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

M.Sc., ZOOLOGY

2024-2025 onwards

PG AND RESEARCH DEPARTMENT OF ZOOLOGY
(For the candidates admitted from 2024 – 2026)

M.Sc. ZOOLOGY

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO 1:	To develop critical analysis and problem solving skills required to interpret the data into structures and mechanisms.
PEO 2:	Gain knowledge of experimental techniques and instrumentation enables to work independently in research in different areas at a global level.
PEO 3:	Actively participate in organizing and presenting acquired knowledge coherently both orally and in written discourse relating to chemistry
PEO 4:	To prepare the students to successfully compete for current employment opportunities and emerge as entrepreneurs.
PEO 5:	Work alongside of physicists, engineers, environmentalists, biomedical scientists, Pharmacists, doctors and other professionals to help solving scientific problems.

CURRICULUM STRUCTURE – PG (ARTS/SCIENCE)
(For I Year 2024 Batch onwards)

Category of Courses	No. of Courses	Hrs	Total Credits
Core Courses (CC)	**12**	**72**	**54**
Core Choice Courses(CCC)	**3**	**18**	**12**
Elective Courses(EC)	**3**	**16**	**11**
Entrepreneurship/ Industry Based Course	**1**	**4**	**3**
Internship	**0**	**0**	**2**
Skill Enhancement Courses (SEC)	**2**	**4**	**4**
Project	**1**	**6**	**4**
Value Added Courses (Extra Credit)*	**2**	**0**	**4**
TOTAL	**22+2**	**120**	**90+4**

SCHEME OF EXAMINATIONS – 2024 Batch
(For PG Arts/Science)

SEMESTER I						
COURSE TYPE	**COURSES**	**HRS**	**CREDITS**	**EXAM DURATION**	**MAX. MARKS**	
Core Course I	CC I - Animal Phylogeny and Biodiversity	6	5	3	25	75
Core Course II	CC II - Cell and Molecular Biology	6	4	3	25	75
Core Course III	CC III - Core Practical (CCI, CCII &CCC I)	6	4	3	40	60
Core Choice Course I	CCC I - Microbiology and Immunology	6	4	3	25	75
Elective Course I	EC I – Aquaculture/ Aquarium Keeping	6	4	3	25	75
	No. of Courses –5	**30**	**21**			

SEMESTER II						
COURSE TYPE	**COURSES**	**HRS**	**CREDITS**	**EXAM DURATION**	**MAX. MARKS**	
Core Course IV	CC IV - Animal Physiology	6	5	3	25	75
Core Course V	CC V - Wild Life Biology	6	4	3	25	75
Core Course VI	CC VI - Core Practical	6	4	3	40	60
Core Choice Course II	CCC II - Economic Entomology	6	4	3	25	75
Elective Course II	EC II - Dairy farming/ Bioinstrumentation	4	3	3	25	75
Skill Enhancement Course I	SEC I - Apiculture	2	2	3	25	75
Value Added Course I	VAC I - Vermiculture	-	2	3	0	100
	No. of Courses –6+1	**30**				
Internship/Industrial Activity during the Summer Vacation after I Year						

SEMESTER III						
COURSE TYPE	**COURSES**	**HRS**	**CREDITS**	**EXAM DURATION**	**MAX. MARKS**	
Core Course VII	CC VII - Developmental Biology	6	5	3	25	75
Core Course VIII	CC VIII - Evolution	6	5	3	25	75
Core Course IX	CC IX - Core Practical (CC V& CC VI)	6	4	3	40	60
Core Choice Course III	CCC III - Research Methodology	6	4	3	25	75
Industry Based Course I	IBC I - Animal Biotechnology	4	4	3	25	75
Skill Enhancement Course II	SEC II - Poultry farming	2	2	3	25	75
Internship/Industrial Activity	Internship/Industrial Activity	-	2			
Value Added Course II	VAC II - Stem Cell Biology	-	2	3	0	100
	No. of Courses –6+1	**30**				

