Response: Primary and secondary immune response, immunity to bacterial infections (humoral and cell-mediated immune response). Hypersensitivity - Allergens and types of hypersensitivity. Autoimmunity– Rheumatoid arthritis.Immunobiotics– definition, respiratory and digestiveailments. Vaccines and Immunization schedule.

Unit IV

General Microbiology: History and scope. Whittaker's and Bergy's classification of microbes. Bacteria - structure of *E. coli*, bacterial growth kinetics, culture media, culture techniques – batch culture. and continuous culture (chemostat and turbidostat). Virus: structure (SARS and T_4 phage) – reproduction of T_4 phage (lysogenic and lytic). Synthetic Biology.

Unit V

Applied Microbiology: Food poisoning,Food spoilage and preservation.Industrial microbiology - Scope and applications – Fermentation process – Fermenter -Wine and Vinegar production. Medical microbiology - Bacterial diseases – Leptospirosis, Syphilis, Pneumonia, viral diseases – COVID -19, Herpes, Hepatitis B, Rabies, fungal diseases – Tineacorporis, Mucormycosis - Mycotoxicosis and Aspergillosis.

Textbook

Arumugam, N., Mani, A., Narayanan, L.M., Dulsy Fatima and Selvaraj, A.M. (2013).*Immunology and Microbiology.*Nagercoil: Saras publications.

Reference Books

1. Kuby, T. (1994). *Immunology*. New York: W.H. Freeman and Company.
2. Tizard, I.R. (1995). *Immunology - an Introduction* (4thed.). Philadelphia: Saunders College Publications.
3. Prescott, Lansing, M. John, P. Harley and Donald A. Klan (2005). *Microbiology*. New York: McGraw Hill Publishing Co. Ltd.
4. Pelczar, Michael J. E.C.S. Chan and Noel R. Krieg (2006). *Microbiology*. New York: Tata McGraw – Hill Publishing Co. Ltd.
5. Roger, Y. Stanier, John L. Ingraham, Mark L. Wheelis and Pager R. Painter (1988). *General Microbiology*. New Delhi: Macmillan India Ltd.
6. David M., Jonathan B., David R.B. and Ivan R. (2006). *Immunology*, VII Edition, Mosby: Elsevier Publication.
7. Subash Chandra Parija (2012). *Microbiology and Immunology*, Elsevier.
8. **E– source**
   https://en.m.wikipedia.org/wiki/Industrial_microbiology

Semester VI
Major Core X – Organic Evolution
Course Code: ZC2063

No. of hours/week	No. of credits	Total number of hours	Marks
6	5	90	100

Objectives

1. To discern the evolutionary significance of animals and origin of species.
2. To provide skills for tracing fossil records, interpreting animal evolution and analysing phylogenetic tree.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	recall the concepts of evolution, origin of life, geological time scale, natural selection, speciation and evidences of evolution.	PSO - 1	R
CO - 2	discuss on the theories of evolution, isolation, variation, speciation, fossils and phylogram.	PSO - 2	U
CO - 3	generalise experimental and natural evidences in support of evolution, genetic equilibrium, speciation, and rate of evolution.	PSO -3	Ap
CO - 4	analyse the major transitions in evolution and phylogeny of animals.	PSO - 3	An
CO - 5	assess and report the evidences in support of natural selection, speciation and evolution.	PSO - 4	E

Unit I

Concepts and Evidences of Evolution: History of evolution - theory of preformation, epigenesist, recapitulation, germplasm and Bear's law.Origin of earth.Origin of life - theories and experiments, origin of prokaryotic and eukaryotic cell.Evidences in support of evolution – morphology and comparative anatomy, embryology, physiology and biochemistry, palaeontology.Geological time scale.

Unit II

Theories and Natural selection: Lamarckism, Neo-Lamarckism. Darwinism, Neo-Darwinism. Natural selection – Stabilizing, directional and disruptive selection.Mutation theory of De Vries.Modern synthetic theory. Variation – types and sources. Hardy-Weinberg law and elemental forces of evolution - mutation, recombination, hybridization, isolation, natural selection, Founder's principle and genetic drift.Fishers' theorem, Genetic load and genetic death.

Unit III

Isolating mechanisms and Speciation: Isolating mechanisms **- t**ypes, origin and evolution of isolating mechanisms, role of isolation in speciation. Species concept - morphological, genetic and biological. Salient features of species, sibling species, subspecies and demes. Speciation - Phyletic and true speciation, mechanism of speciation. Patterns of speciation – allopatric, sympatric, quantum and parapatric.Adaptive radiation (Darwin finches) - Convergent and divergent evolution.

