A.D.M.COLLEGE FOR WOMEN (AUTONOMOUS),

(Nationally Accredited With 'A' Grade by NAAC 4th Cycle)(Affiliated to Bharathidasan University, Tiruchirappalli) **NAGAPATTINAM- 611 001**

PG & RESEARCH DEPARTMENT OF ZOOLOGY

SYLLABUS

B.Sc., ZOOLOGY

2024-2025 onwards

CURRICULUM STRUCTURE – UG (SCIENCE) – I Year 2024 Batch Onwards

Part	Category of Courses	No. of Courses	Hrs	Total Credits
Part I	Language Courses (Tamil/Hindi/French/Arabic/ Sanskrit)	4	24	12
Part II	English Language Courses	4	24	12
Part III	Core Courses (CC) (T – 10, P – 4)	14	70	60
	Minor Course (T – 4 / 5 , P – 2/1)	6	24	16
	Discipline Specific Courses (DSC)	3	10	9
	Project	1	3	3
	Skill Enhancement Courses (SEC)	4	8	8
	Ability Enhancement Courses (AEC)	3	6	6
	Multi Disciplinary Courses (NME)	2	4	4
Part IV	Environmental Studies	1	2	2
	Value Education	1	2	2
	Soft Skill Development	1	2	2
	Summer Internship/Industrial Activity	0	0	2
	Gender Studies	1	1	1
Part V	Extension Activity (NCC/NSS/Sports/Any Other Activities)	0	0	1
	Total	45	180	140

EXTRA CREDIT SCHEME STRUCTURE – 2024 - 2027

Courses	Credits	Semester	Marks
Extra Credit Courses I(Professional English) ECPEA – ECC I – PROFESSIONAL ENGLISH FOR ARTS AND SOCIAL SCIENCES **(Tamil, English, History, Economics, Mathematics, CS, IT, BCA)** ECPEB – ECC I – PROFESSIONAL ENGLISH FOR COMMERCE AND MANAGEMENT **(Commerce & BBA)** ECPEC – ECC I – PROFESSIONAL ENGLISH FOR LIFE SCIENCES **(Zoology, Botany, Biochemistry & Marine)** ECPED – ECC I – PROFESSIONAL ENGLISH FOR PHYSICAL SCIENCES **(Physics, Chemistry & Geology)**	2	I	100
Extra Credit Courses II (Skill Course I – Add on)	2	II	100
Extra Credit Courses III(Skill Course II- Add on)	2	III	100
Extra Credit Courses IV(Skill Course III- Add on)	2	IV	100
Value added course I (Multidisciplinary)	2	V	100
Value added Course II (Same disciplinary)	2	VI	100
Total	**12**		

SCHEME OF EXAMINATIONS – 2024 Batch

(For UG Science)

SEMESTER – I							
PART	**COURSE TYPE**	**COURSES**	**HOURS**	**CREDITS**	**EXAM DURATION**	**MAX. MARKS**	
						CIA	**EXT**
Part I	Language Course I	LC I - Pothu Tamil I	6	3	3	25	75
Part II	English Course I	ELC I – General English I	6	3	3	25	75
Part III	Core Course I	CC I- Biology of Invertebrates	5	4	3	25	75
	Core Practical I	CP I- Biology of Invertebrates and Chordates	3	-	-	-	-
	First Minor Course I	FMC I - Botany I	4	3	3	25	75
	First Minor Practical I	FMP I - Botany II - Practical	2	-	-	-	-
Part IV	Skill Enhancement Course I	SEC I - Apiculture	2	2	3	25	75
	VE	Value Education	2	2	3	25	75
*Extra Credit 1	Extra Credit I	Extra Credit Course I - Professional English		2	-	0	100
		No. of Courses – 6+1		**17+2**			

SEMESTER – II							
PART	**COURSE TYPE**	**COURSES**	**HOURS**	**CREDITS**	**EXAM DURATION**	**MAX. MARKS**	
						CIA	**EXT**
Part I	Language Course II	LC II - Pothu Tamil II	6	3	3	25	75
Part II	English Course II	ELC II - General English II	6	3	3	25	75
Part III	Core Course II	CC II- Biology of Chordates	6	5	3	25	75
	Core Practical I	CP I- Biology of Invertebrates and Chordates	2	3	3	40	60
	First Minor Practical I	FMP I - Botany II - Practical	2	2	3	40	60
	First Minor Course II	FMC II - Botany -III	4	3	3	25	75
Part IV	Skill Enhancement Course II	SEC II - Aquaculture	2	2	3	25	75
	EVS	Environmental Studies	**2**	2	3	25	75
*Extra Credit II	Extra Credit II	Extra Credit Courses II (Skill Course I – Add on)		2	-	0	100
		No. of Courses – 8+1		**23+2**			

SEMESTER – III							
PART	**COURSE TYPE**	**COURSES**	**HOURS**	**CREDITS**	**EXAM DURATION**	**MAX. MARKS**	
						CIA	**EXT**
Part I	Language Course III	LC III - Pothu Tamil III	6	3	3	25	75
Part II	English Course III	ELC III - General English III	6	3	3	25	75
Part III	Core Course III	CC III - Cell Biology	6	6	3	25	75
	Core Practical II	CP II - Cell Biology and Environmental Biology	2	-	-	-	-
	Second Minor Course I	SMC I - Chemistry I	4	3	3	25	75
	Second Minor Practical I	SMP I - Chemistry II -Practical	2	-	-	-	-
Part IV	Multi Disciplinary Course I	NME I - Commercial Zoology	2	2	3	25	75
	Skill Enhancement Course III	SEC III - Poultry Science	2	2	3	25	75
*Extra Credit III	Extra Credit III	Vermiculture (Skill Course II- Add on)		2	-	0	100
		No. of Courses – 6+1		**19+2**			

SEMESTER – IV							
PART	**COURSE TYPE**	**COURSES**	**HOURS**	**CREDITS**	**EXAM DURATION**	**MAX. MARKS**	
						CIA	**EXT**
Part I	Language Course IV	LC IV - Pothu Tamil IV	6	3	3	25	75
Part II	English Course IV	ELC IV - General English IV	6	3	3	25	75
Part III	Core Course IV	CC IV - Environmental Biology	5	5	3	25	75
	Core Practical II	CP II - Cell biology and Environmental Biology	3	3	3	40	60
	Second Minor Practical I	SMP I - Chemistry II- Practical	2	2	3	40	60
	Second Minor Course II	SMC II - Chemistry III	4	3	3	25	75
Part IV	Multi Disciplinary Course II	NME II - Aquarium Keeping	2	2	3	25	75
	Ability Enhancement Course I	AEC I - Bioinstrumentation	2	2	3	25	75
*Extra Credit IV	Extra Credit IV	Computer Literacy (Skill Course III- Add on)		2	-	0	100
		No. of Courses –8+1		**23+2**			

SEMESTER – V							
PART	**COURSE TYPE**	**COURSES**	**HOURS**	**CREDITS**	**EXAM DURATION**	**MAX. MARKS**	
						CIA	**EXT**
Part III	Core Course V	CC V - Animal Physiology	5	5	3	25	75
	Core Course VI	CC VI - Genetics	5	5	3	25	75
	Core Course VII	CC VII - Biotechnology	5	4	3	25	75
	Core Course VIII	CC VII - Microbiology	5	4	3	25	75
	Core Practical III	CP III - Animal Physiology, Genetics, Biotechnology, Microbiology	3	3	3	40	60
	Discipline Specific Elective I	DSE I - Wildlife Biology and Conservation Management/Food and Nutrition	3	3	3	25	75
Part IV	Ability Enhancement Course II	AEC II - Medical lab Technology	2	2	3	25	75
	SSD	Soft Skill Development	2	2	3	25	75
	Summer Internship/Ind. Training	Internship	-	2			
*Extra Credit V	Extra Credit Courses V	Ornamental Fish Culture I (Multidisciplinary)		2	-	0	100
		No. of Courses – 8+1		**30+2**			

SEMESTER – VI							
PART	**COURSE TYPE**	**COURSES**	**HOURS**	**CREDITS**	**EXAM DURATION**	**MAX. MARKS**	
						CIA	**EXT**
Part III	Core Course IX	CC IX - Developmental Biology	6	5	3	25	75
	Core Course X	CC X - Evolutionary Biology	6	5	3	25	75
	Core Practical IV	CP IV - Developmental Biology and Evolutionary Biology	3	3	3	40	60
	Core Course IX	CC IX - Project	3	3	3	25	75
	Discipline Specific Elective II	DSE II - Animal Behaviour / Dairy farming	3	3	3	25	75
	Discipline Specific Elective III	DSE III - Entomology / Public health and hygiene	4	3	3	25	75

Part IV	Ability Enhancement Course III	AEC III - Introduction to Nano Biotechnology	2	2	3	25	75
	Skill Enhancement Course IV	SEC IV- Sericulture	2	2	3	25	75
Part V	GS	Gender Studies	1	1	3	25	75
	Extension Activities	(NCC/NSS/Sports/Any Other Activities)	-	1	-	-	-
*Extra Credit VI	Extra Credit Courses VI	Economic Zoology II (Same disciplinary)		2	-	0	100
		No. of Courses –9+1		**28+2**			

Grand Total – Credit 140 & Extra Credit 12

Controller of Examinations

Semester-I / Core Course- I	CC I - BIOLOGY OF INVERTEBRATES	Course Code:
Instruction Hours : 5	Credits: 4	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K1 -Recalling** **K2-Understanding K3 - Applying** **K4 - Analyzing K5 - Evaluating K6 - Creating**
Course Objectives:	1. To understand the systematic and functional morphology of various groups of invertebrates. 2. To study the characteristics, economic importance, affinities and adaptations of invertebrates. 3. Understand the non chordate animals in the world that surrounds us. 4. Observe the process of evolution from unicellular cells to multi cellular organism. 5. Able to recognize economically important invertebrate fauna.
Unit I	**General characters and classification of protozoa up to Order with suitable examples of biological interest.** Phylum Protozoa - Detailed study of Paramecium 1. Nutrition in Protozoa 2. Protozoa and Human diseases *(Plasmodium, Entamoeba, Trypanosoma, Leishmania, Trichomonas, Toxoplasma, Balantidium* with special reference to mode of infection, pathology and control) Phylum Porifera- Detailed study of Sycon 1. Canal system in sponges 2. Spicules in sponges **18 Hours**
Unit II	**General characters and classification of Coelenterata up to Order with suitable examples of biological interest.** Phylum: Coelenterata - Detailed study of Obelia 1. Corals and Coral reefs 2. Ctenophora-General organization and affinities. Phylum-Platyhelminthes-Detailed study of *Fasciola hepatica*. 3. Parasites affecting Man & Domestic animals (*Schistosoma haematobium, Taenia solium, Hymenolepis nana, Diphyllobothrium latum, Schistosoma nasolis* and *Echinococcus granulosa*) **18 Hours**

Unit III	**General characters and classification of Nemathelminthes up to Order with suitable examples of biological interest.** Phylum-Nemathelminthes .Detailed study of Ascaris 1. Nematode parasites in man (*Enterobius vermicularis, Ancyclostoma duodenale, Wuchereria bancrofti, Dracunculus medinensis, Trichinella spiralis* with special reference to mode of infection, pathology and control). Phylum Annelida-Detailed study of Nereis 2. Adaptive radiation in Polychaetes **18 Hours**
Unit IV	**General characters and classification of Arthropoda up to Order with suitable examples of biological interest.** Phylum Arthopoda - Detailed study of Penaeus monodon 1. Organisation & affinities of Peripatus 2. Crustacean larvae & their significance **3.** Economic importance of Insects**.** **18 Hours**
Unit V	**General characters and classification of Mollusca and Echinodermata up to Order with suitable examples of biological interest.** Phylum Mollusca - Detailed study of Pila globosa 1. Economic importance of mollusca Phylum Echinodermata - Detailed study of starfish- *Asterias rubens* 2. Larval forms of Echinoderms & their significance **3.** Water vascular system in Echinoderms**.** **18 Hours**

TextBook:

1. EKAMBARANATHAAYYARM and ANANTHAKRISHNAN.T.N(1994)

   Manual of Zoology vol.I,S.Viswanathanpvt.Ltd.,Madras.

2. N.ARUMUGANN.C.NAIR,DR.T.MURUGANETAL-Text book of Invertebrates, SarasPublications.

ReferenceBooks:

1. BARNESR.D.(1968) Invertebrate Zoology W.B.,Saunders company, Philadephia.
2. CHENG (`1964) Parasitology.W.B.company, Philadephia.
3. HYMAN.L.H, 1960. The Invertebrates vol.ItoVII (M.C.Hrawhillbook co,.)
5. JORDONE.L and VERMAP.S.(`1983)Invertebrate Zoology S.chand&co
6. KOPTALR.L(1997) Modern textbook of Zoology, Rastogi company, Meerut(VP),India.
7. PARKER and HASEWELL (1964) Text book of Zoology vo.I(Invertebrate) AZTBS.Publisher sand distributes-New Delhi11051- 874pp.
8. PRASAD.S.N.-Textbook of Invertebrate Zoology kitabmahal, Allahabad.

9. DHAMI.P.S and J.K.DHAMI.(2003).Invertebrate Zoology, Chand.R and CoPublishers –New Delhi.
KADAM.K. The Invertebrates Emkay Publication, Delhi.

Course Outcomes

On completion of the course the students should be able to

CO1:	Describe the distinguishing characteristics of the major taxa. Understand biodiversity, habitat, adaptation, organization and taxonomic status of invertebrates
CO2:	Recall certain morphological attributes and physiological processes that are distinct and significant to each Phyla.
CO3:	Understand the systemic and functional morphology of various groups of invertebrates Explain the basic aspects of structural and functional details of Invertebrates
CO4:	To compare and understand the general and specific characteristics within each Phyla.
CO5:	Interpret the affinities, evolutionary relationships and adaptation of the major taxa.