SEMESTER IV						
COURSE TYPE	**COURSES**	**HRS**	**CREDITS**	**EXAM DURATION**	**MAX. MARKS**	
Core Course X	CC X - Environmental Biology	6	5	3	25	75
Core Course XI	CC XI - Genetics	6	5	3	25	75
Core Course XII	CC XII - Core Practical (CC VII& CC VIII)	6	4	3	40	60
Core Course XIII	CC XIII - Project	6	4	3	25	75
Elective Course III	EC III – Sericulture/ Introduction to Nano Biotechnology	6	4	3	25	75
	No. of Courses – Total – 5	**30**				
	Grand Total	**120**	**90+4**			

Controller of Examinations

Semester-I / Core Course-I	Title of the Course CC - I -**ANIMAL PHYLOGENY AND BIODIVERSITY**	Course Code:
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	1. To give a thorough understanding in the origin of life in Invertebrate animals. 2. To acquire an in-depth knowledge on the paleontology in animal world. 3. To develop an holistic appreciation on the phylogeny, relationships and adaptations in animals 4. To understand theories of primate characteristic features, classification and affinities. Learn the animal diversity which is an essential topic for biologists to know the distribution, and phylogeny of animal	
UNITS	**CONTENT**	**HOURS**
Unit I	Phylogeny of Invertebrates: Biogenetic Law – Gastrea Theory – Origin of Matazova – Theories for the Origin of Metazova: Syncytial, colonial and Polyphyletic theory – Origin of Bilateria: Trochophore theory, syncytial, Planuloid theory, Ctenophore theory – Origin and Phylogeny of Annelida: Corn or Fission theory, Cyclomerism theory, Enterocoel theory, Gonocoel theory, Schozocoel theory, Trochophore Theory – Origin of Arthropoda – Onychophora – Trilobita – Eurypterida – Xiphosura.	**18**
Unit II	Phylogeny of Invertebrates: Origin of Mollusca – Phylogeny of Mollusca : Neopilina , Nautiloids, Ammonoids and Belemnites. – Origin of Echinodermata: Coelenterate ancestry, Annelidan ancestry,	**18**

	Laphophorate ancestry, Hemichordate ancestry, Dipleurula theory, and Pentactula theory. Phylogeny of Echinodermata. Echinoderm fossils.	
Unit III	Phylogeny of Vertebrates: Origin of chordates – Theories of origin of Chordates. Ostracoderm: characteristic features, classification and affinities. Origin of vertebrates – Theories for the origin of vertebrates . Placoderms: characteristic features, classification and affinities. Holocephali : characteristic features, classification and affinities. Dipnoi: Affinities. Origin of Fishes: Origin of paired appendages, Apoda. Origin of Amphibia: Characteristics and affinities of Rhynchocephalia.	**18**
Unit IV	Phylogeny of Vertebrates: Origin of Reptilia : connecting link between amphibian and reptilian, Evolution of reptilian, Golden Age of reptiles, Ratitae. Origin of Birds: Fossil bird-Archaeopteryx, Origin of flight in birds. Prototheria and Metatheria: characteristic features, classification and affinities. Origin of primates – adaptive radiation of lemuroids, Tarsius – new world monkeys, old world monkeys and apes, Australopithecus.	**18**
Unit V	Biodiversity: definition – types – genetic, species and ecosystem diversity. Values and uses of biodiversity. Biodiversity measurements, Mega diversity centres. Loss of biodiversity. Conservation of biodiversity : in situ (afforestation, social forestry, agro forestry, Biosphere reserves, national parks and sanctuaries), ex situ (Cryopreservation, gene banks, sperm banks, DNA banks, tissue culture and biotechnological strategies). Biodiversity laws of India. Wild life protection Acts.	**18**

Text Book:

1. Barnes, R.D. (2006), Invertebrate Zoology, Cengage Publications.
2. Barrington, E.J.W. (2012), Invertebrate Structure and Functions, East west press Pvt (L)New Delhi.
3. Waterman, A.J. (1971), Chordate Structure and Function, The Macmillan Company.