Unit IV

Modes of Evolution, Mimicry and Colouration: Modes of evolution – micro, macro, mega and quantum evolution. Coevolution.Molecularevolution.Heterochrony- Paedomorphosis and Peramorphosis.Rate of evolution.Human Evolution – organic, cultural and future evolution.Mimicry and colouration. Extinction - types, causes and significance. Fossils - Types of fossils. Dating of fossils.

Unit V

Phylogenetic analysis: Phylogenetic trees – structure and types. Tools for sequence alignment – BLAST, FASTA.Methods of phylogenetic analysis - phenetic and cladistic,methods for determining evolutionary trees – maximum parsimony, distance and maximum likelihood.Mutations as data source for evolutionary analysis.

Textbook

Arumugam, N. (2019). *Organic Evolution.*Nagercoil: Saras Publications.

Reference books

1. Arora, M.P. (2003). *Evolutionary Biology.* Chennai: Himalaya Publishing House.
2. SanjibChattopadhyay (2012). *LIFE: Evolution, Adaptation and Ethology.* Kolkata: Books and Allied (P) Ltd.
3. Verma, P.S. and V.K. Agarwal (1998). *Concept of Evolution.* New Delhi: S. Chand and Company Ltd.
4. Verma, P.S. and V.K. Agarwal (1982). *Principles of General Biology (Evolution).* New Delhi: S. Chand and company Ltd.
5. Gladis Helen Hepsyba, S. and Hemalatha, C.R. (2009). *Basic Bioinformatics.* Chennai: MJP Publishers.
6. John Britto, A. (2011). *Bioinformatics.*Palayamkottai: St. Xavier' College.
7. Hooman H. Rashidi and Lukas K. Buehler (2000). *Bioinformatics Basics: Application in Biological Science and Medicine*. USA: CRC Press.

Semester VI
Major Elective III – (a) Economic Zoology
Course code: ZC2064

No. of hours/week	No. of credits	Total number of hours	Marks
4	3	60	100

Objectives

1. To acquaint the students with the applied aspects of Zoology.
2. To develop entrepreneurial skills inthe area of applied zoological sciences.

Course Outcomes

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	recall the importance of applied area of biological sciences.	PSO - 3	R
CO - 2	explain the rearing techniques of economically important animals.	PSO -3	U
CO - 3	apply the different strategies adopted in rearing of honey bee, lac insect, silkworm, fishes, fowls and dairy animals.	PSO -4	Ap
CO - 4	choose the profitable culture practices.	PSO -4	An
CO - 5	evaluate the profitability of animal farms.	PSO - 4	E
CO - 6	extend the entrepreneurial skills in establishing animal farms.	PSO - 4	C

Unit I

Apiculture and Lac culture: Apiculture - **s**cope, varieties of honey bees,bees and their society, communication in honey bees.Bee pasturage, food of honey bees, relationship between plants and bees.Methods of bee keeping - primitive and modern.Economic importance of honey bee products- honey, bee wax, bee venom, pollen, royal jelly, andpropolis.Enemies and diseasesof honey bees.Honey extraction and processing. Steps involved in starting apiary. Funding sources for beekeeping projects.Lac culture - life history of lac insect- host plants- rearing of lac insect- processing of lac, composition of lac.Economic importance of lac.

Unit II

Sericulture: Scope, Silk Road, CSB. Moriculture - varieties of mulberry, methods of propagation, harvesting of leaves.Types of silk and silkworms.*Bombyxmori*- life cycle,rearing, mounting, spinning, harvesting of cocoons.Silk reeling techniques, and marketing.Diseases of silkworm - pebrine, grasserie, Flacherie, sotto diseases, muscardine.Insect pest of silkworm -uzifly.Economic importance of sericulture.

Unit III

Poultry: Scope, Poultry industry in India, commercial layers and broilers. Poultry housing - types. Management of chick, growers, layers and broilers.Sexing in chicks, debeaking, Diseases of poultry – Ranikhet, Fowl pox, Coryza, Coccidiosis, Polyneuritis, vaccination.Duck farming- introduction- duck breeds – housing - feed management – breeding – disease management – marketing. Economic importance of poultry farming.