Web Resources

https://en.wikipedia.org/wiki/Invertebrate

https://www.britannica.com/animal/invertebrate

https://www.toppr.com/guides/biology/animal-kingdom/phylum-chordata/

Mapping of Course Outcomes with Programme Outcomes & Programme Specific Outcome

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

S- Strongly correlating

M- Moderately Correlating

W- Weakly Correlating

N- No Correlation

Semester-I / Core Practical-I	**CP I - BIOLOGY OF INVERTEBRATES AND CHORDATES - PRACTICAL**	Course Code:
Instruction Hours: 3	Credits: 3	Exam Hours: 3
Internal Marks – 40	External Marks- 60	Total Marks: 100

Course Objectives:	**1.** To demonstrate the internal anatomy of Invertebrate and vertebrate animals. **2.** To study about the various characteristic features and adaptations of Invertebrates and vertebrate animals. **3.** To mount the important parts of Invertebrate animals. **4.** Understand the comparative anatomy of chordates. **5.** Learn biological significance of invertebrates and chordates.
Unit I	**DISSECTIONS** 1. Earthworm: Digestive system and Nervous system 2. Lamellidens: Digestive system 3. Pila: Digestive system **18 Hours**
Unit II	**MOUNTING** 1. Earthworm: Body setae 2. Prawn: Appendages 3. Mouth parts of Mosquito, Honey Bee and House Fly. 4. Pila: Radula **18 Hours**
Unit III	**SPOTTERS** 1. Classify Giving Reason. Amoeba, Plasmodium, Metridium, Megascolex, , Periplaneta,. 2. Draw labeled sketch T.S.of Planaria, T.S. of Sea anemone, T.S of Taenia solium, & T.S of Nereis. 3. Biological significance Gemmule of sponge, Physalia, , Heteronereis, Limulus, Sepia, 4. Relate structure and function Sponge Spicules, Tape worm- Scolex, Nereis- Parapodium, Starfish- Pedicellari, 5. Write notes on adaptation Madrepora, Chaetopterus, Cyclops, Octopus, Mytilus, **18 Hours**
Unit IV	**BIOLOGY OF CHORDATA** Dissection Shark: Mounting of Placoid scales Fish – Digestive system **18 Hours**

Unit V	**SPOTTERS** 1. Classify giving reasons: Balanoglossus, Shark, Calotes versicolar, Pigeon, Rabbit b)Biological significance Amphioxus, Ascidian,Narcine Axolotyl larva, Draco volans, Chaemelion. c) Write notes on Gambusia affinis, Hippocampus, Anabas scandans, Alytes, Bat,Viper, Kingfisher d) Relate structure and function Echeneis, Exocoetus, Poison apparatus of Cobra, Quill feather of bird e) Draw labeled Diagram Endoskeleton of Frog: Skull, Pectoral, Pelvic girdle, Fore limbs and hindlimbs. **Preparation of e- museum with 10 invertebrate and 10 chordate specimens** **18 Hours**

Text Book:

1. EKAMBARANATHA AYYAR M and ANANTHAKRISHNAN.T.N(1994)Manual of Zoology vol.I, S.Viswanathan pvt.Ltd., Madras.

2. AYYAR E.M and ANANTHAKRISHNAN .T.N ,1992. Manual of zoology ,Vo.II(11hordate), Viswanathan .S (Printers and Publishers), Pvt., Ltd., Madras 981pp.

Reference Books:

1. BARNES R.D.(1968)Invertebrate zoology W.B.,Saunders company,Philadephia.
2. CHENG (`1964) Parasitology. W.B.company, Philadephia.
3. JORDON, E.L and VERMA .P.S. 1955. Chordate Zoology and Elements of Animal Physiology., S.Chand & Co.
4. KOTPAL , R.L(1997) Modern Text Book of Zoology Vertebrates, Rastogi Publications Meerut, India.
5. MAJUPURIA T.C., 1978. Introduction to Chordates, Pradeep Publications, Jullundur.
6. PARKER and HASEWELL .1964.Text book of zoology Vol.II (Chordata), A.Z.T.B.S

e- Resources:

Earthworm: Digestive system: **https://www.youtube.com/watch?v=mtxjZu0suiw**
Lamellidens: Digestive system:
https://www.youtube.com/watch?v=C-3GqvLswc8
Prawn: Appendages: https://www.youtube.com/watch?v=xb7rw4Hz1c8

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Dissect and identify the internal organs of invertebrate organisms
CO 2:	Understand the mounting techniques of parts of the organisms
CO 3:	Understand the diversity of invertebrates and its outline systematic. Discuss their affinities and adaptations to different modes of life
CO 4:	Dissect and identify the internal organs of chordates animals
CO 5:	To infer the affinities, evolutionary relationships and adaptation of the major taxa and to explain their economic importance with respect to Chordates

Mapping of Cos with Pos & PSOs

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

Semester-I/ Skill Enhancement Course - I	**SEC-I - APICULTURE**	Course Code:
Instruction Hours : 2	Credits: 2	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K1 -Recalling** **K2-Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**
Course Objectives:	1. To Understand the Biology of Honey bee 2. Learn the Teaching of apiculture 3. Understand the economic importance of honey 4. Skill in the apiary management 5. Ability to do apiary cost benefit analysis
Unit I	**History and Scope of Bee keeping**: Systematic Position- Identification of honey bee- Drone bee, Worker Bee and Queen bee. Kinds of Honeybees in India. **6 Hours**
Unit II	**Honey Extraction**: Honey extracting equipments – honey extractor, uncapping knife, uncapping tray, collecting vessel. Appliances of Apiaries- Comb frames, Queen excluder, Drone Excluder, Bee veil and Smoker, Newton's Bee hive. **6 Hours**
Unit III	**Arranging an Apiary:** location of an Apiary, preparation of an Apiary- Handling of Honey bees. Choice of Honey bee colony in apiculture. Bee pollination and advantages **6 Hours**
Unit IV	**Bee products**: Bee Products and benefits - Honey – Chemical composition, nutritional and medicinal value of Honey, Nectar, Bee wax, propolis, Royal Jelly, Bee Pollen, **6 Hours**
Unit V	**Honey bee diseases**: Bacteria, Fungi and Viral Diseases. Brood diseases and Adult diseases. **6 Hours**

Text Book:

1. **K.V.Jayashree , C.S. Tharadevi and N. Arumugam 2018.** Apiculture, Saras publication.
2. NAGARAJA.N&RAJAGOPAL.D–Honey Bees, Disease, Parasites, Pests, Predators and their Management – MJP Publishers – Chennai

Reference Books:

1. CHERIAN, R. & K.R.RAMANATHAN, 1992, - Bee keeping in India.
.MISHRA, R.C., 1985 – Honey bees and their Management in India, ICAR.
2. SINGH, S. 1992 – Bee Keeping – ICA
3. SHARMA, P. and SINGH, L. 1987 – Hand book of Bee keeping, controller printing and stationery, Chandigar.
4. RARE, S. 1988 – Introduction to Bee keeping, Vikas Publishing house.
5. SHUKLA, G.S. and UPADHYAY V.B (1997) Economics zoology, Rastogi Publication, Meerut.
6. MORSE, R.A. 1990. The ABC and XYZ of Bee culture 40th edition A.1 Root & co., Ohio.
7. MANJU YADAV – Economic zoology – Discovery Publishing house – New Delhi.
8. RAVINDRANATHAN K.R. – A Text book of Economic Zoology.
9. SATHE T.V. – Fundamentals of Bee Keeping –Daya Publishing House – Delhi.
10. NAGARAJA.N&RAJAGOPAL.D – Honey Bees, Disease,Parasites,Pests,Predators and their Management – MJP Publishers – Chennai.

Web Resources:

https://en.wikipedia.org/wiki/Beekeeping
https://study.com/academy/lesson/apiculture-definition-importance.html
https://apinz.org.nz/

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Know the scope of bee keeping and Learn various concepts of apiculture.
CO 2:	Understand what makes the scientific study of anima land the Bee keeping equipments
CO 3:	Engage in field-based research activities to understand
CO 4:	Be aware of a broad array of career options and activities in human medicine.
CO5:	Know the well the theoretical aspects taught besides learning techniques for gathering data in the field

Mapping of Course Outcomes with Programme Outcomes & Programme Specific Outcome

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	M	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S

CO3	S	S	M	S	S	S	M	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S- Strongly Correlating

M- Moderately Correlating

W- Weakly Correlating

N- No Correlation

Semester-II / Core Course-II	**CC II -BIOLOGY OF CHORDATES**	Course Code:
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K1 -Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**
Course Objectives:	1. To impart current knowledge about the chordate animals of biological interest. 2. To know about the Origin, systematic and functional morphology of various groups of chordates. 3. To study the salient features affinities and adaptations of chordates. 4. Able to describe the diversity in form structure and habits of vertebrates. 5. Skill to explain characteristics and classifications of different vertebrates
Unit I	**Prochordates and cyclostomes** 1. Origin of Chordates 2. Protochordata – Distinctive features and affinities of Amphioxus, Balanoglossus and Ascidian. 1.General Topic: Retrogressive metamorphosis in Ascidian. 2. Cyclostomata – Distinctive features and affinities **18 Hours**
Unit II	**Fishes and Amphibians** Gnathostomata- Detailed study of *Scoliodon sarrakowa* (shark) General Topic 1.Dipnoi and its affinities 2. Accessory respiratory organs in fishes. 3.Adaptive features of Apoda. 4.Parental care in Amphibia. **18 Hours**
Unit III	**Reptiles and Birds** Detailed study of Calotes and Pigeon 1.Identification and distribution of poisonous and non- poisonous snakes of India. Poison apparatus **18 Hours**

Unit IV	**Mammals** Detailed study of Rabbit. 1.Dentition in Mammal. 2.Aquatic mammals and their adaptations. 3.Prototheria special features with examples **18 Hours**
Unit V	**Comparative Anatomy** 1.Comparative study of Heart and Brain in Shark, Frog, Calotes, Pigeon and Rabbit. 2. Endoskeleton of Frog. **18 Hours**

Text Book:

1. AYYAR E.M and ANANTHAKRISHNAN .T.N ,1992. Manual of zoology Vo.II(chordata),Viswanathan .S (Printers and Publishers), Pvt., Ltd., Madras 981pp.
2. DR.THANGAMANI .A, DR.PRASANNAKUMAR.S, DR.NARAYANNAN .L.M, DR.ARUMUGAM. N, 9 th Revised Edition. Saras Publication.

Reference Books:

1. JORDON, E.L and VERMA .P.S. 1955. Chordate Zoology and Elements of Animal Physiology., S.Chand & Co.
2. KOPTAL , R.L(1997) Modern Text Book of Zoology Vertebrates, Rastogi Publications Meerut, India.
3. MAJUPURIA T.C., 1978. Introduction to Chordates, Pradeep Publications, Jullundur.
4. PARKER and HASEWELL .1964.Text book of zoology Vol.II (Chordata), A.Z.T.B.S Publishers and distributiors , New Delhi 110051m 952 pp.

Web Resources:

1. https://www.differencebetween.com/difference-between-fish-and-vs-amphibians/
2. https://www.nwf.org/Educational-Resources/Wildlife-Guide/Mammals
3. https://www.britannica.com/browse/Birds-Reptiles-Vertebrates

Course Outcomes:

On completion of the course the learner will be able

CO : 1	Identify the general and specific characteristics of the different classes and the organization of the representative types
CO : 2	Recognize and describe the major groups of chordates
CO : 3	Understand the diversity of Chordates and its outline systematic.
CO : 4	Understand the unique features, taxonomy and functional morphology of different classes of chordates
CO : 5	To infer the affinities, evolutionary relationships and adaptation of the major taxa.

Mapping of Course Outcomes with Programme Outcomes & Programme Specific Outcome

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S- Strongly Correlating

M-Moderately Correlating

W- Weakly Correlating

N- No Correlation

Semester-II / Skill Enhancement Course-II	**SEC-II- AQUACULTURE**	Course Code:
Instruction Hours: 2	Credits: 2	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1 -Recalling K2 -Understanding K3 -Applying K4 - Analyzing K5 - Evaluating K6 - Creating
Course Objectives	• Students should know basic concepts in Aquaculture.
	• To know about the Types, Feed - formulation - feeding methods
	• Study the Shrimp hatchery technology
	• Learn about the diagnosis, prevention and control measures
	• Students should know basic concepts in Central aquaculture research organizations

Unit I	Importance of aquaculture- Present status, prospects and scope in India. Freshwater aquaculture- Brackishwater aquaculture- Mariculture - Metahaline culture in India. Types of fish culture - Water quality management for aquaculture. Control of parasites, predators and weeds in culture ponds. **6 Hours**
Unit II	Procurement of seed from natural resources- collection methods and segregation. Hatchery technology for major carps and freshwater prawn. Artificial seed production – Breeding under control conditions, induced breeding technique, larval rearing, packing and transportation Commercial substitute for pituitary extracts. **6 Hours**
Unit III	Shrimp hatchery technology - Hatchery design, brood stock management, spawning, larval rearing, Shrimp developmental stages, algal culture, packing and transportation. Shrimp culture technology - extensive culture methods semi- intensive - intensive culture methods - Edible and Pearl oyster culture - pearl production. Crab culture. Economic importance of Lobster, Sea urchin and Sea cucumber - by-products. **6 Hours**
Unit IV	Fish and Shrimp diseases and health management – infectious diseases - Bacterial, Fungal, Viral, Protozoan; Non-infectious - environmental and nutritional diseases. Diseases diagnosis, prevention and control measures. **6 Hours**
Unit V	Types of ornamental fishes (freshwater and marine), their breeding behavior and biology. Oviparous, Ovo-viviparous and Viviparous fishes. Central aquaculture research organizations- CMFRI, , MPEDA and its activities. **6 Hours**

Text Book:

1. Pillay, T. V. R. (1990). Aquaculture: Principles and Practices. Blackwell Scientific Publications Ltd.
2. Santhanam, R. (1990). Fisheries Science. Daya Publishing House.

Reference Books:

1. Das M. C. and Patnaik, P. N. (1994) Brackish water culture. Palani paramount Publications, Palani, T. N.
2. Day, F (1958). Fishes of India , VoL I and Vol. II. William Sawson and Sons Ltd., London.
3. Jhingran, V. G. (1991). Fish and Fisheries of India. Hindustan Publishing Co., India
4. Maheswari. K. (1983) Common fish disease and their control. Institute of Fisheries Education, Powarkads (M.P).
5. Sinha, V.R. P. and Srinivastava, H. C. (1991). Aquaculture Productivity. Oxford and IBH Publications CO., Ltd., New Delhi.
6. Yadav, B. N. (1997). Fish and fisheries.Daya Publishing house, New Delhi.