Reference Books:

1. Gupta, Rajiv.K, (2011), Advancements in Invertebrate Taxonomy and Biodiversity.
2. Highnam, K.C. and Hill, L. (1979), The Comparitive Endocrinology of Invertebrates, ELBS & Edward Arnold (Publishers) Ltd., London.
3. Hyman, G.H., The Invertebrates, Vol. I to VII, McGraw Hill Book Co., Inc., N.Y
4. Jan, A.Pechenik,(2014), Biology of the Invertebrates. McGraw – Hill Publications.
5. Kotpal, R.L.,(2015), Minor Phyla, Rastogi Publication, Meerut.
6. Vasantika Kashyap (1997), Life of Invertebrates, Vikas Publishing House Pvt. Ltd., New Delhi.

7. Alessandro Minelli,(2009), Perspectives in Animal Phylogeny and Evolution, Oxford University Press.
8. Colbert, H. Edwin (2011), Evolution of the Vertebrates, Wiley Eastern Limited, New Delhi.

Web Resources:

1. https://opentextbc.ca/biology2eopenstax/chapter/animal-phylogeny/
2. https://www.annualreviews.org/doi/abs/10.1146/annurev-ecolsys-120213-091627

https://www.ibe.upf-csic.es/animal-biodiversity-and-evolution

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Understand and study of the Origin and phylogeny of Invertebrates and Chordates
CO 2:	Understand the primitive forms of invertebrates and vertebrates distribution
CO 3:	Understand the status and mode of living of different forms of animals.
CO 4:	Learn the animal phylogeny and its evolution
CO 5:	Students understand the biodiversity of Invertebrates and 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

S – Strongly Correlated
M – Moderately Correlated
W-Weakly Correlated
N – No Correlation

Semester-I / Core Course-II	Title of the Course **CC- II –CELL AND MOLECULAR BIOLOGY**	Course
Instruction Hours: 6	Credits: 4	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	1. To understand the cell structure in molecular level. 2. To provide the basic idea about cell cycle and regulation 3. To know the structure and importance of genetic material 4. To study the RNA synthesis in prokaryotes and eukaryotes 5. To understand the prokaryotes and eukaryotes gene expression and regulation	
UNITS	**CONTENT**	**HOURS**
Unit I	**Cell membrane:** Molecular organization- molecular models – cell permeability – cell surface differentiations . **Structure and functions of cells:** Cell organelles – Mitochondria, Golgi complex, Endoplasmic reticulum, Ribosomes and Lysosomes.. **Methods of cell study** : Micrometry – cell culture methods – cell fractionation technique – cytochemical staining methods.	**18**
Unit II	**Nucleus:** Nucleoplasm and cytoplasmic relationship-Hammeling's experiment, isolation techniques; ultra structure of nuclear envelop and nucleoplasm. **Chromosomes:**–Biochemistry – Organization of chromatin; Chromosomal types – polygene and lamp brush chromosome. **Cell division:** Cell cycle and mitosis- significance of mitosis; meiosis and reproductive cycle- regulation and significance of meiosis. Cell cycle-(steps – regulation and control).	**18**
Unit III	**Nucleic acid:** DNA and DNA types, their topology and functions **DNA replication:** Types of replication- conservative, dispersive and	**18**

	semiconservative methods; Process of replication – Origin, replication fork, regulation in prokaryotes and eukaryotes; Role of enzymes and other protein factors in DNA synthesis. **DNA damage:** Sources and types of DNA damage; Nuclear versus mitochondrial DNA damage; Senescence and apoptosis; DNA damage and mutations. **DNA repairing mechanism:** Excision repair, SOS repair and mismatch repair.	
Unit IV	**RNA synthesis:** Process of transcription- preinitiation, initiation, promoter clearance, elongation and termination; role of enzymes and other protein factors; Measuring and detecting transcription; reverse transcription; synthesis of mRNA in prokaryotes and eukaryotes; synthesis of rRNA; synthesis of tRNA; RNA processing- capping and polyadenylation.RNA editing, Splicing.	**18**
Unit V	**Genetic code:** Process of translation – initiation, elongation and termination and post translational process; role of enzymes and proteins in protein synthesis – Genetic code. **Gene regulation:** Lac operon- Structure, genetic nomenclature, lactose analogs, regulation in cyclic AMP and uses in molecular biology; Trp operon- repression and attenuation. **Protein transport:** Intracellular compartments and protein sorting; vesicular traffic in secretory and endocytic pathway, transport from ER through Golgi to lysosome and endosome. Control of gene expression at transcription level regulation of phages, virus. Prokaryotic and eukaryotic gene expression, role of chromatin in regulating gene expression and gene silencing.	**18**

Text Book:

1. **Dipak** Ajoy Paul, (2011), Text Book of Cell and Molecular Biology, Books & Allied (P) Ltd., KolKata
2. **Kumar Kan, Soma Halder,** (2009), Cell biology, Genetics , Molecular Biology,
   New Central Book Agency , NewDelhi.