Unit IV

Dairy Farming: Scope, indigenous and exotic breeds, establishment of a typical dairy farm. Management of cow - New born, 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.Dairy Farming**:** Pasteurization.Goat farming – common breeds – construction and maintenance of shed.Economic importance of dairy farming.

Unit V

Aquaculture: Aquaculture in India, important cultivable organisms and their qualities. Culture – types, Indian major carps, marine prawn and pearl oyster. Diseases of fishes – bacterial gill rot, viral hemorrhagic septicemia, saprolegniasis. Fish parasites – Argulus and *Ichthyophthirius.*Integrated fish culture - paddy cum fish culture (Pokkali), fish cum poultry farming, fish cum dairy farming, fish cum pig farming. Ornamental fish culture – setting an aquarium, aquarium fishes.Economic importance of aquaculture.

Textbook

Shukla, G.S. and Upadhyay, V.B. (2016).*Economic Zoology.* Jaipur: Rastogi Publications.

Reference Books

1. Vasantharaj David, B. (2004). *General and Applied Entomology*(2nded.). 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 Keeeping.* Nagercoil : Saras Publications.
4. Johnson, M. and Kesary, M. (2015). *Sericulture* (5thed.).Marthandam: CSI Press.
5. Ganga, G. and SulochanaChetty (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. John Moran (2005). *Tropical Dairy Farming.* Australia: Landlinks Press.
8. Uma Shankar Singh (2008). *Dairy Farming.* New Delhi: Anmol Publishers.
9. Arumugam, N., Murugan, T., Johnson Rajeshwar, J. and Ram Prabhu, R. **(**2011). *Applied Zoology.* Nagercoil: Saras Publications.

E-sources

1. https://www.notesonzoology.com/poultry/duck-rearing-in-india-poultry-farming/565
2. https://krishijagran.com/agripedia/beekeeping-in-india-a-complete-guide-to-beekeeping-for-beginners/
3. https://www.indiafilings.com/learn/financing-beekeeping-activities/
4. https://www.agrifarming.in/loans-and-subsidies-on-beekeeping-in-india-apiculture
5. https://www.notesonzoology.com/poultry/duck-rearing-in-india-poultry-farming/565
6. https://megcooperation.gov.in/duck_farming/Modern_Duck_Farming_Practices.pdf
7. https://megcooperation.gov.in/duck_farming/Modern_Duck_Farming_Practices.pdf
8. https://www.agrifarming.in/duck-farming-business-plan-beginners
9. https://www.agrifarming.in/goat-farming-in-india-a-step-by-step-guide

Semester VI
Major Elective III – (b) Sericulture
Course Code: ZC2065

No. of hours/week	No. of credits	Total number of hours	Marks
4	3	60	100

Objectives

1. To impart knowledge on mori-and sericulture.
2. To develop entrepreneurial skill and create business opportunities.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	recognise mulberry varieties, silkworms, cocoons and silk.	PSO - 1	R
CO - 2	interpret the importance of sericulture, nutritive value of mulberry, diseases and pest of mulberry and silkworm, grainage technology, cocoon and silk marketing.	PSO - 2	U
CO - 3	practice sericulture and produce ecofriendly byproducts.	PSO - 4	Ap
CO - 4	analyse the practices of mori- and sericulture, the quality of cocoon and silk.	PSO - 3	An

Unit I

Introduction and Moriculture: Importance of Sericulture, Silk Road, CSB, Training facilities in sericulture, Sericulture as cottage industry. Moriculture- common varieties of mulberry, optimum conditions for mulberry growth, planting system, methods of propagation, irrigation, biofertilizers, green manuring - Triacontanol and Seriboost, pruning, harvesting and preservation of leaves. Nutritive value of mulberry leaves.

Unit II

Diseases and Pests of Mulberry: Fungaldiseases - white root rot, fusarium root rot, stem canker disease, wilt disease, leaf spot disease and powdery mildew diseases.Bacterial diseases - leaf blight disease androtdisease.Viraldiseases - dwarf disease and leaf mosaic disease.Nematode - root knot disease. Deficiency diseases - Nitrogen, Phosphorus, Magnesium, Iron and Potassium. Pests - termites, Bihar hairy caterpillar, thrips, almond leaf borer, stem girdler beetleand papaya mealy bug.