Web Resources:

1. https://www.fao.org/4/AC232E/AC232E00.htm
2. https://www.slideshare.net/SaiprasadBhusare/ornamental-fish-species-list
3. https://agritech.tnau.ac.in/farm_enterprises/Farm%20enterprises_%20ornamental%20fisheries.html

Course Outcome

Upon completion of this course, Students would have

CO : 1	To develop knowledge on the fish farm and their maintenance. Understand the methods of fish seed and feed production and develops knowledge on hatchery techniques
CO : 2	To apply the knowledge about different culture methods in aquaculture and gain knowledge on fish and shrimp breeding techniques and larval culture
CO : 3	Identifies the different fishes diseases, diagnosis and their management strategies. Understands Ornamental fishes and central aquaculture organizations
CO : 4	To Learn about the Fish and Shrimp diseases and health management
CO : 5	To know the Types of ornamental fishes

Mapping of Cos with Pos & PSOs

COs	PO					PSO				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	S	S	M	M	S	S	S	M	M	S
CO2	S	S	S	M	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	S	S	M
CO4	S	S	M	S	S	S	S	M	M	S
CO5	S	S0	M	S0	M	S	M	L	S	S

S- Strongly Correlating

M-Moderately Correlating

W- Weakly Correlating

N- No Correlation

Semester-III / Core Course-III	**CC III - CELL BIOLOGY**	Course Code:
Instruction Hours: 6	Credits: 6	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K1 -Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**
Course Objectives:	• To study about the techniques of cell and cellular organelles. • To understand the basic concept of cell structures and functions. • To know the cell structure at molecular level in prokaryote and Eukaryote • Know different molecular and biologic technique • Able to differentiate prokaryotic and eukaryotic protein synthesis mechanism
.**Unit I**	Microscopy – Principles and applications of Light and Electron Microscopes – SEM, TEM. Micro-technique – tissue fixation, embedding, sectioning and staining. Prokaryotes and Eukaryotes – Ultra structure and Organization of Prokaryotes– Bacteria- Virus – Bacteriophage and Animal cell. **18 Hours**
Unit II	Cell membrane - Structure, Modification and functions. Cell organelles- Structure and functions of Mitochondria – Golgi body - Endoplasmic - Reticulum – Lysosome,Centrosome. Ribosomes. **18 Hours**
Unit III	Ultra structure and functions of Nucleus , nucleolus, fine structure of chromosomes, nucleosome concept and role of histones, euchromatin and heterochromatin, Giant chromosomes. Cell division and cell cycle (Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle. Cellular ageing and cell death. Biology of Cancer cell. **18 Hours**
Unit IV	Gene concept: Structure of DNA - Types and functions of RNA - DNA Replication and DNA-repair mechanisms - Genetic Code - Codon, Anticodon. **18 Hours**

Unit V	Protein Synthesis and processing: Transcription –Initiation – Elongation and elongation factors and Termination; Translation, translational inhibitors, Post-translational modification of proteins. Gene regulation: Operon model transcription – Transcription factors, Regulation in prokaryotes. **18 Hours**

Text Book:

1. ARUMUGAM.N.(2014) – Cell Biology. Saras Publication.

2. DE ROBERTIES&DE ROBERTIES. 1988, Cell & Molecular biology, International edition, Hong kong.

Reference Books:

1. KUMAR, H.D, 1988, Molecular Biology and Biotechonology, Vikas Publishing house, New Delhi.
2. POWER,C.B. 1989.Essential of Cytology, Himalaya Publishing house ,Bombay. 3.VERMA P.S&AGARWAL .V.K. 1985 Cytology. Chand .S & Co.
4. TOMAR.B.S&SINGH .S.P. 10th EDI.Cell Biology. Rastogi Publication, Meerut.
5. MUNESWARAN. A.1999. Cell Biology, Brighton Book House, Madras.
6. BERRY .A.K. 2007. A Text book of Cell Biology, Emkay- Publications,Delhi
7. MEYYAN.R.P – Genetics .Saras Publication

e- Resources:

http:// www.biologybrowser.org.

1. https://web.uri.edu/cmb/cell-and-molecular-biology/#:~:text=CMB%20is%20the%20study%20of,define%20their%20structure%20and%20function.
2. https://bio.libretexts.org/Bookshelves/Cell_and_Molecular_Biology
   https://www.nature.com/subjects/molecular-biology

Course Outcomes:

On completion of the course the learner will be able

CO 1:	To impart knowledge about the prokaryotic and eukaryotic cell, biosynthesis of cellular membranes and organelles and the unified role it plays for the ultimate sustainability of the organisms.

CO 2:	Rigorous foundation in the principles of molecular and cellular biology give insights into the mechanisms involved in the synthesis and function of macromolecules such as DNA, RNA, and proteins.
CO 3:	Ability to make connections between the molecular mechanisms, holistic understanding of biological organization and function from the molecules to cells, tissues, organs and entire organism.
CO 4:	Studying Cells at molecular level trains the students to think logically, critically and quantitatively.
CO 5:	Learn to interpret statements made in the scientific literature, as well as in non-science areas, based on evidence, not anecdote.

Mapping of Cos with Pos & PSOs

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S- Strongly Correlating

M- Moderately Correlating

W- Weakly Correlating

N- No Correlation

Semester-III&IV / Core Practical-II(III&IV)	**CP II - (III & IV) - PRACTICAL II**	Course Code:
Instruction Hours: 2	Credits: 3	Exam Hours: 3
Internal Marks -40	External Marks-60	Total Marks: 100

Course Objectives:	• To Know the techniques of cell and molecular biology and Environmental Biology • Ability to observe different stages of cell division. • Skill to differentiate different cell types. • To expose the students about the types of natural resources and their importance. • Know the environmental conservation and identification of insect
Unit I	Handling of Compound microscope to study cell types. Squash preparation of Onion root tip to study the stages of Mitosis. **18 Hours**
Unit II	Squash preparation of Grasshopper testis to study the stages ofMeiosis. Squash preparation of Salivary gland of Chironomous larva to study the Giant chromosome. **18 Hours**
Unit III	Centrifuge – Microtome Human, Cell types – Epithelial – Muscular and Vascular Preparation and identification of Barr Body **18 Hours**
Unit IV	Hydrological studies of water samples pH, Temperature ,Dissolved oxygen, Nitrate and Phosphate. Identification of marine & freshwater plankton. **Quantitative analysis of plankton**. **18 Hours**
Unit V	Estimation of Population Density of Grass Land Insect By Sweep Net Method Species interactions, Animal association – symbiosis, Commensalism, Mutualism, Antagonism, Antibiosis, Parasitism, Predators and Competition **Preparation of e museum and video clipping related to core practical** **18 Hours**

Text Book:

1. ARUMUGAM.N.(2014) – Cell Biology. Saras Publication.
2. ARUMUGAM.N Developmental Biology, Saras publication

Reference Books:

1. DE ROBERTIES&DE ROBERTIES. 1988, Cell & Molecular biology, International edition, Hong kong.
2. CLARK, W.R 1991 The experimental foundations of modern immunology, Jhonwiley & Sons.
3. VEERA BALA RASTOGI, Developmental Biology, KedarNath Ram Nath Publishers, Meerut.
4. DAVID A. THOMPSON. 2011. Cell and Molecular Biology Lab. Manual.
5. P.GUNASEKARAN. 2007. Laboratory Mannual in Microbiology. New Age International.

6. D O HALL, S E HAWKINS. 1974. Laboratory Manual of Cell Biology. British Society for Cell Biology, Published by Crane, Russia.
7. MARY L. LEDBETTER. 1993. Cell Biology: Laboratory Manual. Edition: 2. Published by RonJon Publishing.
8. L.SY .FATHIMA .I and N. ARUMUGAM 1998 immunology Saras Publications.

e.Resources:

1. Squash preparation of Onion root tip to study the stages of Mitosis
   https://wwyoutube.cw.om/watch?v=5-ur7bWqlDQ

   Hydrological studies of water samples
2. **https://www.youtube.com/watch?v=ezZBpMfBgI4**

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Understand cell type and have thorough knowledge on microscope.
CO 2:	Ability to identify different stages of cell division and get thorough training on squash preparation.
CO 3:	Understand different cell types in human tissues and trained to operate the instrument microtome, centrifuge.
CO 4:	Understand and trained different developmental stages of chick. And get hands on training in mounting of chick blastoderm.
CO 5:	Learn lymphoid organs and know the technique of cell imprinting.

Mapping of Cos with Pos & PSOs

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	M	S	S	S	S	S
CO2	S	M	M	S	S	S	M	S	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	S	S	SM
CO5	S	S	S	S	S	S	S	S	S	S

S- Strongly correlating

M-Moderately Correlating

W-Weakly Correlating

N-No Correlation

Semester-III NME I	**NME I – COMMERCIAL ZOOLOGY**	Course Code:
Instruction Hours: 2	Credits: 2	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K1 -Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**
Course Objectives:	1. To bring about awareness to the various branch of Zoology available to get self employment opportunity. 2. To generate employments. 3. To motivate to become entrepreneurs. 4. Skill to develop apiculture in their own house. 5. Ability to produce vermicompost.
Unit I	**Vermiculture :** Common species – *Eigenia, Endrilues* and *Perionix excavates*. Biology of Earthworm – Vermicomposting – Required conditions- Methods (Pit & Heap) – Advantages - Economic importance. **6 Hours**
Unit II	**Apiculture –** Species of Honey Bee, Types of Honey Bee – Newton's Bee hive – Care and Management – Honey extraction, Extracting Equipments – Nutritive and Medical value of Honey. Advantages – Economic importance of Apiculture.) **6 Hours**
Unit III	**Lac Culture** –Types of Lac - Life cycle of Lac insect – Harvesting and Extraction of Lac- Uses of Lac – Enemies of Lac - Economic importance of Lac. **Sericulture**: Importance of sericulture- Types of silkworm –Methods of sericulture- Rearing of silkworm - Life cycle of *Bombyx mori* – Economic importance of Silk. **6 Hours**
Unit IV	**Aquaculture** –Definition – salient characters of aquaculture-Types of aquaculture practices - Construction and Management of Pond. Culture practices of Common carp. **Shrimp Culture**– *Penaeus monodon.* **Pearl culture.** **6 Hours**
Unit V	**Poultry farming** – Types of Poultry – Care and Management – Poultry Nutrition – Diseases and their management – Composition and Nutritive value of egg – Economics of Poultry production. **6 Hours**

Text Books:

1.PILA, T.V.R 1988, Aquaculture principles and practices. Fishing news books.
2.RAMASAMY. P. 1992 Disease of Shrimps in Aquaculture systems, Vanitha publication

Reference Books:

1. SANTHANAM R 1987 Fisheries science Daya publishing house.
2. SHUKLA G.S and UPADHYAY V.B 1997 Economics Zoology Rastogi publications, Meerut.
3. ARUMUGAM N Aquaculture Saras publications.
4. MORSE R.A 1990 The ABC and XYZ of Bee Culture 40th Edition A.I Root & Co Ohio.
5. MARY VIOLET CHRISTY**.A.** Vermitechnology **,** MJP Publishing ,Chennai.

e-Resources:

1. **https://growingspaces.com/what-is-vermiculture/**
2. **https://www.nal.usda.gov/animal-health-and-welfare/beekeeping**
3. **http://ekrishiuasb.karnataka.gov.in/ItemDetails.aspx?depID=4&subDepID=%202&cropID=0**

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Learn the courses with excitement of biology along with the self employment opportunity in Vermiculture.
CO 2:	Students interested in entrepreneurship and start some small business based on their interest and experience on apiculture.
CO 3:	Ability to impart complex technical knowledge relating to economic importance of Lac and sericulture.
CO 4:	Work precisely in aquaculture field by learning culture practice and construction, management of pond.
CO 5:	Familiar with poultry farming to generate employment opportunity.

Mapping of COs with POs & PSOs

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	M	S	M	S	S	M	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	M	S	M	S	S	M	S
CO4	S	S	S	M	S	M	S	S	S	S
CO5	S	S	S	S	S	S	S	M	S	S

S- Strongly correlating
M-Moderately Correlating
W-Weakly Correlating
N-No Correlation

Semester-III/ Skill Enhancement Course-III	**SEC III – POULTRY SCIENCE**	Course Code:
Instruction Hours: 2	Credits: 2	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K1 -Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**
Course Objectives:	• To understand the basics in poultry science. • To understand the management strategy • To Understand the economic importance of Poultry • Skill in observing poultry diseases. • Skill to become an entrepreneur
Unit I	Introduction of Poultry Science – History & Development of Commercial Poultry Industry in India. Classification and Types of Fowls. Housing and Equipments – Construction of Poultry shed, Deep litter system, Cage system. Farming practices of Emu, Turkey, Quail and their importance. **6 Hours**
Unit II	Poultry Nutrition – Feed formulation for Chicks, Growers, Phase I to Phase III Layers & Broilers. Processing and Preservation, Feed additives. Nutrient requirements of chickens. **6 Hours**
Unit III	Poultry Breeding –Breeding principles - Breed selection methods - Methods of mating- Incubation, Hatchery Management. Brooding, Debeaking – Vaccination, Sanitation and Waste disposal. **6 Hours**
Unit IV	Economically important Poultry diseases Bacterial [Salamonellosis, Pasteurellosis, E.Coli infection], Viral [Ranikhet disease, Fowl pox infections, Bronchits Infection, Bursal disease], Fungal [Aflatoxicosis, Ochratoxicosis], Protozoan [Coccidiosis] – Ticks and Mites – Prevention and Control **6 Hours**
Unit V	Composition and Nutritive value of egg – Microbial spoilage – Preservation and storage of egg. Poultry meat – Care and Management of Slaughtering – Preservation of Poultry meat – Marketing of Poultry meat – Marketing of Poultry meat. Economic importance of Chicken. **6 Hours**

Text Book:

1. **BANERJEE, G.C** (1992) A Text book of Animal Husbandry, Oxford and IBM Publishing & co., New Delhi.
2. **SHUKULA, G.S** and **UPADHYAY**, **V.B** (1997) Economic Zoology, RakeshRastogi Meerut

Reference Books:

1. M.R. GNANAMANI – Modern aspects and commercial Poultry keeping – Deepam Publication.
2. JAGADISH PRASAD – Animal Husbandry & Dairy Science.
3. GOVE HAMBIDGE (2012) Diseases and Parasites of Poultry. Published by Biotech Books, New Delhi.
4. KEITH WILSON (2007) A Hand book of Poultry Practice. Published by Agrobios, Jodhpur.
5. RAM PRAKASH SINGH (2008) Published by Biotech Books, New Delhi.

e- Resources:

1. **https://www.msdvetmanual.com/poultry/nutrition-and-management-poultry/nutritional-requirements-of-poultry.**
2. **https://www.sciencedirect.com/topics/veterinary-science-and-veterinary-medicine/poultry-nutrition**
3. **https://www.agropustaka.id/wp-content/uploads/2020/04/agropustaka.id_buku_Commercial-Poultry-Nutrition-3rd-**

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Know commercial poultry industry in India..
CO 2:	Understand types of poultry, feed formulation and additives
CO 3:	Have practical knowledge on poultry breeding processes, waste disposal and sanitation.
CO 4:	Aware of poultry disease prevention and control measures.
CO 5:	Familiar with management of slaughtering, marketing of poultry meat and its economic importance.