Reference Books:

1. Bruce Alberts,(2017).Molecular Biology of the Cell,Garland Science Publishing Inc,New York.
2. DeRobertis, E.D.P. , F.A., Saez, and E.M.R. De Robertis Jr. 1975. Cell biology. W.B. Saunders Company, Philadelphia.
3. Du Praw, E.J. 1968. Cell and Molecular Biology. Academic Press New York.
4. Geoffrey, M.Cooper Robert E.Hausman(2013), The Cell, Publisher Sinauer Associates Inc
5. Gerald Karp,(2013). Cell Biology, Publisher Wiley.
6. Giese, A.C. 1962. Cell Physiology. W.B. Saunders Company, Philadelphia.
7. Freifelder D 1996. Molecular Biology, 2nd edition, Narosa Publishing house

8. Lewin, B. 2000. Genes VII Oxford university press.
9. Stryer, L. 1995. Biochemistry. W.H. Freeman and company.
10. Voet, D and Voet, J. 1995. Biochemistry, 2nd edition. John Wiley and Sons Inc.

e- Resources:

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
3. https://www.nature.com/subjects/molecular-biology

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Understand the cell structure in molecular level.
CO 2:	Understand basic idea of cell cycle and regulation to apply in research.
CO 3:	Job offers: Research Scientist in Cancer Research center, Adayar
CO 4:	Research Scientist in Tata Memorial Centre for Advanved Treatment in Cancer, Parel Mumbai
CO 5:	Technical officer in Centre for cellular and Molecular Biology(CCMB), TIFR at Hyderabad

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	M	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	M	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	M	S	S

S – Strongly Correlated
M – Moderately Correlated
W-Weakly Correlated
N – No Correlation

Semester-I / Core Course III	CP-I –**PRACTICAL I** (CC I , II & CCC I)	Course Code:
Instruction Hours: 6	Credits: 4	Exam Hours: 3
Internal Marks -40	External Marks- 60	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	1. To familiar with identification of invertebrates and chordates animals 2. Understand the mounting technique. 3. To get hands on training in culturing of animals. 4. Understand the alternate digital dissection by video clippings 5. To know the mendelian characters and its significance.	
Unit I	**A. INVERTEBRATES and CHORDATS** **1. Taxonomy** **TAXONOMY OF INVERTEBRATES** **1. Taxonomy**. **Phylum: Protozoa** Euglena, Amoeba , Plasmodium **Phylum:Porifera** Sycon, .Spongilla **Phylum:Coelentrata** Physalia, Aurelia, Sea anemone **Phylum:Platyhelminthes** Planaria, Fasciola, Taenia **Phylum:Aschelminthes** Ascais **Phylum:Annelida** Nereis, Earthworm, Leech **Phylum:Arthropoda** Penaeus, Scolopendra, Scorpion, Peripatus **Phylum:Mollusca** Chiton, Dentalium, Aplysia, Mytilus, Sepia **Phylum:Echinodermata**	**18**