Unit III

Biology of silkworm: Taxonomic position of *Bombyxmori.*Races and classification of *B. mori,*life cycle of *B. mori* - morphology of egg, larva, pupa and adult.Diseases of silkworm – Protozoan - pebrine, Bacterial – bacterialflacherie and septicemia, Viral -infectiousflacherie and Gattine,

Fungal – muscardine. Pest - Uzi fly and Tachinidfly. Grainage technology -grainages, procedures in a grainage.Diapause and non-diapausingeggs.Transport of eggs.

Unit IV

Silkworm rearing: Mulberry silkworm – rearinghouse, rearing appliances, rearing operations - disinfection, brushing, maintenance of optimum conditions for rearing, feeding, bed cleaning, spacing, care during moulting. Rearing methods -chawki rearing and rearing of late age larvae - shelf, floor and shoot rearing.Sampoorna.Mounting - methods of mounting, precautions to be taken during mounting, harvesting of cocoons. Non - mulberry silkworm rearing: Eri, Tasar and Muga.

Unit V

Cocoon and Silk marketing: Transport of cocoons, physical and commercial characteristic of cocoons, defective cocoons, cocoon markets. Silk reeling: stifling -sun drying, steam stifling, hot air stifling, storage of stifled cocoons, sorting of cocoons, deflossing, cocoon riddling, cocoon mixing, cocoon cooking - open pan and three pan system, brushing, reeling operations.Reeling appliances: country charka, cottage basin and, filature. Re-reeling, lacing, skeining,raw silk testing, marketing.By products and wealth from Seri-wastes.

Textbook

Johnson, M. and Kesary, M. (2015).*Sericulture*.Marthandam: CSI Press.

Reference Books

1. Ganga, G. and J. SulochanaChetty (1997). *An Introduction to sericulture*. Delhi: Oxford and IBH Pub. Co. Pvt. Ltd.
2. Food and Agriculture organization (1976). *Manual on sericulture I, II & III.* Delhi: Oxford and IBH Pub. Co. Pvt. Ltd.
3. Jolly,M.S. (1987). *Appropriate Sericulture Techniques.* Mysore: CSR & TI.
4. Ullal,S.R. and M.N. Narasimhanna (1987). *Hand book of practical sericulture.* Bangalore: CSB.
5. Narasimhanna,M.N. (1988). *Manual on silkworm egg production.* Bangalore: CSB.
6. Dandin,S.B. and Giridhar, K. (2000). *Hand book of Sericulture Technologies.* Bangalore: CSB.

Semester VI
Major Elective III – (c) Aquaculture
Course Code: ZC2066

No. of hours/week	No. of credits	Total number of hours	Marks
4	3	60	100

Objectives

1. To familiarize the basic aspects of culture practices of fin and shellfishes.
2. To develop skills on aquaculturepractices for income generation and to create a self-employment venture.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	recall the culture practices of cultivable aquatic organisms and their management.	PSO - 3	R
CO - 2	explain the culture techniques of fin fish, shell fish and seaweeds.	PSO - 3	U
CO - 3	Apply the different strategies adopted in aquaculture.	PSO - 4	Ap
CO - 4	assess the growth of culturable organism in all season to get extra profit *via* integrated farming.	PSO - 4	An
CO - 5	evaluate the nutritive value and marketability of culturable organisms.	PSO - 4	E
CO - 6	establish an aqua industry for self-employment.	PSO - 4	C

Unit I

Aquaculture and its types: Scope, importance of aquaculture in India. Types of aquacultures – freshwater, brackish water/coastal and marine, rice-fish culture or integrated fish farming.Construction of ponds.Types of fish ponds – nursery, rearing and culture ponds.Ornamental fish culture– prerequisites – aquarium – types of aquaria.

Unit II

Culture practices and Feed: Extensive, intensive, semi – intensive. Water quality management. Culture practices in India - cold water fish culture, warm water fish culture, monoculture, poly culture, cage culture, pen culture, Pokkali culture, tank system and raceway system.Weedcontrol.Fish feed - types, formulation and preparation.Live feed and their culture – *Artemia*, diatoms,rotifers and algae.Seaweed culture.

Unit III

Fin and Shellfish culture: Characteristics of cultivable fishes. Fin fish culture -culturable organisms– culture of Indian major carps and murrel. Shellfish culture - cultivable organisms – Culture of crab, freshwater prawn, pearl culture and edible oyster. *Biofloc* technology - culture,applications, advantages and disadvantages.