Mapping of COs with POs & PSOs

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

S- Strongly correlating, M-Moderately Correlating
W-Weakly Correlating N-No Correlation

Semester-1V / Core Course-IV	**CC -IV - ENVIRONMENTAL BIOLOGY**	Course Code:
Instruction Hours: 5	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K1 -Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 – Evaluating** **K6 - Creating**
Course Objectives:	1. Learn the role of Biotic and Abiotic factors in the environment. 2. Know the principle and concept of ecosystem and Biogeochemical cycles. 3. Understand the community ecology. 4. Know the environmental pollution and biomagnifications. 5. Learn the energy crisis of the environment.
Unit I	Definition – Branches of ecology; Environment: Atmosphere (Air), Hydrosphere (Water), Lithosphere (Soil); Abiotic factors: Temperature and light – Effects of light and temperature on animals. Biotic factors: Animal association – symbiosis, Commensalism, Mutualism, Antagonism, Antibiosis, Parasitism, Predators and Competition. **18 Hours**
Unit II	Ecosystem; Natural ecosystem and Man-made ecosystems - Trophic levels, Energy flow, Ecological pyramids and Productivity - Food chain and Food Web. Principles and concepts of Biogeochemical cycles- carbon, oxygen and nitrogen, Habitat Ecology: Fresh Water, Marine Water and Terrestrial habitat. **18 Hours**
Unit III	Community Ecology: Types of Communities; Characteristics of Community – Stratification - Community interdependence – Ecotone - Edge effect; Ecological Niche – Ecological succession. Population ecology: Population Size and Density, Natality, Mortality, Age Structure, Biotic Potential, Population Dynamics, Emigration and Immigration; forest and agriculture, aquatic resources and their conservation. **18 Hours**
Unit IV	Environmental Pollution: Air, Water, Land, Noise, Thermal and Radiation. EIA, GIS, Global warming and Biomagnifications. Biological indicators and their role in environmental monitoring. **18 Hours**

Unit V	Environmental conservation and management Energy Crisis: Conventional Sources of Energy-Coal, Oil and Natural Gas, Thermal Power, Nuclear power- Non-Conventional sources of Energy – Solar, Wind, Tidal, Wind and Bio- energy. Wildlife conservation – Sanctuaries and National parks. **18 Hours**

Text Book:

1. Sharma, P.D. 2010 (Tenth Edition) Ecology and Environment, Rastogi Publications, Meerut.
2. Verma P.S. and V.K. Agarwal, 2007. Environmental Biology. S. Chand and Co., NewDelhi.

Reference Books:

1. Clarke,G.L.1954–ElementsofEcology,JohnWiley&Sons.N.Y.
2. Odum E.P.1971. Fundamentals ofecology.W.B.Saunders Co., Philadalphia.
3. Kendeigh, S.C., 1961 –Animal Ecology, Prentice Hall.
4. S.S. Purohit, D.H. Shanmiand A.K. Agarwal, 2004 – Environmental Sciences: A New Approach, Agrobix, Jodhpur.
5. Arumugam, N.2009. Concepts of ecology. Saras publications,Nagarkoil.
6. Verma, P.S and V.K. Agarwal. 2007. Cell biology, Genetics, Molecular Biology, Evolution and Ecology. S.Chand and Company ltd. NewDelhi.
7. Claude, F., Christiane, F., Paul, M. and Jean, D. 1998. Ecology Science and Practice. Oxford & IBH Publishing Co .Pvt Ltd. ,Delhi.
8. Rastogi, V.B. and M.S. Jayaraj. 1997. Animal ecology and distribution of animals. Kedarnath,Ramnath.

e- Resources:

1. **https://education.nationalgeographic.org/resource/ecosystem/**
2. **https://www.eea.europa.eu/help/glossary/eea-glossary/natural-ecosystem**
3. **https://www.enelgreenpower.com/learning-hub/environmental-pollution**

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Compare the role of Biotic and Abiotic factors in the environment and animal association
CO 2:	Able to interpret the principle and concept of natural and made ecosystem and Biogeochemical cycles.

CO 3:	Understand the community ecology and population dynamics
CO 4:	Estimate the environmental pollution and biomagnifications.
CO 5:	Interpret the conventional and non conventional energy resources of the environment and terrestrial resources

Mapping of COs with POs & PSOs

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

S- Strongly correlating
M- Moderately Correlating
W-Weakly Correlating
N-No Correlation

Semester-IV/ Non Major Elective-II	**NME-II - AQUARIUM KEEPING**	Course Code:
Instruction Hours: 2	Credits: 2	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K1 -Recalling** **K2 - Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**
Course Objectives:	1. To create knowledge on self employment opportunity of ornamental fishes 2. To provide the knowledge of ornamental fishes and their equipment 3. To understand the different breeding techniques of ornamental fishes 4. To know about the Diseases and their control 5. To learn about Breeding
Unit I	Introduction and scope - Aquarium fish keeping as hobby and cottage industry. Commercial aspects like national and international market. To create knowledge on self employment opportunity. **18 Hours**
Unit II	External morphology of a typical fish. Exotic and endemic varieties of ornamental fishes **18 Hours**
Unit III	Aquarium preparation and maintenance - Kinds of tanks, tank setting, biological filter and aeration, water management, planting, lighting and feeds. Budget for setting up an Aquarium Fish Farm as a Cottage Industry. **18 Hours**
UNIT IV	Live fish transport- handling, feeding and forwarding techniques of fish. Fish Diseases and their control. **18 Hours** .
UNIT V	Breeding – Common characters and sexual dimorphism of Fresh water and Marine aquarium ornamental fish varieties such as Guppies, Mollies, Sword tails, Platy, Siamese fighters and Gold fish, Butterfly fish, Blue morph and Anemone fish. **18 Hours**

REFERENCE BOOKS:

1. Santhanam, P., Sukumaran, N. & P. Natarajan, A manual of freshwater aquaculture (1987), Reprint 1999, Oxford & IBH Publishing Company Pvt., Ltd., New Delhi.
2. Cliff Harrison, A colour guide to Tropical Fish (1980), Chartwell Books, INC, Cerkshire, printed in Hon Kong.

Text Book:

1. Mill Dick, 1993: Aquarium Fish, Daya Pub.co., New Delhi
2. Sanjib saha and Mayukhmala Concept of Aquarium Fish Keeping **(**2024) Arco Publishing Company, INC New York.
3. O'Connell, R. F., The freshwater aquarium (1977), Arco Publishing Company, INC New York.
4. JingranV.G., 1991: Fish and Fisheries in India – Hindustan Publ.co. New Delhi

e.Resources:

1.https://www.petstock.com.au/blog/articles/how-to-setup-a-fish-tank
2. https://www.petmd.com/fish/setting-freshwater-aquarium
3. https://www.aquariumcoop.com/blogs/aquarium/how-to-set-up-a-fish-tank

Course Outcomes

On completion of this course, students will;

CO1	Students to learn about different ornamental fishes and identify the diseases of them
CO2	To develop entrepreneur potential in the field of aquarium and get self employment
CO3	To learn setting up an Aquarium
CO4	To gain knowledge on Live fish transport
CO5	To gain Knowledge about culture of ornamental fish culture

Mapping of Cos with Pos & PSOs

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

S- Strongly correlating
M-Moderately Correlating
W-Weakly Correlating
N-No Correlation

Semester-IV / Ability Enhancement Course-I	**AEC I – BIOINSTRUMENTATION**	Course Code:
Instruction Hours : 2	Credits: 2	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K1 –Recalling** **K2 -Understanding** **K3 -Applying** **K4 -Analyzing** **K5 Evaluating** **K6 - Creating**
Course Objectives:	1. This course will give an understanding about the working principles, construction and applications of the instruments used in the studies related to various disciplines of Biological sciences 2. Understand the mechanism of different microscope 3. Know different spectroscopy 4. Familiar cell separation technique 5. Hands on training in advanced electrophoresis technique
Unit I	**Basic Instruments** Principles, operation protocol & applications of the following instruments: Weighing balance, pH meter, Polarography, Radioactivity, ECG, FTIR. **6 Hours**
Unit II	**Microscopy** Observation of different microbes. Light – Bright & Dark field; Phase contrast, Inverted Phase contrast; Fluorescent, Electron – TEM & SEM; Confocal. **6 Hours**
Unit III	**Spectroscopy** Colorimeter, Spectrometer, UV visible spectrometer, X – ray spectrometer, ELISA reader, Atomic absorption spectrometer, Flame photometer, Flourimeter & Spectro photometer **6 Hours**

Unit IV	**Separation Techniques** Centrifugation - Principle, operation, types & applications. Chromatography - Principle, operation & applications - Paper – ascending, descending & Circular, TLC, HPTLC, GC, HPLC, Column Chromatography, Ion Exchange & Affinity Chromatography, LC – MS. **6 Hours**
Unit V	**Electrophoresis** Native & denatured - zone, iso-electro focusing & Isotachophoresis 1D & 2D. PCR, MALDI-TOF **6 Hours**

Text Books:

1. S.SADASIVAM., A. MANICKAM. 1996. Biochemical Methods. 2nd Edition. New Age International (p) Ltd, Publishers.
2. DR. G.RAJAGOBAL., DR. B.D.TOORA. 2001. Practical Biochemistry. 1st Edition. Ahuja Book Company Pvt.Ltd.

Reference Books:

1. .JAYARAMAN. 2000. Laboratory Manual in Biochemistry. New Age International (p).
2. PLUMMER MU, DAVID T.PLUMMER. 1988. Introduction to Practical Biochemistry. Tata McGraw-Hill Education.
3. M. MOOYOUNG. 1985. Comprehensive Biotechnology. Vol. 2, 3 & 4. Pergamon press.

e-Resources:

1. **https://www.atascientific.com.au/spectrometry/**
2. **https://academic.oup.com/jmicro**
3. **https://www.cleaverscientific.com/what-is-electrophoresis/**

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Learn the concept of basic instruments such as pH, Electronic balance, ECG,FTIR and radioactivity and explore its role in various fields
CO 2:	Understand the principles behind the usage of different microscope.
CO 3:	Apply their knowledge in the principle and instrumentation of various separation techniques
CO 4:	Analyze the working and sedimentation mechanism of different centrifuge

CO 5:	Understand how electrophoresis separate DNA, RNA, or protein molecules based on their size and electrical charge.

Mapping of COs with POs & PSOs

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

S- Strongly correlating
M-Moderately Correlating
W-Weakly Correlating
N-No Correlation

Semester-V/ Core Course-V	**CC V - ANIMAL PHYSIOLOGY**	Course Code:
Instruction Hours: 5	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K1 -Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**
Course Objectives:	• Understand the Nutritional requirement of food and its metabolism.. • Study the structure and function of respiration. • Acquire in depth knowledge about the Excretion. • Understand the functions of receptors and bioluminescence. • Understand the role of endocrine organs in human.
Unit I	Nutrition-Food requirements-Carbohydrates, Proteins, Fats, Minerals, and Vitamins. Digestive-enzymes and their role in digestion – metabolism of Protein, Carbohydrates and Lipids. Absorption and assimilation of digested food materials. Balanced diet, BMR and BMI. **18 Hours**
Unit II	Respiration- Structure of mammalian lungs and gaseous exchange- Transport of Oxygen–Transport of CO_2. Circulation: Structure of mammalian heart and its working mechanism – Heart beat and Cardiac cycle. Myogenic and neurogenic hearts. Properties and Functions of blood - ECG - Blood Pressure - factors contributing to heart problems. **18Hours**
Unit III	Excretion - Nitrogenous waste material and their formation. Structure and function of mammalian kidney and nephron - mechanism of urine formation. Osmotic and ionic regulation by freshwater and marine animals. Muscles - structure and types of muscles -mechanism of muscle contraction. **18 Hours**

Unit IV	Structure of nerve cell. Conduction of nerve impulse, Structure of synapse, mechanism of synaptic transmission –Neurotransmitters. Bioluminescence – Biological clocks. Receptors: types, Photoreceptor - Structure of Human eye - Physiology of vision, Phonoreceptors – Structure of Human ear- organ of Corti- working mechanism. **18 Hours**
Unit V	Endocrine glands – structure and hormones of Hypothalamus, Adenohypophysis, Neurohypophsis, Pineal gland, Thyroid gland, Parathyroid, Thymus, Adrenal and Pancreas. Endocrine control of mammalian reproduction. – Male and female hormones – Hormonal control of Menstrual cycle in humans. Hormones of insects. **18 Hours**

Text Book:

1. Rastogi, S.L., 1997. Essential of Animal Physiology. New Age International Publisher, NewDelhi.
2. Verma, P.S. and V.K. Agarwal.1992. Animal Physiology. S. Chand and Co. NewDelhi.

Reference Books:

1. Mariakuttikan and N.Arumugam, 2002. Animal Physiology. Saras Publication,Nagarcoil.
2. Sambasivaiah, Kamalakararao and Augustine Chellappa 1990. A Text book of Animal Physiology and Ecology, S. Chand& Co., Ltd., New Delhi - 110 055.
3. Parameswaran, Anantakrishnan and AnantaSubramananiam, 1975. Outlines of Animal Physiology, S. Viswanathan Pvt.Ltd.,
4. William S. Hoar, 1976. General and Comparative Physiology, Prentice Hall of India Pvt. Ltd., NewDelhi.
5. Wood, D.W., 1983.Principles of Animal Physiology 3rd Ed.,
6. Prosser, C.L. Brown 1985. Comparative Animal Physiology, Satish Book Enterprise, Agra - 282003.

e- Resources:

1. **https://www.uoanbar.edu.iq/BasicEducationCollege**
2. **https://www.researchgate.net/publication/376232222_Animal_Physiology**
3. **https://repository.poltekkes-kaltim.ac.id/**

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Know the role of nutrition in human and its source, types and importance
CO 2:	To understand the mechanism of human respiration
CO 3:	Understand the mechanism of respiration in human.
CO 4:	Recognize the complimentary relationship of structure and function of nerves and describe the interactions between different organ systems to maintain homeostasis.
CO 5:	Able to explain the receptors and biological rhythmsin response to internal and external environmental changes.