	Antedon, Cucumaria, Echinus **TAXONOMY OF CHORDATES** **SUB PHYLUM: PROTOCHORDATA** Amphioxus, Balanoglossus, Ascidian, Petromyzon **Pisces:** Shark , Echenein, Ophiocepalus, Anguilla, Exocoetus, Syngnathus , **Amphibia:** Ichthyophis, Salamandra, Bufo, Chelone, Sphenodon, Naja, Crocodylus, **Aves :** Parrot , Owl, Sparrow **Mammals:** Bat, Rabbit, Rattus	
Unit II	**2. Mounting** Prawn - Appendages Teleost – Scales Honeybee – Sting **3. Spotters** Invertebrate larval forms. Invertebrate fossils – Ammonoids, Belemnoids, Nautiloids and Echinoclem fossils. Minor Phyla – Chaetognatha, Rotifera, Phoronida and Sipunculida. **4. Dissections** Video clipping of dissection of shark, frog, calotes and rat can be shown to the students. A student can make use of material available in any search web site for online dissection of shark, frog, calotes, rat using Apple quick time software.	**18**
Unit III	**5. Culturing of Animals** A visit to atleast any 2 of following Vermiculture, apiculture, sericulture, ornamental fish culture, poultry or dairy farm or Biofertilizer or Biopesticide Industry in order to evoke interest in self employement.	**18**
Unit IV	**B. CELL AND MOLECULAR BIOLOGY** 1. Human Buccal Smear 2. Squash preparation of Onion root tip to study the stages of Mitosis.	**18**

Unit V	**C. MICROBIOLOGY& IMMUNOLOGY** Culture techniques – culture of bacteria. – Preparation of smears and simple staining. Specific staining – negative staining &Gram staining. **Immunology** Identification of lymphoid organs in rat / mouse. Determination of human blood group by haemagglutination test and assessment of specificity of antigen – antibody reactions. Detection of the specific reactivity of precipitating antibody (Igg) with fractionated antigens by immune electrophoresis, Vidal- test. Spotters –antigen , antibody reaction, Immunoelectrophorosis	**18**

Text Book:

1. **Barnes, R.D** Invertebrate Zoology, Cengage Publications. . (2006),
2. **Barrington, E.J.W.** Invertebrate Structure and Functions, East west press Pvt (L)New Delhi. (2012),

Reference Books:

1. Gupta, Rajiv.K, Advancements in Invertebrate Taxonomy and Biodiversity. (2011)
2. Highnam, K.C. and Hill, L. The Comparitive Endocrinology of Invertebrates, ELBS & Edward Arnold (Publishers) Ltd., London. (1979).
3. Alessandro MinelliPerspectives in Animal Phylogeny and Evolution, Oxford University Press. ,(2009)
4. Colbert, H. Edwin Evolution of the Vertebrates, Wiley Eastern Limited, New Delhi. (2011)
5. Bruce Alberts Molecular Biology of the Cell,Garland Science Publishing Inc,New York. ,(2017).
6. William.S, Klug et al Genetics, Published by Pearson Education India.,(2016)
7. **Patel, A.H.** Industrial Microbiology. Laxmi Publications New Delhi, **(2015)**.
8. MARK Peakman and **Diego vergani** Basic and clinical immunology. **Publisher Churchill Livingstone,** (2009)**.**

Web Resources:

1. **https://www.immunology.org/public-information/what-immunology#:~:text=Immunology%20is%20the%20study%20of,as%20autoimmunity%2C%20allergy%20and%20cancer.**
2. **https://uwm.edu/biology/research/cell-and-molecular-biology/#:~:text=Cell%20and%20Molecular%20Biology%20encompasses,%2C%20lipids%2C%20and%20carbohydrates).**

3. https://microbiologysociety.org/why-microbiology-matters/what-is-microbiology.html

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Obtain thorough knowledge in the identification of vertebrate and chordate animals
CO 2:	Familiar with mounting techniques
CO 3:	Know to culture economically important animals
CO 4:	Able to do microbial culture technique
CO 5:	Understand the mendelian traits.

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	M	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S
CO3	S	S	S	S	S	M	S	M	M	S
CO4	S	M	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	M	S	M	S

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-I / CCC- I Core Choice Course	Title of the Course CCC-I **MICROBIOLOGY AND IMMUNOLOGY**	Course Code:
Instruction Hours: 6	Credits: 4	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	1. To provide an over view of the microbial world, its structure and function 2. To give students an intensive and in-depth learning in culture techniques 3. To familiarize the learner with the applied aspects of microbiology 4. To know the immunity and immune system of human 5. To study the immunodeficiency diseases and its diagnostic techniques	
UNITS	**CONTENT**	**HOURS**
Unit I	History and Scope of microbiology - Outline classification of microorganisms – Bacteria, fungi, algae, and virus. Bacterial growth and nutrition requirements, Culture techniques - media preparation -types of culture media , isolation and Identification methods. Peservation of pure culture, Aerobic and anaerobic culture techniques.	**18**
Unit II	Microbes in food - Role of microbes in food production; Microbes of milk, food contamination , poisoning and spoilage – sources, symptoms and prevention of food borne infections – Bacterial and fungal toxins – methods of detection and detoxification – food sanitation in food manufacture. Microbes in fermentation – production of ethanol, lactic acid, vinegar, microbial enzymes.food preservation.	**18**