Unit IV

Diseases: Bacterial - Fish Tuberculosis, Cotton mouth disease. Viral - Infectious pancreatic necrosis, Spring Viremia of Carp, Viral Haemorrhagic Septicemia. Fungal – Dermatomycosis, Branchiomycosis.Parsitic diseases – Whirling Disease, Diplostomosis, Costiasis.Miscellaneous diseases - Epizootic Ulcerative Syndrome.Diseases of ornamental fishes –Viral -Lymphocystis, Bacterial - Fin and Tail Rot, Fungal - Saprolegniasis, Protozoan parasite - *Ichthyophthirius*, *Costia*, *Argulus*and*Ergasilus.*

Unit V

Harvesting and Marketing: Crafts and gears - post-harvest technology – Transportation - Rigor mortis - fish spoilage - Fish preservation techniques. Fish marketing - Co-operative marketing in fisheries.Governmental agencies in aquaculture -CMFRI, MPEDA, ICAR, CIFA, CAA, NFDB, CIBA, FFDA and Department of Animal Husbandry and dairying.

Textbook

Arumugam, N. (2010). *Aquaculture.*Nagercoil: Saras Publications.

Reference Books

1. Chandral, Lily Premila and Latha. (2009). *Aquaculture.* Nagercoil: C.S.I. Diocesan Press
2. Santhana Kumar, G and A. M. Selvaraj (2002). *Concepts of Aquaculture*. Nagercoil: Meenam Publications.
3. Santhanam, R. (1995). *Fisheries Science.* New Delhi: Daya Publishing House.
4. Jhingran, V.G. (1997). *Fish and Fisheries of India.* New Delhi: Hindustan Publishing Co.
5. Khanna, S.S. (1988). *Introduction to Fishes.* Allahabad: Central Book Dept.

E-sources

1. https://www.agrifarming.in/types-of-fish-farming-methods-and-systems-in-india
2. https://www.agrifarming.in/aquaculture-in-india-types-of-aquaculture-a-full-guide).
3. https://krishi.icar.gov.in/jspui/bitstream/123456789/26376/1/Biofloc%20manual%20final%2024-28-9-19.pdf
4. https://www.agrifarming.in/biofloc-technology-bft-in-aquaculture-india-a-full-guide
5. https://www.nfdb.gov.in/PDF/Biofloc%20booklet%20v6.pdf
6. https://www.shaikhinsuranceinvestment.com/post/biofloc-fish-farming-benefit-investment-profit

Semester V& VI

Major Practical IV -Ecology and Toxicology & Organic Evolution

Course Code: ZC20P4

(Conducted during Semester V & VI)

No. of hours/week	No. of credits	Total number of hours	Marks
4	2	60	100

Objectives

1. To investigate the relationship between the organisms and their environment.
2. To develop skill to identify variation, speciation and phylogeny.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	recall the protocols to analyze water quality and variation in finger prints.	PSO - 1	R
CO - 2	identify the zooplankton, serial homology, mutant forms of *Drosophila*, mimicking animals and fossils.	PSO - 2	U
CO - 3	interpret the evolutionary concepts, natural selection, variations, gene frequency and prodigality of nature through experiments.	PSO - 3	Ap
CO - 4	analyze physical and chemical factors of natural ecosystem and lethal concentration of pesticide.	PSO - 4	An

Ecology and Toxicology

1. Detection of transparency of water by Secchi disc.
2. Quantitative estimation of oxygen in water samples.
3. Estimation of salinity of water samples.
4. Estimation of CO_2 in water samples.
5. Mounting of plankton.
6. Study of food chain and food web in a terrestrial ecosystem.
7. Estimate insect population using quadrate method.
8. Preparation of different concentrations of toxicants (percentage, ppt, ppm).
9. Determination of LC_{50} of a pesticide (toxicity curve method).
10. Study of pond ecosystem and field report of the visit (compulsory).

Museum specimens/ Slides/ Models/ Charts:

Water sampler, Water cycle, Ecological Pyramids, Energy Flow, Edge effect, Mutualism - Hermit crab and Sea anemone, Commensalism - *Echeneis* and Shark, Parasitism - Sacculina on Crab, Competition – prey and predator, Cyclomorphosis - *Daphnia*.

Organic Evolution

1. Observation of Serial homology in prawn.
2. Study of Analogy – wings of animals (charts/ models/ specimen)
3. Demonstration ofprodigality of nature - Frog.
4. Observation ofmutant forms in *Drosophila*.
5. Observation of variation in finger prints.
6. Observation of variations in the markings of Umbonium shells.
7. Demonstration of the effect of natural selection on gene frequency using beads.
8. Demonstration of the effect of genetic drift on gene frequency using beads.
9. Demonstration of sequence alignment by BLAST and construction of cladogram.
10. Identification of types of fossils.