Mapping of COs with POs & PSOs

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

S- Strongly correlating
M-Moderately
Correlating W-Weakly
Correlating
N-No Correlation

Semester-V / Core Course - VI	**CC VI GENETICS**	Course Code:
Instruction Hours: 5	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1 -Recalling K2 -Understanding K3 -Applying K4 - Analyzing K5 - Evaluating K6 - Creating
Course Objectives	1. 1.To understand the structure and functions of nucleic acids 2. To know the causes and effects of mutations 3. To comprehend the importance of genetic variation in evolution 4. To know about the harmful effects of genetic variations in humans, their cumulative effect in human population and the molecular basis of variations. 5. To understand the Molecular Genetics
Unit I	**Mendelian Genetics and Inheritance:** Mendelian genetics: Mendelian experiments, laws of Mendel, Monohybrid, Dihybrid, back and test cross; Interaction of genes: Incomplete dominance, co dominance, complementary genes, supplementary genes, inhibiting genes, lethal genes and atavism. Inheritance: Polygenic inheritance- skin colour; multiple alleles- ABO blood groups and coat colour in rabbit; extra chromosomal inheritance- shell coiling, kappa particles; sex linked inheritance – eye colour in Drosophila, colour blindness and hemophilia in man. **18 Hours**
Unit II	**Linkage and Crossing Over**: Linkage: Linked genes, complete and incomplete linkage. Crossing over: molecular mechanisms of crossing over, kinds of crossing over, models of recombination. Chromosome mapping: inference and coincidence, haploid mapping, somatic cell hybridization. **18 Hours**
Unit III	**Cytogenetics**: Variation in chromosome number and structure: position effect, chromosomal mutation and evolution. Gene mutation: types, molecular basis of mutation, mutational hot spots, reversion; radiation and chemical agents as mutagens; Detection of mutation - ClB method and muller-5 method. **18 Hours**
Unit IV	**Human and Microbial Genetics:** Human genetics: Karyotype and ideogram; sex determination - Barr body technique, drumstick method; chromosomal abnormalities in humans, Pedigree analysis; diagnosis of genetic abnormalities; Eugenics, Euphenics, and Euthenics. Population genetics and evolution: gene

	pool, gene frequency and genotype frequency; Hardy-Weinberg law of equilibrium. Unit 5: Bacterial genetics : Conjugation, transformation, transduction and chromosome mapping . **18 Hours**
Unit V	**Molecular Genetics:** Insertion elements, transposable elements, retroelements; integrons and antibiotic resistance cassettes; the lactose system and operon model, tryptophanoperon, role and relative positions of promoters and operators, feedback mechanism. **18 Hours**

Text Books

1.Guptha G. K., 2013. Genetics Classical to Modern, Rastogi publishers, Meerut.
2.Veer Bala Rastogi., 2019. Text Book of Genetics, Medtech
3.Verma P. S. and V. K. Agarwal., 2018. Genetics, S. Chand & Company Pvt Ltd.

References Books

1.Cooper, Geoffrey M., 2018. The cell: A Molecular Approach, Eighth Edition, Oxford University Press.
2.De Robertis, E. D. P and E.M.F Robertis, 2017. Cell and Molecular Biology 8th Edition, LWW.
3.Fletcher H and Hickey I., 2015. Genetics, IV Edition. GS, Taylor and Francis Group, New York and London.
4.Russel, Peter J. 2013. Genetics: A Molecular Approach, Pearson.

Web Resour

1. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/molecular-genetics
2. https://www.ncbi.nlm.nih.gov/books/NBK7908/
3. https://www.toppr.com/ask/question/linkage-and-crossingover

Course Outcomes

On completion of this course, students will

CO1	Understand the basis of inheritance and expression of genes.
CO2	Correlate changes in genetic makeup and phenotypic changes in progeny.
CO3	Analyse the causes of variations in genetic material and predict the effect in a population using different techniques.
CO4	Explain the role of cellular processes and different genetic elements in the expression of genes.
CO5	Compile the factors which contribute to changes in gene expression and specify the changes which contribute to evolution.

Mapping of Cos with Pos & PSOs

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

S- Strongly correlating W-Weakly Correlating
N-No Correlation, M-Moderately Correlating

Semester-V / Core Course- VII	**CC VII BIOTECHNOLOGY**	Course Code:
Instruction Hours: 5	Credits: 4	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1 -Recalling K2 -Understanding K3 -Applying K4 - Analyzing K5 - Evaluating K6 - Creating
Course Objectives	• Know the application of biotechnology in Biological sciences
	• Well known the mechanism of gene transfer in prokaryotes
	• Learn the role of genetic engineering in human welfare.
	• Understand the molecular markers and its application in biotechnology
	• Know the role of microbes in bioremediations
UNIT I	**Biotechnology** –Definition, Scope and Importance – Applications of Biotechnology. Genetic Engineering and Gene Cloning: Tools of Genetic Engineering: Enzymes - Gene cloning vectors - pBR 322 Plasmid, Ti plasmid, pSV plasmid and simian virus 40. Preparation of desired DNA; *In vitro* construction of rDNA. **18 Hours**
UNIT II	**Gene Transfer Mechanisms**: Bacterial Conjugation, Transformation, Transfection, Transduction, Microinjection, Electroporation, Microprojectile, Shot Gun method, Ultrasonication, Liposome fusion, Microlaser. Selection (Screening) of Recombinants: Immunochemical Method and Colony Hybridization - Gene cloning in prokaryotes - Gene library and cDNA library. **18 Hours**
UNIT III	**Genetic Engineering for Human Welfare**: Production of Insulin, Somatotropin (HGH), Human Interferons, Vaccine and their applications; Transgenic animals and their uses. Animal Biotechnology: Requirements for Animal cell culture – Maintenance and storage of Cell lines -Methods for Cryopreservation - Cell Bank–Animal Bioreactors and their uses **18 Hours**
UNIT IV	**Molecular markers and their applications**: Restriction Fragment Length Polymorphism(RFLP) – Random Amplified Polymorphic DNA (RAPD) – Minisatellites or Variable Number of Tandem Repeats (VNTRs) – Microsatellites (SSRs); PCR (Amplification of DNA) – Applications of PCR Technology. DNA sequencing methods: Sanger's method and Automatic DNA sequencing; DNA Fingerprinting– Applications of DNA fingerprinting. **18 Hours**
UNIT V	**Environmental Biotechnology**: Waste treatment–anaerobic and aerobic treatment. Microorganisms in Pollution control – Bioremediation, Biological Bleaching, Biomass Production, Bio-fuels and Bio-prospecting. **18 Hours**

TEXT BOOK

1.Dubey, R.C. 2014. A Text book of Biotechnology. S.Chand and Company Ltd, NewDelhi.
2.Gupta, P.K.2004.Biotechnology and Genomics (1stEdition) Rastogi Publications.

References Books

1.Kumerasan, V.2014. Biotechnology (Revised Edition), Saras Publications, Kanyakumari.
2. Ignacimuthu, S.J.2002. Basic Biotechnology. Tata McGraw – Hill Publishing Company, Ltd., NewDelhi.
3.Das, H.K. 2005. Text book of Biotechnology (Second edition).Wiley Dreamtech India (P) Ltd., NewDelhi.

Web Resources

1. **http://www.bbtech.sc.chula.ac.**
2. **https://boku.ac.at/en/ifa-tulln/institut-fuer-umweltbiotechnologie**
3. **https://www.khanacademy.org/science/ap-biology/gene-expression-and-regulation/mutations-ap/a/genetic-variation-in-prokaryotes**

Course Outcomes

On completion of this course, students will be able

CO1	Know the different breeds and dairy development in India.
CO2	Identify cattle nutrition, preservation of green fodder, feed additives and feed formulations
CO3	Ability to impart complex technical knowledge relating to dairy reproductive physiology and disease control measures
CO4	Ability to have critical thinking and efficient problem solving skills in the milk secretion, chemistry and microbiology of milk
CO5	Capability for asking relevant/appropriate questions relating to issues and problems in the field of dairy products

Mapping of COs with POs & PSOs

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	M	S	S	S	S	S
CO2	S	S	S	S	M	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S- Strongly correlating
M-Moderately Correlating
W-Weakly Correlating
N-No Correlation

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Semester : V / Core Course : **VIII**	**CC VIII - MICROBIOLOGY**	Course Code:
Instruction Hours: 5	Credits: 4	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K1 -Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**
Course Objectives:	**1.** Learn classification of microbes, structure and economic importance of microbes. **2.** Ability to do sterilization of microbes and culture methods. **3.** Know the microorganism in extreme environment. **4.** Know the food born infection and quality of food. **5.** Skilled in diagnosis of disease causing microbes.
Unit I	**History and Scope of microbiology**- Classification of microbes.Structure of *a bacterium.*Bacterial respiration and reproduction – economic importance of bacteria. Classification of viruses- physical and chemical structures of viruses on the basis of capsid symmetry - enveloped (Herpes virus), helical (TMV) and icosahedral (Polyomaviruses), complex (Bacteriophage) and Virion. **15 Hours**
Unit II	**Concept of Sterilization** - Physical and Chemical methods of sterilization. Stains and staining techniques. Bacterial nutrition and Growth- Nutritional types. Growth factors, Types of culture - culture media- Isolation of pure culture –Colony morphology and growth- Growth curve and Growth kinetics. **15Hours**
Unit III	**Microbiological analysis of water purity**- Microorganisms in fresh water and marine water. Microorganisms of different soils - interactions with the atmosphere. Microorganisms in extreme environments- Thermophilic, Methanogenic and Halophilic. Photosynthetic bacteria, Cyanobacteria some Archaea who live in extreme conditions like cold, and space. **15 Hours**

Unit IV	**Food borne infections and intoxications** - Clostridium, Salmonella, and Staphylococcus –microtoxins in food with reference to Aspergillus species- Quality assurance- microbiological quality standards of food, government regulatory practices and policies- FDA, EPA. **15 Hours**
Unit V	**Morphological characteristics**-Parthenogenesis,laboratory diagnosis and treatment of any five disease causing Protozoa, Bacteria, Virus and Fungus. Prevention and control. **15Hours**

Text Book:

1. Dubey R.C, D.U. Maheshwari 2005. A Text book of Microbiology, S.Chand and company Ltd, NewDelhi.
2. Rao, A.S. 2001. Introduction to Microbiology. Prentice Hall of India Private Limited, NewDelhi.

Reference Books:

1. Pelczar, M.J., Chan, E.S., Kreig, N.R. 1993. Microbiology (Fifth edition). Tata McGraw-Hill Publishing Company Ltd., NewDelhi.
2. Purohit, S.S. 2005. Microbiology Fundamentals and applications (Sixth Edition). Student edition,Jodhpur.
3. Raman Rao, P.V. 2005. Essentials of Microbiology. CBS Publishers and Distributors, NewDelhi.
4. Malacinski, M.G. 2006. Essentials of Microbiology Narosa Publishing House, NewDelhi.
5. Narayanan, L.M., Selvaraj, A.M and N.Arumugam. 1999. Microbiology Saras Publication, Nagercoil.
6. Ananthanarayanan, R. and JayaramanPaniker, C.K. 1990. Text Book of Microbiology. Orient LongmanLtd.,

e- Resources:

1. https://dchealth.dc.gov/service/food-borne-infections-and-intoxications
2. https://www.rapidmicrobiology.com/test-method/theory-and-practice-of-microbiological-water-testing
3. http://nexusacademicpublishers.com/uploads/portals/History_and_Branches_of_Microbiology.pdf

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Understand the economic importance of microbes.
CO 2:	Hands on training in culture of microbes.
CO 3:	Know the microorganism in different environment and its effect on human.
CO 4:	Know the pathogenic organisms and standards of food.
CO 5:	Hands on training in the laboratory diagnosis of disease causing microbes.

Mapping of COs with POs & PSOs

CO/PO	**PO**					**PSO**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S- Strongly correlating
M- Moderately Correlating
W- Weakly Correlating
N- No Correlation

Semester-V/ Core Practical III	**CP III - CORE PRACTICAL III (CC V,VI,VII,VIII)**	Course Code:
Instruction Hours: 3	Credits: 3	Exam Hours: 3
Internal Marks -40	External Marks-60	Total Marks: 100

Cognitive Level	**K1 -Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**
Course Objectives:	1. To learn qualitative and quantitative tests of macromolecules 2. To get hands on training to operate the instrument 3. To learn the mendelian's concepts 4. To observe the evolutionary characters of an animals 5. To learn the basic technique of microbiology laboratory
Unit I	**Animal Physiology** 1. Qualitative and quantitative tests for proteins, 2. Qualitative tests for carbohydrates and fats 3. Human salivary amylase activity in relation to Temperature and pH. 4. Identification of Nitrogenous waste products 5. Enumeration of RBCs/WBCs by haemocytometer **12 Hours**
Unit II	**GENETICS:** 1. Recording of Mendelian traits in Man, 2. Blood grouping of man, 3. Pedigree Analysis. 4. Gene interaction (Complementary gene interaction) 5. Models: Monohybrid and Dihybrid crosses. 6. Quantitative gene inheritance 7. Drosophila- Male and femaleidentification, Genetic importance, Mutants (Wing, body colour, eye colour). 8. sex linked inheritance –colour blindness in man 9. . linkage –Margins experiment of Drosophila melanogaster 10. Development of physical linkage map by conventional method

	11. sex dextermination- Barr body from oral mucosa of a human female. 12 Hours
Unit III	**Biotechnology:** 1. Isolation of DNA from tissues 2. Plasmid isolation by demonstration. 3. PCR Technology. 4. Southern Blotting 5. Spotters: plasmid pBR322, Ti plasmid, and Simian virus. 12 Hours
Unit IV	**Microbiology** 1. Demonstration of sterilization procedure for culture media and equipment. 2. Preparation of culture media for microbes, 3. Serial dilution techniques (in groups) 4. Isolation and Identification of microbes in water sample (demonstration and observations.) 5. Fixing and gram staining of bacteria 6. Hanging drop preparation of *Lactobacillus.* **12 Hours**
V	**Spotters:** 1. Haemoglobinometer, 2. Kymograph, 3. Sphygmomanometer. 4. Models of Amino acids, Haemoglobin, ATP, Steroids. 5. Muscles: Cardiac muscle, Striated muscle, Non striated muscle 6. Models for DNA, RNA, tRNA Structure and DNA replication 7. Karyotypes of normal male and female. Klinefelter's syndrome, Turner's syndrome and Down's syndrome 8. Laminar Air flow, Autoclave, Petri-dish, Inoculation loop. **Preparation of e museum and video clippings based on the core practical**

Text Book:

1. Dr.K.Rama Rao, 2020.Developmental Biology practical manual, Satavuhana University.
2. Timothy G.Barraclough, The Evolutionary Biology of species. Oxford University Press.