Unit III	Causative agents, modes of transmission, symptoms, diagnosis, Prevention and control of the following diseases in Man : **Bacterial Disease** : Pneumonia, Diphtheria, Rheumatic fever, Whooping cough, Tuberculosis, Meningitis, Botulism, Typhoid, Cholera, Gonorrhea, Plague and leprosy. **Viral diseases** – Influenza, Measles, Mumps, Chicken pox, Hepatitis, Poliomyelitis, Rabies, Japanese encephalitis, Yellow fever and HIV infection (AIDS).	**18**
Unit IV	Immunity – Humoral and cell mediated immunity. Lymphoid organs in Man – primary lymphoid organs, secondary lymphoid organs; Cells of the immune systems ; Haemopoiesis – Antigens, Haptens, Epitopes and Paratopes; Immunoglobulins – structure and classes of immunoglobulins; Complements pathway – Biological functions of complement Hypersensitivity.	**18**
Unit V	Immunodeficiency diseases – primary and secondary immunodeficiency – AIDS – Life cycle – Transmission of HIV – Symptoms – Diagnosis, treatment for AIDS – Monoclonal& Polyclonal antibodies; Immunological techniques – precipitation – VDRL test – Immuno diffusion – Immuno electrophoresis – Agglutination – Blood typing – Widal test – Coomb's test – passive agglutination – Immuno fluorescence – ELISA – HLA typing -RIA .	**18**

Text Book:

1. **PELCZER, M.J.,REID, R.D**. and **CHAN, E.C.S**. (1996), Microbiology, V Ed., Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. **ANANTHANARAYANAN, T** and **JAYARAM PANIKER, C.K**. (2000), Text Book of Microbiology, VI Ed., Orient Longman Ltd., Madras.
3. **Ananthanarayanan, T** and **Jayaram paniker, C.K**.and Arti Kapil (2013), Text Book of Microbiology, 9th Edi.Publi: University press(India) Pvt. Ltd., ISBN-13:978-8173718892.

Reference Books:

1. **Michael,J. Pelzer, J.R,ECS. Chan**,(2001) Microbiology. McGraw Hill Publishing Company Ltd., New Delhi.
2. **Purohit, S.S,**(2006)Microbiology, Fundamentals and Applications (Agro botanical Publications)
3. **Patel, A.H.(2015),** Industrial Microbiology. Laxmi Publications New Delhi.
4. **Ross, F.C**., Introductory Microbiology (Bell and Howell Company, London)
5. **Dubey, R.C**.(2013) Microbiology, S.chand Co., New Delhi.
6. **Anil K.Sharma . (2019) Immunology: An IntroductoryTextbook. 1st Edition. Jenny Stanford Publishing. ISBN: 9789814774512**

7. **David P**. Stites, Abba I. Terr, Basic & Clinical immunology 8th edition, a Lange medical book publishers
8. **Ivan Roitt**,2011. Essential immunology. 8th edition Wiley-Blackwell scienceLtd..

Web Resources:

https://www.pdfdrive.com/biochemistry-genetics-molecular-biology-d18198970.html

https://www.pdfdrive.com/molecular-cell-biology-molecular-cell-biology-d7302545.html

https://www.pdfdrive.com/cell-biology-d33458612.html

https://www.pdfdrive.com/biochemistry-genetics-molecular-biology-d18198970.html

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Understand an overview of the microbial world, its structure and function
CO 2:	Students have intensive and in-depth learning in culture techniques and familiarize the learner with the applied aspects of microbiology
CO 3:	Student will be able to identify the cellular and molecular basis of immune responsiveness
CO 4:	Learners understand immunology is the branch of biomedical science that deal with immune system in both health and diseases
CO 5:	Job offer: Epidemiologist, Pathology Assistant, Teacher, Veterinarian Associate, Medical and clinical Laboratory Technologists.