Models / Charts / Specimen

Homology - fore limbs of vertebrates, Vestigial organs, Nautiloid fossil, *Limulus*, *Peripatus*, *Archaeopteryx*, Darwin finches, Industrial melanism, Ancon sheep, Monarch and Viceroy butterfly, Stick insect, Krait and *Lycodon*, Phylogenetic tree.

Semester VI
Major Practical V –Developmental Zoology & Immunology and Microbiology
Course Code: ZC20P5

No. of hours/week	No. of credits	Total number of hours	Marks
4	2	60	100

Objectives

1. To familiarize the students with various immunological and microbiological techniques.
2. To implement experimental protocols and adapt them to carry out usingbiological techniques.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	identify developmental stages, immune cells, lymphoid organs and microorganisms	PSO - 3	R
CO - 2	explain immunological and microbiological protocols.	PSO - 2	U
CO - 3	develop skills needed for future research in developmental Zoology, immunology and microbiology and biotechnology.	PSO - 1	Ap
CO - 4	differentiate the types of eggs, placenta, parts of immune system, Gram positive and negative bacteria and microbial and immunological assay applicable to clinical research.	PSO - 4	An

Developmental Zoology

1. Temporary mounting of Frogegg and sperm.
2. Temporary mounting and observation of Chick embryo.
3. Demonstration of induced ovulation in frog(virtual demonstration).
4. Effect of thyroxine on Amphibian metamorphosis (demonstration).
5. Observation of developmental stages in an insect.
6. Observation of frog’s sperm motility.
7. Observation of regeneration in earthworm (demonstration).
8. Submission of report on chick embryo development.
9. Identification of types of egg based on shell and yolk.
10. Embryonic development of egg of Zebra fish (demonstration).

Museum specimens/ Slides/ Models/ Charts

Sperm and egg of Human, Cleavage (2, 4, 8 and 16 cell stage), blastula and gastrula of frog, Placenta – Diffuse, Discoidal, Zonary and Cotyledonary, Condoms, copper T, *Invitro* fertilization, budding in hydra.

Immunology & Microbiology

1. Dissection of Lymphoid organs of Rat (Virtual demonstration).
2. Demonstration of Radial immuno diffusion.
3. Demonstration of Hemagglutination.
4. Observation of immune cells – Blood smear preparation.
5. Preparation of culture media for bacteria and fungi.
6. Demonstration of Serial dilution technique.
7. Examination of bacterial motility by Hanging drop technique.
8. Identification of bacteria by simple staining.
9. Identification of bacteria by Gram staining.
10. Study of the effect of pH on growth of bacteria based on turbidity.

Charts/ Models/ Instruments

Escherichia coli, T_4phage, Zika virus, Bacterial growth curve, Chemostat, Autoclave, Hot airoven, Inoculation loop, Haemocytometer, Micrometer- Stage and Ocular.

Value Added Courses

Ecofriendly products of sericultural wastes
Course code: VAZ173

Total No. of Hours	Theory Hours	Training Hours
30	15	15

Objectives

1. To understand the different wastes of sericulture.
2. To make value-added products from the sericulture wastes.
3. To understand the entrepreneurial opportunities in the field of sericulture.

Section	Topics	Hours
1	Sericulture: Introduction. Wastes of Sericulture.	3
2	Classification of by-products. Wastes of Moriculture: Preparation of compost, methodology, chemical analysis of compost.	7
3	Wastes of silkworm rearing - by-products - Silkworm oil, manure from Silk worm faeces and litter.	7
4	Cocoons wastes - Pupa: nutritional value - food and feed. Cocoon handicrafts. Silk wastes - By-product of silk reeling - silk-based handicrafts.	7
5	Medicinal and cosmetic uses: Nutraceutical, medicinal and cosmetic uses of mulberry plants, silkworm, pupa and silk moth.	6

Reference books:

1. Johnson, M. and Kesary, M. (2015). *Sericulture*. Fifth edition. Marthandam: CSI Press.
2. S.R.Ullal and M.N. Narasimhanna. (1987). *Hand book of practical sericulture*. Bangalore: Central Silk Board.

Poultry

Course code : VAZ204

Total Number of Hours	Theory Hours	Training Hours
30	10	20

Objectives:

1. To make the students know about the rearing of poultry as a profitable selfemployment opportunity.
2. To apply entrepreneurial and teamwork skills in finding, evaluating and beginning the process of implementing new venture concepts.