References book

1. Verma P.S And V.K Agarwal 1992 Animal physiology S. Chand & Co.
2. Mariakuttian A & Arumugam N – Animal Physiology – Saras Publication
3. Dr. A. Amsath, 2021 , Practical Manual in Zoology , MMA Publication. Pattukottai.
4. Anurudh K.singh, 2011, Practical manual , chromosome, Genes and Genomes, Maharshri, Dayanand University,Haryyanaa

e- Resources:

https://en.m.wikipedia.org
https:// www.nature.com
https://en.m.wikipedia.org
https://openoregon.pressbooks.pub

Course Outcomes:

On completion of the course the learner will be able

.CO 1:	Understand the water quality parameters
CO 2:	Able to examine the planktons.
CO 3:	Understand the animal associations.
CO 4:	Able to handle the basic immunological technique
CO 5:	To learn the lymphoid organs.

S- Strongly correlating
M-Moderately
Correlating
W-Weakly Correlating
N-No Correlation

Semester : V / Discipline Specific Elective –I	**DSE-I. WILDLIFE BIOLOGY AND CONSERVATION MANAGEMENT**	Course Code:
Instruction Hours: 3	Credits: 3	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K1 -Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**
Course Objectives:	1. To understand and discuss the importance of wildlife, its values, modern concepts in wildlife management, and relevant conservation policies. 2. To assess and instil strong foundations on wildlife policies and be familiar with a variety of laws and regulations. 3. To analyse and design appropriate approaches to turn conflict into tolerance and coexistence, with an emphasis on the human dimensions of human-wildlife interactions. 4. To evaluate and integrate all the related areas like Fundamentals in Ecology, Forestry, Natural Resource Conservation approaches and develop the role PVA models for protection of Endangered species. 5. To explain the advanced scientific basis for wildlife management and discuss National and International Efforts for successful wildlife conservation.
Unit I	**Biodiversity Extinction and Conservation Approaches-** Perspectives and Expressions. Identification and prioritization of Ecologically sensitive area (ESA). Coarse filter and fine filter approaches. Regional and National approaches for biodiversity conservation. **15 Hours**
Unit II	**Theory and Analysis of Conservation of Populations:** Stochastic perturbations - Environmental, Demographic, spatial and genetic stochastic. Population viability analysis-conceptual foundation, uses of PVA models. Management Decisions for small populations using PVA models. Minimum viable populations & recovery strategies for threatened species. **15 Hours**

Unit III	**National and International Efforts for Conservation:-** International agreements for conserving marine life, Ramsar convention), Conservation of Natural Resources. Overview of conservation of Forest &Grassland resources. CITES, IUCN, CBD National Forest Policy, 1988, National Wildlife Action Plan 2017-2031, Wildlife Protection Act 1972, National and State Biodiversity Action Plans and other Forests and Environmental Acts. **15 Hours**
Unit IV	**Wildlife in India -** Wildlife wealth of India & threatened wildlife, Reasons for wildlife depletion in India, Wildlife conservation approaches and limitations. Wild life Habitat: Characteristic, Fauna and Adaptation with special reference to Tropical Forest. Protected Area concept: National Parks, Sanctuaries and Biosphere Reserves, cores and Buffers, Nodes and corridors. Community Reserve and conservation Reserves. **15 Hours**
Unit V	**Management of Wildlife**: Distribution, status. Habitat utilization pattern, threats to survival of Slender Loris, Musk deer, Great Indian Bustard, Olive Ridley turtle. Wild life Trade & legislation, Assessment, documentation, Prevention of trade, Wild life laws and ethics. **15 Hours**

Text Books:

1. Robinson W L and Eric G Bolen, 1984. Wildlife Ecology and Management, Maximillan Publishing Company, New York, p 478.
2. Aaron, N.M.1973 Wildlife ecology, W.H. Freeman Co. San Francisco, U.S.A.

Reference Books:

1. Gilas R H Jr.(ed.), 1984. Wildlife Management Techniques, 3rd ed. The Wildlife Society, Washington D.C., Nataraj Publishers, Dehra Dun, p 547.
2. Rodgers W A, 1991. Techniques for Wildlife Census in India - A Field Manual: Technical Manual - T M - 2. WII.
3. Saharia V B, 1982. Wildlife of India, Natraj Publishers, Dehra Dun.
4. Goutam Kumar Saha and Subhendu Mazumdar, 2017. Wildlife Biology: An Indian Prospective, PHI Publisher, Delhi.
5. Katwal/Banerjee, 2002. Biodiversity conservation in managed and protected areas, Agrobios, India.
6. Ashok Shantilal Kothari and BomanFramji Chhapgar; Wildlife of the Himalayas and the Terai Region (Bombay Natural History Society)"

E-Resources:

1. https://libraryguides.uwsp.edu/c.
2. https://www.wildcru.org/research/wildlife-trade-references/
3. https://www.environment.sa.gov.au/topics/plants-and-animals/living-with-wildlife/principles-for-managing-wildlife

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Understand the need of wildlife conservation and categories of IUCN
CO 2:	Know wildlife sanctuaries and National parks and Convention on wetlands of International Importance of wild animals
CO 3:	Learn wildlife census techniques and methods
CO 4:	Understand the importance of Zoo's and case study
CO 5:	Know wildlife protection Acts

Mapping of COs with POs & PSOs

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

S- Strongly correlating
M-Moderately Correlating
W-Weakly Correlating
N-No Correlation

Semester : V / Discipline Specific Elective –I	**ELECTIVECOURSE-II FOOD AND NUTRITION**	Course Code:
Instruction Hours: 3	Credits: 3	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K-1Acquire/Remember** **K2-Understand** **K3-Apply** **K-4Analyze** **K-5Evaluate** **K-6Create**	
Course Objectives	**Course Aims:** To learn food sources and energy metabolism in different age Group to keep healthy life. • Tocrateawarenessofrequirementofnutritionindifferentage group. • To know the diettherapy. • Toknowthebasalbodymetabolism. • Tounderstandthenutritiondeficiencyanddisorders	
UNIT	**Content**	**No.ofHours**
I	Source food composition, properties and storage of common foods, functions of food in relation to health – classification of food based on nutrients, food preservation – food additives. Types of food - bodybuilding foods, energy foods and protective foods – Bomb colorimeter.	**12**
II	Essential nutrients: fats, carbohydrates and proteins, Energy needs. Definition of unit of energy – Kcal, RQ, SDA, NPU, Basal metabolism – BMR – factors influencing BMR. Role of fiber in diet.	**12**

III	Micro and macro mineral nutrients: Distribution, sources, metabolic functions and deficiency manifestion vitamins– classification, sorce function sand Deficiency disorder– hyperandhypovitaminosis.Waterandelectilytebalance	**12**
IV	Nutrition in different stages – Infants, children, adolescents, pregnant, lactating women and old persons.	**12**
V	Principles of diet therapy. Diet during stressed conditions, laborer and patients, therapeutic diets for anemia, malnutrition, obesity, diabetes mellitus and allergy.	**12**

TextBooks:

1. L.G.MEYERS,FoodChemistry,,CBS,2004,Puiblishers&Distributor

ReferenceBooks:

1. POLTER2001,Foodscience, CBSpublishers &Distributers
2. SWAMINATHAN. M.S, , Essential of food nutritions,Vol I& II ,Bangalore printing

ANNIE FREDRICK, 2006 A Testbookof food and nutrition,lotus press.

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Understand foodsources,typesand itscomposition
CO 2:	Learntheessentialnutrientsandbasal bodymetabolism
CO 3:	Understandthemineralnutrientsanditsdeficiencydisorders.
CO 4:	Awareoftherequirement ofnutrition indifferentagegroups
CO 5:	Know the principles of diet therepy

MappingofCOs withPOs&PSOs

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

Semester-V/ Ability Enhancement Course -II	**AEC II - MEDICAL LAB TECHNOLOGY**	Course Code:
Instruction Hours: 2	Credits: 2	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K1 -Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**
Course Objectives:	1. Know the clinical use of instrumentation. 2. Study the analysis of blood, urine, sputum, semen and stool. 3. Study the nature and causes of various diseases. 4. Understand the blood component in human. 5. Skill in diagnosing the human disease.
Unit I	Clinical Diagnostic equipments – Sphygmomanometer – Stethoscope – Compound microscope Centrifuge – Hot air over – Autoclave – Incubator – Refrigerator – Laminar airflow – Spectrophotometer – X-ray(Chest, Heart, Plain, Abdomen, Bones), MRI & CT Scans – ECG and EEG. **18 Hours**
Unit II	Collection of Blood – Blood grouping – blood bank – Haemocytometer – Total count of Blood cells (RBC & WBC). Differential count of WBC (Leishman's stain), Platelet count, Absolute Eosinphil counts, Packed cell volume, ESR, Determination of clotting time and Bleeding time. Haemoglobinometer – Hb (Sahli's method) – Aneamias, Digital Glucometer – Blood glucose. **18 Hours**
Unit III	Glucose tolerance test(Diabetes Mellitus), Atherosclerosis, Heart failure, Cholesterol, HDL, LDL, Urea, Creatine, Creatitine, Bile salts and Bile pigments. Composition of Urine, Methods of Urine analysis for sugar, Urea & Albumin. Glucosuria – fehling's test, Pregnency test and vidal test. **18 Hours**

Unit IV	General Examination – Temperature, Pulse, BP (Normal, Hypertension and Hypotension), Edema and Jaundice. Medical Emergencies – Respiratory failure, Shocks, Acute Gastroentreritis (food poisoning), haemophilia, Acute renal failure, Hypoglycemia, Amoebic dysentery, Snake bite,. Safety precautions and First aid treatment for Superficial Wounds, Burns, and Electrical shock. **18 Hours**
Unit V	Diagnostic methods of Protozoan parasites – Malarial parasites and Entamoeba histolytica – Helminthes parasites – Ascaris, Tapeworm, Wuchereria bancrafti and Hook Worm. VDRL test, ELISA, Thyroid function test, Analysis of semen, Sputum and stools. **18 Hours**

Text Books:

1. SAMUEL K.M – Notes on Clinical lab.
2. ARUMUGAM.N.2014.Biotechniques- Saras Publication – Nagerkoil – Kanyakumari.

Reference Books:

1. METHAS P.J 1988, Practical medicine for student and Practitioners. The National book Department Mumbai, Pp 1-180.
2. GURUMANI N 2006, Research methodology for biological science. MJP Publications, Chennai.
3. HAROLD VARIEY 1988 Practical Clinical Biochemistry. 4.CHATTERJEE- Clinical Biochemistry.
5. KANAI .L.MUGARGEE-2005, Medical Laboratory Technology-A Procedure Manual for routine diagnostic tests-Tata Megraw Hill Publications.
6. PANIKAR C.K J AND ANATHANARAYANAN- A Text book of Microbiology. 7.LEHINGER – Biological Chemistry.
8. RAJAN.S& SELVI CHRISTY.R – Experimental Procedures in life sciences – Anjanaa Book – Koyembedu – Chennai.
9. RAMNIK SOOD ,2015 Concise Book of Medical laboratory Technology- Health Science Publications

e-Resources:

1. https://ves.ac.in/tulsitech/
2. https://www.ncbi.nlm.nih.gov/books/NBK532915/
3. https://diabetes.org/about-diabetes/diagnosis

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Acquired technical skills will help the students for collecting and processing biological specimens for analysis
CO 2:	Understand fundamental analytical principles and processes used in clinical laboratory testing
CO 3:	Application of medical laboratory test will enable the students to understand normal and abnormal
CO 4:	Students enable their critical and analytical thinking in the detection of diseases
CO 5:	Application of medical laboratory procedures will enable the students to distinguish normal and abnormal microscopic pathogens

Mapping of COs with POs & PSOs

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

Semester-VI Core Course-IX	**CC IX - DEVELOPMENTAL BIOLOGY**	Course Code:
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K1 -Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**
Course Objectives:	1. Understanding of the processes of early embryonic development, to analyze the mechanisms of development. 2. Learn theories of fertilization and cleavage. 3. Ability to find out fate maps, morphogenetic movements and developmental stages of chick embryo. 4. Study metamorphosis in amphibian. 5. Know the human health care and artificial insemination and Birth control.
Unit I	Gametogenesis: Spermatogenesis – Cells in seminiferous tubules, Spermiogenesis, structure and types of sperm. Oogenesis – Growth of oocyte, vitellogenesis, organization of egg cytoplasm. Polarity and symmetry – Maturation of egg, egg envelops-Types of eggs. **12 Hours**
Unit II	Fertilization: External and Internal fertilization, sperm – egg interaction, physiological changes in the organization of egg cytoplasm – Theories of fertilization. Cleavage–Patterns of cleavage–radial, spiral and bilateral; Types–meroblastic, holoblastic and superficial – Factors affecting cleavage – Chemodifferentiation. **12 Hours**
Unit III	Blastulation – Types of blastula. Fate maps. Presumptive organ forming areas in Frog and Chick. Gastrulation in Frog and Chick-Morphogenetic movements- Development of brain and eye in Frog. Developmental stages of Chick embryo up to 96 hours and organogenesis. **12 Hours**

Unit IV	Foetal membranes in Chick and Mammals – Placentation in Mammals-types and physiology. Organizer concept and embryonic induction. Regeneration in Planarians and Amphibians. Metamorphosis in Amphibians. Cryopreservation of gametes/embryos - Ethical issues in cryopreservation **12 Hours**
Unit V	Mammalian reproduction: Mammalian reproductive cycle, Hormonal regulation, Endocrine changes associated with normal pregnancy, Induced ovulation in humans – Precautions and health care during Human Pregnancy and Gestation- infertility. Artificial Insemination – Concept of test-tube baby – Birth control methods – Factors involved in Teratogenesis. Aging and senescences: Biology of senescences-cause of aging- mechanism involved in apoptosis. **12 Hours**

Text Book:

1. Beril., N. J.1974. Developmental Biology. Tata Mc Graw-Hill Publishing Company Ltd. NewDelhi.
2. Berry.A.K.2007. An Introduction to Embryology, Emkay Publications, New Delhi-51.

Reference Books:

1. Arumugam.N. 1998. Developmental Biology, SarasPublications,
2. Balinsky, B.I. 1981. An Introduction to Embryology.
3. W.B.SaundersCompany.Philadelphia.S.Banerjee, Development Biology, Dominant Publishers, NNewDelh.
4. Verma, P.S. And Agarwal V.K. 2005. Chordate Embryology (Developmental Biology)S. Chand&Company Ltd., NNewDelhi.
5. Veer balarastogi, Developmental biology, KedarnathRamnath publishers, meerut.
6. Rastogi, V.B and Jayaraj, M.S. 2002. Developmental Biology KedarNath Ram Nath,Meerut.
7. Twymann, R.M. 2003. Developmental Biology. Viva Books Private Ltd., New Delhi.

e- Resources:

https://en.m.wikipedia.org

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Develop critical understanding how a single-celled fertilized egg becomes an embryo and then a fully formed adult
CO 2:	Understand how does development affect organization of phenotypes and their variation
CO 3:	Aware of the reproductive cycle, hormones, Birth control and critically assess relevant scientific literature in reproductive biology and present their argument in oral and written work
CO 4:	Explain the concept of Immunology, Mechanism of immunity, Immunity regulating cells.
CO 5:	Understand the Basic structure, classes and function of Antibodies, Antigen-Antibody interaction

Mapping of COs with POs & PSOs

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

S- Strongly correlating

M-Moderately Correlating

W-Weakly Correlating

N-No Correlation

Semester-VI / Core Course- X	**CC X- EVOLUTIONARY BIOLOGY**	Course Code:
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1 -Recalling K2 -Understanding K3 -Applying K4 - Analyzing K5 - Evaluating K6 - Creating
Course Objectives	1. Evolutionary biology is a branch of the biological sciences concerned with the origin of life and the diversification and adaptation of life forms over time. 2. This course helps to understand the important processes, principles, and concepts on evolution. 3. To provide adequate information on the Lamarckism - Neo Lamarckism – Darwinism, Neutral Theory of Molecular Evolution, and Human Genome Project. 4. To explain the importance of the fossil records in evolutionary studies, and the role of phylogenetic studies in the wider context of biodiversity and conservation. 5. In this course, we will apply the knowledge of human evolutionary history to simulate how genetic variation within and among human populations affects risk, diagnosis, and treatment of modern diseases.
UNIT-I	Inorganic and organic evolution-History of evolutionary thought, Primordial earth and primeval atmosphere, Chemical origin of life: Synthesis of organic molecules, Urey-Miller experiment, Origin of prokaryotes and eukaryotes. **18 Hours**
UNIT-II	Lamarckism - Neo Lamarckism - Darwinism - Neo Darwinism and modern synthetic theory - DeVrie's Mutation theory – modern concepts of mutation - Mutation and their role in evolution - Animal colouration and Mimicry. **18 Hours**
UNIT-III	Isolating mechanisms - Modes of speciation-Hybridization is an evolutionary catalyst- Law of Adaptive Radiation- Adaptive radiation in reptiles and mammals - Convergence and parallelism - Evolutionary constancy. **18 Hours**
UNIT-IV	Morphological, physiological and biochemical, embryological, Taxonomical and geographical evidences -Palaeontological evidences – evolutionary genomics. Types of rocks - Geological time scale – Nature of fossils- Dating of fossils - Fossil records of man and fossil records of horse. **18 Hours**
UNIT-V	Natural selection in action in man- level of selection- Eugenics, Euphenics and Euthenics- Adaptation- Human Genome Project – Evolution and ethics. **18 Hours**

Text Books

1.Ridley, M., 2004. Evolution. III Edition. Blackwell Publishing.

2.Lull, R.S. 2010. Organic evolution, The Macmillan, New York.

.

References Books

1.Burns GW. 1972. The Science of Genetics. An Introduction to Heredity. Mac Millan Publ. Co.Inc.

2.Gardner EF. 1975. Principles of Genetics. John Wiley & Sons, Inc. New York.

3.Harth and Jones EW. 1998. Genetics – Principles and Analysis. Jones and BarHett Publ. Boston.

E- Resources

1. https://homework.study.com/explanation/define-inorganic-evolution.html
2. https://www.ck12.org/flexi/life-science/theory-of-evolution/define-neo-lamarckism-and-its-role-in-evolutionary-theory./
3. https://www.livescience.com/474-controversy-evolution-works.html

Course Outcomes

On completion of this course, students will be

CO1	To understand the Primordial earth and theories on origin of life
CO2	To integrate and assess Lamarckism - Neo Lamarckism – Darwinism
CO3	To analyse various fossil records of man and fossil records of horse, various types of rocks - Geological time scale.
CO4	To explain the Nature of fossils- Dating of fossils, evidences of evolution, Adaptive radiation in reptiles and mammals,
CO5	To construct and compile the role of Human Genome Project, Evolution in the diagnosis, and treatment of diseases.

Mapping of Cos with Pos & PSOs

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

S- Strongly correlating
M-Moderately Correlating
W-Weakly Correlating
N-No Correlation

Semester-V Core Practical IV	Title of the Course **CORE Practical – IV (CC IX&CC X)**	Course Code:
Instruction Hours: 3	Credits: 3	Exam Hours: 3
Internal Marks -40	External Marks- 60	Total Marks: 100

Unit I	1. Preparation of sperm suspension in bull and observation of spermatozoa. 2. Study of the rate of motility of live sperm in bull semen. 3. Vaginal smear preparation in Rat/Mouse to study the stages of oestrous cycle. **18 Hours**
Unit II	**1.** Chick: Blastulation, and Gastrulation **2.** Dissection and morphology observation of the 4 -14 somite chick embryo (24-34 Hours). **3.** Dissection and morphology observation of the 24-38 somite chick embryo (48 - 85 Hours). **4.** Culture of early chick embryo *in vitro*. 5. Mounting of 72 and 96 hours chick embryo.. **18 Hours**
Unit III	1. Frog Egg 2. Frog cleavage 2,4 and 8cell stages 3. Larval developmental stages of Drosophila 4. Chromosome squash preparation from Drosophila larval salivary gland. 5. Patterns of regeneration in the planarian. **18 Hours**
Unit IV	**EVOLUTIONARY BIOLOGY** 1. Study of fossils from models/pictures. 2. Study of homology and analogy from suitable specimens. 3. Demonstration of role of natural selection and genetic drift in changing allele frequencies using simulation studies. 4. Graphic representation and interpretation of data of height/weight of a sample of 100 humans in relation to their age and sex. **18 Hours**
Unit V	1. Speciation experiments in microbes. 2. Species richness study in animal sampling.

	3. Study on the evolution of man. **Preparation of e museum and video clippings based on the core practical** **18 Hours**

Text Book:

1. Annadurai, B. 2009. A Textbook of Immunology and Immunotechnology. S.Chand& Company Ltd., New Delhi
2. Sharma, P.D. 2010 (Tenth Edition) Ecology and Environment, Rastogi Publications,Meerut.

Reference Books:

1. Shastri, N.V. 2005. Principles of Immunology. Himalaya Publishing House, DDelhi
2. Clarke,G.L.1954–ElementsofEcology,JohnWiley&Sons.N.Y.
3. Odum E.P.1971. Fundamentals of ecology. W.B. Saunders Co., Philadalphia

e- Resources:

https://en.m.wikipedia.org
https:// www.nature.com
https://en.m.wikipedia.org
https://openoregon.pressbooks.pub

Course Outcomes:

On completion of the course the learner will be able

.CO 1:	Understand the water quality parameters
CO 2:	Able to examine the planktons.
CO 3:	Understand the animal associations.
CO 4:	Able to handle the basic immunological technique
CO 5:	To learn the lymphoid organs.

S- Strongly correlating
M-Moderately Correlating
W-Weakly Correlating
N-No Correlation

Semester-VI/ Discipline Specific Elective-II	**DSE- II- ANIMAL BEHAVIOUR**	Course Code:
Instruction Hours: 3	Credits: 3	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1 -Recalling K2 -Understanding K3 -Applying K4 - Analyzing K5 - Evaluating K6 - Creating
Course Objectives	**1.** To make them understand the fundamental concepts of Heritability of behaviour and its unique adaptive strategies. 2. To explain the Nature of Animal perception and their behavior. 3. To provide adequate information on the Biological aspects of Behavioural learning. 4. To understand the' Animal awareness and Emotion and Intelligence 5. Know the Organization of circadian system in multicellular animals and clock system.
UNIT-I	Genetic material, Genes and chromosomes, Genetic variation, Single and Polygenic inheritance of behaviour, Heritability of behaviour, Natural selection and behaviour, Frequency distribution of phenotypes, Darwinian fitness, Evolution of adaptive strategies. **18 Hours**
UNIT-II	Sexual selection, Altruism, Sexual strategy and social organisation, Animal perception, Neural control of behaviour, Sensory processes and perception, Visual adaptations to unfavourable environments. **18 Hours**
UNIT-III	Coordination and Orientation, Homeostasis and Behaviour, Physiology and Behaviour in changing environments, Animal Learning, Conditioning and Learning, Biological aspects of learning, Cognitive aspects of learning. **18 Hours**
UNIT-IV	Instinct and learning, Displacement activities, Ritualization and Communication, Decision making behaviour in Animals, Complex behaviour of honey bees, Evolutionary optimality, Mechanism of Decision making. The mentality of Animals: Languages and mental representation, non-verbal communication in human, mental images, Intelligence, tool use and culture, Animal awareness and Emotion. **18 Hours**

UNIT-V	Organization of circadian system in multicellular animals; Concept of central and peripheral clock system; Circadian pacemaker system in invertebrates with particular reference to Drosophila; Photoreception and photo- transduction; Molecular bases of seasonality; The relevance of biological clocks for human welfare - Clock function (dysfunction); Human health and diseases – Chrono pharmacology, chrono medicine, chronotherapy. **18 Hours**

Text Books

1. David McFarland, 1985.Animal Behaviour, Longman Scientific & Technical, UK.576pp.
2. HarjindraSingh, 1990. A TextBook of Animal Behaviour, AnomolPublication, 293pp.

Reference book

1. Michael D. Breed and Janice Moore, 2012. Animal Behaviour, Academic Press, USA, 359pp.
2. Aubrey Manning and Martin Stamp Dawkins, 2012. An Introduction to Animal Behaviour, 6th Edition, Cambridge University Press, UK. 458pp.
3. Davis E.Davis, 1970. Integral Animal Behaviour, Mac Millan Company,London, 118pp.
4. Jay, C. Dunlap, Jennifer, J. Loros, Patricia J. De Coursey (ed). 2004. Chronobiology Biological time Keeping, Sinauer Associates Inc, Publishers, Sunderland, MA.

E- Resources

1. https://pubmed.ncbi.nlm.nih.gov/31116388/
2. https://academic.oup.com/book/1451/chapter/140837272
3. https://animaltalk.com.au/mindset-animal-accomplish/

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	M	L	L	M	M	L	L
CO2	S	M	L	L	S	L	M	M	L	M
CO3	M	L	M	L	S	S	M	S	M	S
CO4	S	S	S	S	M	S	L	L	L	M
CO5	S	L	L	L	M	L	L	S	M	S

S- Strongly correlating
M-Moderately Correlating
W-Weakly Correlating
N-No Correlation

Semester- VI / Discipline Specific Elective-II	Title of the Course **EC II -DAIRY FARMING**	Course Code :
Instruction Hours: 3	Credits: 3	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1 -Recalling K2 -Understanding K3 -Applying K4 - Analyzing K5 - Evaluating K6 - Creating
Course Objectives	• Students should know basic concepts in Vermiculture
	• To learn Construction of Model Dairy House
	• To know about Feeding of pregnant dairy animals - Feeding pregnant heifer.
	• To study the Dairying as a source of additional income and employment.
	• Students should know the basics of Vaccination

UNITS	CONTENT	HOURS
I	Introduction to Dairy Farming- Advantages of dairying- Classification of breeds of cattle-Indigenous and exotic breeds- Selection of dairy cattle. Breeding-artificial insemination-Dairy cattle management-General Anatomy.	6
II	Construction of Model Dairy House - Types of Housing - Different Managemental Parameters - Winter Management - Summer Management	6
III	Feedstuffs available for livestock- Roughages -Concentrates - Energy rich concentrates - Protein rich concentrates - Mineral Supplements - Vitamin Supplements - Feed additives - Feeding management - Calves Feeding - Feeding of adults - Feeding of pregnant dairy animals - Feeding pregnant	6

	heifer.	
IV	Milk-Composition of milk-milk spoilage-pasteurization - Role of milk and milk products in human nutrition – Dairying as a source of additional income and employment.	6
V	Contagious disease - Common Bacterial - Protozoal - Helminth and Viral Diseases - Parasitic Infestation - Vaccination - Biosecurity.	6

Text Book:

1.The Veterinary Books for Dairy Farmers by Roger W. Blowey.
2. Hand Book of Dairy Farming by Board Eiri.

3. Handbook of animal husbandry TATA, S.N ed., ICAR 1990

Reference Books:

1. 15. James. N. Marner, 1975. Principles of dairy processing, wiley eastern limited, New Delhi.
2. Baradach, JE. Ryther. JH. and, MC larney WO., 1972. Aquaculture. The farming and Husbandry of Freshwater and Marine Organisms. Wiley

InterScience, NewYork.

Course Outcome

Upon completion of this course, Students would have

CO : 1	To understand the various practices in Dairy farming. To know the needs for Dairy farming and the status of India in global market.
CO : 2	To be able to apply the techniques and practices needed for Dairy farming.
CO : 3	To know the difficulties in Dairy farming and be able to propose plans against it.
CO : 4	To Learn about the Dairying as a source of additional income and employment.
CO : 5	To know the Contagious disease

Mapping of Cos with Pos & PSOs

	PO					PSO				
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	M	S	L	L	S	S	M	S	L	M
CO2	M	S	S	S	M	S	M	L	S	S
CO3	M	S	S	S	S	S	S	S	S	M
CO4	M	S	S	S	M	M	L	L	M	M
CO5	S	S	S	M	S	M	S	L	S	S

S- Strongly correlating
M-Moderately Correlating

W-Weakly Correlating

N-No Correlation

Semester-VI/ Discipline Specific Elective-III	**DSE III- ENTOMOLOGY**	Course Code:
Instruction Hours: 4	Credits: 3	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Course Objectives	• To understand the classification and working of insect systems • To understand their adaptations to the environment • To look in to some commercial applications of entomology with Beneficial insects, sericulture, insect pests and their control, vector Borne diseases etc. Skill to rear and mass production of commercially important insects. • Skill to identify the harmful insect and pest.
UNIT-I	Taxonomy and Classification: Classification and key characters of important Orders such as Coleoptera (Rhinoceros beetle), Lepidoptera (Plain tiger butterfly), Diptera (Aedes mosquito), Hemiptera (Bedbug), Hymenoptera (Indian Honey Bee), Orthoptera (Grasshopper), Isoptera,(Termites). **18 Hours**
UNIT-II	Biology of insects: General organization of a typical Insect – types of head; Thorax–Abdomen – Antenna– Mouth Parts, Legs–Wings Senseorgans; Sound producing organs; Structure of Digestive system – Circulatory system – Excretory system – Respiratory system –Nervous system–Reproductive system; Metamorphosis and types; Types of larvae and pupae; Role of endocrine and pheromones **18 Hours**
UNIT-III	Commercial Entomology: Apiculture- Biology and life- history of honeybees: Methods of beekeeping –Equipment and tools-Apiary management, Bee products, Diseases of honeybees. Sericulture-Mulberry sericulture-Non-Mulberry sericulture-Lac culture:-Propagation of lac insects -Natural enemies of lac insects and their management-Lac extraction **18 Hours**
UNIT-IV	Harmful insects: Vector borne diseases: Method of transmission of parasitic agents with special reference to mosquitoes and housefly. Host–parasite interaction with examples. Polyphagous insect pests: Locusts, termites, hairy caterpillars, cutworms, grampod borer **18 Hours**
UNIT-V	Insect pests and their control: Insects as crop pests: Major pests ofthe following crops and their life cycles, Types of injuries and nature of damage caused to paddy (Brown pant hopper), sugarcane (Root borer), pulses (plume moth), vegetables(brinjal-Shoot and fruit borer), Coconut (Red PalmWeevil) and stored grain Pests (Pulse beetle). **18 Hours**

Text Books:

1.NAYAR,K.K.,ANANTHAKRISHNAN,T.N.ANDB.V.DAVID. 1989. General and Applied Entomology. Tata McGraw Hill Publications, New Delhi

2.V.B.AWASTHI,2009. Introduction to General and Applied Entomology. 3rd Revised Edition .Scientific Publishers, India.Jodhpur.