Section	Topics	Hours
1	**Poultry Industry**: Sexing in one day old chicks, General principles of building poultry house. Poultry housing, Laying cages- Californian cages.	**4**
2	**Poultry manure:** volume, composition and values. Nutritional content of eggs.	**4**
3	**Poultry Management:** Practical aspects of chick rearing, Lighting, summer and winter management, Debeaking - Forced moulting.	**4**
4	**Poultry Nutrition:** Non – nutritive feed additives, Feed stuff for poultry, Feed formulation, Special feed formulae	**4**
5	**Requirements of poultry feed:** Importance of feed additives in poultry feed. Preparation of supplementary feed for poultry	**4**
6	**Poultry diseases:** viral, bacterial, fungal diseases, vaccination, Homeopathy in poultry diseases	**4**
7	**Marketing:** marketing channels, types and risks of poultry marketing	**4**
8	**Documentation and report:** Record maintenance, Preparation of final report	
9	**Oral Presentation**: Power point presentation	
10	**Visit:** Visit to nearby poultry farms	**2**

Reference books:

Gnanamani, M.R. (2005). *Profitable Poultry Farming*. Madurai: J. Hitone Publications.

Silkworm Rearing Technology
Course code : VAZ205

Total number of hours	Theory Hours	Training Hours
30	10	20

Objectives:

- To know the basic necessities required for silkworm rearing
- To know the influence of various factors on silkworm growth and development.
- To understand the methods of silkworm rearing.

Silkworm Rearing Technology		
Section	**Work plan:** Planning for silkworm rearing, Egg transportation, Chawki & late age silkworm rearing, mounting & cocoon harvesting	**Hours**
1	Planning for silkworm rearing: Estimation of leaf yield and quality, brushing capacity; selection of silkworm races / breeds and hybrids.	3
2	Rearing houses: Types, location and orientation; rearing houses for young (chawki) and grown up (late-age) silkworms; rearing appliances and their uses. Importance of disinfection and hygiene.	4
3	Egg transportation – time and devices; egg incubation – methods and black boxing; methods of brushing silkworms.	3
4	Harvesting, transportation and preservation of mulberry leaves.	2
5	Chawki silkworm rearing: Rearing methods and operations.	4
6	Late age silkworm rearing: Rearing methods and operations.	4
7	Moulting: Characteristic features - before, at and after moult; care during moulting.	2
8	Mounting - types of mountages, methods of mounting matured silkworms, environmental requirements during spinning and density of mounting.	4
9	Cocoon harvesting, sorting, packing, transportation and marketing, preparation of crop harvest report.	4

Reference books:

1. Ganga.G. and Sulochana Chetty (1997). An Introduction to Sericulture . Delhi; Oxford and IBH Publishing Co. Pvt. Ltd.

Culture of Freshwater Organisms

Course Code:VAZ206

Total No. of Hours	Theory Hours	Training Hours
30	10	20

Objectives

1. To impart theoretical knowledge and hands on training on culture and breeding of commercially important freshwater organisms.
2. To impart hands on training on feed and feed technology and setting up of ornamental fish unit and its maintenance.

The Work plan of this course includes the Collection, Identification, Feeding Strategies, Breeding, Construction of Aquarium and Pond, Diseases and Marketing

Section	Topic	Hours
1	**Collection and Identification** Methods of collection, taxonomic identification of native and exotic freshwater fishes.	3
2	**Feeding strategies for freshwater fishes** Types of feed, Feed formulation, feeding schedule and feeding methods.	3
3	**Techniques of freshwater fish breeding and culture** Methods in egg layers and live-bearing fishes, tests for selection of good quality seed, source & transport of seed, stocking time and density, size of stocking, acclimatization, estimation of survival rate.	3
4	**Construction and setting up of Aquaria and Ponds** Accessories for aquarium, pond site selection, design and construction of ponds. Water quality parameters. Pond preparation and management.	3
5	**Live feed culture techniques** Artemia, Daphnia, Chironomous, Tubifex	3
6	**Freshwater fish diseases and their management** Air-borne, protozoan, fungal and bacterial diseases and parasites.	3
7	**Marketing and Economics of freshwater fish culture**	3

	Marketing channels, types and risks of fish 3marketing	
8	**Government participation and support in aquaculture**	3
9	**Documentation and Report** Record maintenance, Preparation of final report	3
10	**Oral presentation** Power point presentation	3

Reference Books

1. Pillay, T.V.R. (1990). Aquaculture: Principles and Practices. England: Fishing News Books Ltd.
2. Jhingran, V. G. (1991). Fish and Fisheries of India, New Delhi: Hindustan Publications.

Culture of Fish Feed Organisms
Course code : VAZ207

Total No. of Hours	Theory Hours	Training Hours
30	10	20

Objectives

1. To impart theoretical knowledge and hands on training on culture of fish feed organisms.
2. To provide hands on training on culture techniques of fish feed organisms and setting up of live feed organism unit and its maintenance.

The work plan of this course includes the

Culture of Fish Feed Organisms	
Section	**Work plan: classification, nutritional values, biology and culture techniques of rotifers, cladocerance, copepods, microworms, earthworms and Artemia.**
1	**Introduction to Fish food organisms** Types of fish feed organism, their nutritional values, and use in aquaculture practices.
21	**Rotifers** Rotifer - Introduction, classification, biology and nutritional value of rotifers, culture conditions, culture procedures: Stock culture of rotifers, Mass production – Batch culture, Continuous culture
32	**Cladocerans** Cladocerans – Introduction, classification, biology and nutritional value of cladocerans. Daphnia - classification, biology and nutritional value of Daphnia, culture techniques – Tank culture, Pond culture
4	**Copepods** Copepods - Introduction, classification, biology and nutritional value of copepods, culture techniques – Tank culture
5	**Microworms** Chironomid larvae – Introduction, classification, biology and nutritional value of copepods, mass culture techniques. Tubifex – classification, biology and nutritional value of Tubifex, mass culture of Tubifex.
6	**Earthworms** Earthworm – Classification, biology and nutritional value of earthworm, culture methods, maintenance and harvesting.
7	**Artemia** Artemia - classification, biology and nutritional value of Artemia, physiology of the hatching process, culture techniques.
8	**Government participation and support in aquaculture**
9	**Documentation and Report** Record maintenance, Preparation of final report.
10	**Oral presentation** Power point presentation.

Fish processing and value added products

Course Code:VAZ208

Total No. of Hours	Theory Hours	Training Hours
30	10	20

Objectives

1. To impart theoretical knowledge on fish processing and value added products.
2. To impart hands on training on fish processing and value added products.

The Work Plan of this course includes Handling, spoilage, processing of fish, Preparation of value added products and marketing.

Section	Topic	Hours
1	**Fish handling** Proximate composition of fish; hygiene and sanitation in fish handling; identification and isolation of *E. coli*, *Streptococci*, *Staphylococus aureus* etc in fish.	4
2	**Fish spoilage** Indices of fish spoilage; pesticide residues; quality of water and ice; seafood toxins.	3
3	**Fish processing** Handling, pre-processing and freezing of fish products, post harvest handling of fish; canning and preservation of fish and shell fish; salting and drying of fish; Principle of fish preservation and processing. Processing of fish by traditional methods – salting, sun drying, smoking, marinating and fermentation. Theory of salting, methods of salting –wet salting and dry salting. Drying and dehydration- theory, importance of water activity in relation to microbial growth .Sun drying and artificial drying- solar dryer. Packaging and storage of salted and dried fish. Different types of spoilage in salt cured fish. Quality standard for salted and dry fish. Fish preservation by smoking- chemical composition of wood smoke and their role in preservation. Methods of smoking and equipments used for smoking.	7
4	**Value added products** Value added fishery products -. Marinaded and fermented fish products – role of acids in marinades, Fish and prawn pickles, fish sauce and Fish paste, traditional Indian fermented products. Principles and methods of preparation of various fish paste products like fish sausage, fish ham, surimi, fish cake, kamaboko etc. Diversified fish products: battered and braided products-fish finger, fish cutlet, fish wafer, and fish soup powder etc and imitation products. Value addition.	5
5	**Marketing** Quality assessment of individual by-products, Packing methods, Marketing.	3
6	**Documentation and Report** Record maintenance, Preparation of final report	5
7	**Oral presentation** Power point presentation	3

Reference Books

1. Arumugam, N. (2010): *Aquaculture*. Nagercoil: Saras Publication.
2. Kulikov, P.I. (1971). *Production of Meal, Oil and Protein – Vitamin Preparation in the fishing Industry*. New Delhi: Amerind Publishing Co. Pvt. Ltd.