Reference Books:

a. RAMAKRISHNA AYYAR T.V. 1989. Handbook of Economic Entomology for SouthIndia. Books and Periodicals Supply Service, New Delhi.

b. FROST S.W.1994. General Entomology. Narendra Publishing House, Delhi.

c. DENNIS S.HILL. 1993.AgriculturalInsect Pests ofthe Tropics and their Control.Second Edition, Cambridge University Press, U.K.

d. CHARLESATRIPLEHOMANDNORMANF.JOHNSON2005.

Borror and DeLong's Introduction to the Study of Insects Thomson Brooks/Cole Publishing. U.S.A.

e. RAJEEV K.UPADHYAY, MUKERJII K.G. CHANDA, B.P. AND DUBEY, O.P.

1998. Integrated Pest and Disease Management. APH Publishing Corporation, NewDelhi.

f. V.B.AWASTHI,2007.Agricultural Insect Pests and their control..Scientific.

E- Resources

1. **https://www.huck.psu.edu/assets/uploads/documents/Introduction-to-Insects.pdf**
2. **https://www.dhanuka.com/blogs/list-of-bugs-and-insects-harmful-to-the-agriculture-industry**
3. **https://hicare.in/blog/common-diseases-caused-by-harmful-insects/**

Course Outcomes

On completion of this course, students will be

CO1	To Know about the steps required to do insect systematic and classify insect pest using key characters.
CO2	To Understand morphology of insect pest.
CO3	To Apply the skill for various sustainable commercial production of apiculture, sericulture and lac culture.
CO4	To Understand the impact of harmful insect pest in agriculture.
CO5	To understand the Primordial earth and theories on origin of life

Mapping of COs with Pos & PSOs

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

S- Strongly correlating
M-Moderately Correlating
W-Weakly Correlating
N-No Correlation

Semester-VI/ Discipline Specific Elective-III	**DSE III- PUBLIC HEALTH AND HYGINE**	Course Code:
Instruction Hours: 4	Credits: 3	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K1 -Recalling** **K2-Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**
Course Objectives:	1. To enlighten the non- major elective students about the general knowledge on their health and hygiene. 2. To create general health awareness the hazardous impacts and remedy. 3. Understand the communicable and non communicable disease and its prevention. 4. Understand the different environmental pollution and its hazards. 5. Learn WHO programme of public health and hazards.
Unit I	Scope of Public health and Hygiene – nutrition and health – classification of foods – Nutritional deficiency diseases- Vitamin deficiency diseases. **6 Hours**
Unit II	Environment and Health hazards: Environmental degradation – Pollution – Air, Water, Land and Noise-associated health hazards **6 Hours**
Unit III	Communicable diseases and their preventive and control measures. Measles, Hepatitis, HIV /AIDS,Cholera, Malaria and Filariasis. **6 Hours**
Unit IV	Non-Communicable diseases and their preventive measures.Genetic diseases, Cancer, Cardio vascular diseases, Chronic respiratory disease, Diabetes, Epilepsy. **6 Hours**
Unit V	Health Education in India – WHO Programmes – Government and Voluntary Organizations and their health services – Precautions, First Aid and awareness on epidemic/sporadic diseases. **6 Hours**

Text Books:

1. PARK AND PARK, 1995: Text Book of Preventive and Social Medicine – BanarsidasBhanot Publ. Jodhpur – India.

Reference Books:

1. VERMA, S. 2020 : Medical Zoology, Rastogi publ. – Meerut – India
2. SINGH, H.S. AND RASTOGI, P. 2009 : Parasitology, Rastogi Publ. India.
3. DUBEY, R.C AND MAHESWARI, D.K. 2007 : Text Book of Microbiology- S. Chand & Co. Publ. New Delhi – India.

e-Resources:

1. http:// www.dettol.co.in

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Understand public health practice requires multidisciplinary team of public health workers and professionals.
CO 2:	Improve the quality of life through promotion of healthy behaviors including mental health.
CO 3:	Learn healthy habits to protect yourself from disease and prevent germs and infectious diseases from spreading.
CO 4:	Understand the Socioeconomic impact of non-communicable diseases.
CO 5:	Aware of public health is the result of society's efforts as a whole, rather than that of single individuals

Mapping of Cos with Pos & PSOs

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

S- Strongly correlating
M-Moderately Correlating W-Weakly Correlating
N-No Correlation

Semester-VI/ Ability Enhancement Course - III	**AEC-III- INTRODUCTION TO NANOBIOTECHNOLOGY**	Course Code:
Instruction Hours: 2	Credits: 2	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Course Objectives	• To make them understand the fundamental concepts of Nanotechnology and its unique properties.
	• To provide knowledge on the synthesis of various characterization techniques
	• To highlight the importance of fabrication techniques and their biological applications.
	• To demonstrate the applications of nanomaterials in various streams
	• To make them learn toxicity mechanisms and regulatory functions of nanomaterials.

UNITS	CONTENT
UNIT I	**Generic Methodologies for Nanobiotechnology:** Introduction to nanotechnology - challenges and opportunities associated with biology on the nanoscale. Top-down approaches – sputtering - chemical etching - thermal/laser ablation - mechanical/ball missling. Bottom-up approaches - vapour deposition - sol-gel process - spray pyrolysis - aerosol process - bioreduction. Advantages and disadvantages of nanotechnology. 6 **Hours**
UNIT II	**Nanomaterials Synthesis and Characterization Techniques:** Synthesis of nanoparticles - characterization techniques - UV-Visible spectrophotometer - Field Emission Scanning-Electron Microscopy (FE-SEM) - Energy Dispersive X-ray (EDX) - High Resolution-Scanning Electron Microscopy (HR-TEM) - Dynamic Light Scattering (DLS) - zeta potential -Fourier Transform - Infra red (FT-IR) - X-ray Diffraction (XRD) and Raman spectroscopy. 6 **Hours**
UNIT III	**Introduction to Sensors:** Principles of biosensors -types - important component of biosensor - materials for biosensor applications. Fabrication of biosensor devices - electrochemical methods - techniques used for microfabrication - biological applications. 6 **Hours**

UNIT IV	**Bionanomaterials:** Biomolecules for designing nano-structures - nanoprinting of DNA - RNA - proteins - biological and medical applications. Classification of nanomaterials - properties and applications of bionanomaterials - tissue engineering - drug delivery - controlled release and disease diagnosis. 6 **Hours**
V	**Toxicology and Environmental Safety:** Introduction to nanomaterials - toxicological effects - bioaccumulation - biotransformation - cytotoxicity and genotoxicity. Mechanism of nanomaterials toxicity - oxidative stress - ecotoxicity - mutagenicity and immunotoxicity. Ethics and regulations issues in nanotechnology - exploration pattern matters associated with nanotechnology - social impacts and human resources for nanotechnology. 6 **Hours**

Text book

1. Niemeyer, C.M. and Mirkin, C.A. (2004). Nanobiotechnology: Concepts, Applications and Perspectives. Wiley – VCH.
2. Goodsell, D.S. (2004). Bionanotechnology: Lessons from Nature. Wiley Online Library.

REFERENCES:

1. Sahu, S.C. and Casciano, D.A. (2014). Handbook of Nanotoxicology, Nanomedicine and Stem cell use in Toxicology. John Wiley & Sons, Ltd.
2. . Bagchi, D., Bagchi, M., Moriyama, H. and Shahidi, F. (2013). Bio-Nanotechnology: A Revolution in Food, Biomedical and Health Sciences. Wiley-Blackwell Publishers.
3. Parak, W. and Feliu, N. (2020). Colloids for Nanobiotechnology - Synthesis, Characterization and Potential Applications. Elsevier Science.
4. Brechignac, C., Houdy, P. and Lahmani, M. (2007). Nanomaterials and Nanochemistry. Springer publication.
5. Klabunde, K.J. (2001). Nanoscale Materials in Chemistry. Wiley Interscience Publications.
6. Klabunde, K.J. (2001). Nanoscale Materials in Chemistry. Wiley Interscience Publications.
7. Cao, G. (2004). Nanostructures and Nanomaterials -Synthesis, Properties and Applications. Imperial College Press.
8. Zhao, Y. and Nalwa, H.S. (2006). Nanotoxicology - Interactions of Nanomaterials with Biological Systems. American Scientific Publishers.
9. Webster, T.J. and Ghosh, S. (2021). Nano biotechnology: Microbes and Plant Assisted Synthesis of Nanoparticles - Mechanisms and Applications. (I Edition), Elsevier Science.
10. Papazoglou, E.S. and Aravind Parthasarathy. (2007). Bionanotechnology - Synthesis Lectures on Biomedical Engineering. Morgan and Claypool publishers.

E.Resources

1. https://www.britannica.com/technology/nanotechnology/Nanofabrication

2. https://pubs.rsc.org/en/content/articlelanding/2018/nr/c8nr02278j

3. https://link.springer.com/book/10.1007/978-981-10-2468-9#toc

Course Outcome

Students would have acquired clear knowledge on

CO : 1	Upon successful completion of this course the students would be able to: Acquire mastery of synthesis procedures and their chemical interactions
CO : 2	Understand the fundamental applications of various analytical instruments.
CO : 3	Understand the usage of biosensor devices for the early detection of infectious diseases.
CO : 4	Apply bionanomaterials in biomedical research and therapeutic applications
CO : 5	Profile the individual nanomaterial toxicity profile and mechanistic pathways.

Mapping of Cos with Pos & PSOs

	PO					**PSO**				
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	S	M	S	S	S	S	M	S	S	S
CO2	S	S	M	S	S	S	M	M	S	S
CO3	S	M	M	S	S	S	S	S	S	M
CO4	M	S	M	M	S	S	S	S	S	M
CO5	M	S	S	S	M	S	M	S	S	M

S- Strongly correlating
M-Moderately Correlating

W-Weakly Correlating

N-No Correlation

Semester-V / Skill Enhancement - **IV**	**SEC –IV SERICULTURE**	Course Code:
Instruction Hours: 2	Credits: 2	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1 -Recalling K2 -Understanding K3 -Applying K4 - Analyzing K5 - Evaluating K6 - Creating
Course Objectives	• Students should know basic concepts and techniques in Sericulture.
	• To study about the Moriculture
	• To learn about Egg-storage and transportation
	• To study Rearing houses and equipment
	• To learn about the Physical and commercial characteristics of cocoons

UNIT I	Introduction to textile fibers; types- natural and synthetic fibers; sources of silk fiber- Tasar, Muga, Anaphe, Gonometa, Fagara, spider and mussel; properties and importance of silk fiber. History, development, status, characteristics and advantages of sericulture in India**.** **6 Hours**
UNIT II	Host plants; Moriculture- distribution, morphology, propagation- seedling, cutting, grafting, layering and micropropagation methods, maintenance- irrigation, manuring and pruning, pests and diseases of mulberry. 6 **Hours**
UNIT III	*Bombyx mori*- morphology, anatomy, life cycle, geographical locations, larval moults, voltinism, indigenous and commercial races. Diapause. Egg-storage and transportation**.** **6 Hours**
UNIT IV	Rearing houses and equipment. Rearing operations- disinfection, brushing, feeding and spacing. Moulting and spinning. Harvest. Rearing methods- chawki, lasso, showa, shelf-rearing, floor-rearing and shoot rearing. Diseases of *Bombyx mori*- protozoan, bacterial, viral and fungal. Pests of silkworm- Uzi fly, desmestids, mites, ants, nematodes, aves and mammals. 6 **Hours**
UNIT V	Physical and commercial characteristics of cocoons. Cocoon harvesting and marketing. Cocoon sorting, stifling, deflossing, riddling, cooking, brushing, reeling and re-reeling. Weaving. By-products of sericulture industry. **6 Hours**

Text Books:

1. Singh, Amardev & Ravinder Kumar. 2013. Sericulture handbook Vol 1, Biotech.
2. M. Madan Mohan Rao. An Introduction to Sericulture, 2nd edition, BS Publications

Reference Books:

1. G. Ganga and J. Sulochana Chetty. 2019. An introduction to sericulture, 2nd edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

2. M. Johnson and M. Kesary. 2019. Sericulture, Saras publication, Tamilnadu.

e-Resources:

10. https://agritech.tnau.ac.in/sericulture/
11. https://csb.gov.in
12. https://www.slideshare.net/Nayananayu2/2-a-chapter-morphology-and-life-cycle-of-silkworms-species-and-their-host-plants

Course Outcome:	
Upon completion of this course, Students would have	
CO : 1	To understand the various practices in sericulture. To know the needs for sericulture and the status of India in global market.
CO : 2	Able to apply the techniques and practices needed for sericulture.
CO : 3	To know the difficulties in sericulture and be able to propose plans against it.
CO : 4	To know the Diseases of *Bombyx mori*
CO : 5	To Learn the By-products of sericulture industry.

Mapping of Cos with Pos & PSOs

	PO					**PSO**				
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	M	L	L	L	L	L	M	S	L	L
CO2	L	M	L	M	L	M	M	S	M	L
CO3	M	S	L	L	L	M	L	L	M	S
CO4	M	S	M	S	M	M	L	L	S	S
CO5	M	M	L	M	M	L	L	L	L	M

S- Strongly correlating, W-Weakly Correlating, N-No Correlation, N-No Correlation

M-Moderately Correlating