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	S	S	S	S	M	S

S - Strongly Correlated
M - Moderately Correlated
W-Weakly Correlated
N – No Correlation

Semester-I / **Elective Course I**	**EC -I –AQUACULTURE**	Course Code:
Instruction Hours: 6	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	• 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

UNITS	**CONTENT**	**HOURS**
I	Importance of aquaculture- Present status, prospects and scope in India. Freshwater aquaculture- Brackish water aquaculture- Mariculture - Metahaline culture in India. Types of fish culture -Types of fish ponds for culture practice. Topography, site selection - water quality - soil condition and quality – structure and construction design and layout - Inlet and outlet. Water quality management for aquaculture. Control of parasites, predators and weeds in culture ponds. Fish farm implements - Secchi disc - aerator - pH meter - tools for hypophysation - feeding trays – Fishing gears used in aqua farming.	18
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. Classification of fish feed- Artificial feeds Types, Feed - formulation - feeding methods. Live feed- Microalgae, Rotifer, Artemia and their culture.	18
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 - Biofloc technology - Culture operations (water quality, feed and health management) -	18

	harvesting, preservation and marketing. Brackish water fish culture. Edible and Pearl oyster culture - pearl production. Crab culture. Economic importance of Lobster, Sea urchin and Sea cucumber - their by-products. Types of Seaweeds - species and methods of culture – by-products	
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.	18
V	Types of ornamental fishes (freshwater and marine), their breeding behavior and biology. Oviparous, Ovo-viviparous and Viviparous fishes. Setting and maintenance of freshwater Aquarium tanks. Central aquaculture research organizations- CMFRI, CIBA, CIFT, CIFA, CIFE, MPEDA and its activities.	18

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.
3. Sinha, V.R. P. and Srinivastava, H. C. (1991). Aquaculture Productivity. Oxford and IBH Publications CO., Ltd., New Delhi.
4. Yadav, B. N. (1997). Fish and fisheries.Daya Publishing house, New Delhi.

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.

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

Semester-I / **Elective Course I**	**EC -I –- AQUARIUM KEEPING**	Course Code:
Instruction Hours: 6	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 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-II/ Core Course-IV	Title of the Course **CC IV** **ANIMAL PHYSIOLOGY**	Course Code:

Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• To understand the basics in physiology • To know the physiology of different organs • To gain knowledge about hormones and their feedback mechanism • Learn role of receptors in man • Understand the biological rhythm and biological clock	
UNITS	**CONTENT**	**HOURS**
Unit I	Homeostatic mechanism - Osmo and Ionic regulations in Fishes; Temperature and pH regulations in animals; Acclimatization to high altitudes; Hydrostatic pressure; Buoyancy, Nutrition – Nutritional requirements, types, essential, aminoacids, and fatty acids – vitamins and their role. Respiration – Respiratory pigments and their functions. Exchange of gases – transport of O2 and CO2 – regulatory mechanisms; Haemoglobin – Chemistry – structure – Respiratory quotient-neural and chemical regulation of respiration.	18
Unit II	Circulation – Heart,-Functions of Heart, heart beat, cardiac rhythm and regulation; Blood coagulation; Types of transport mechanisms, blood pressure, ECG; Excretion – Excretion in relation to different habitats – Detoxification pathways of Ammonia, Urea, and Uric acid formation, Vertebrate Nephron –	18
	Mechanisms of urine formation and Acid base balance. Nervous system - Neurons,- Nerve impulse action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture.	

Unit III	Chemistry of muscular contraction, Photoreceptor – Vertebrate eye, photo chemistry, visual information and adaptations of eye. Phonoreceptor – Vertebrate ear, physiology of hearing; Electric organs, Bioluminescence – chemistry and control; Chronobiology –Biological rhythm and biological clock.	18
Unit IV	Endocrine glands in vertebrates and feedback system in endocrine regulation of vertebrates. Pituitary gland (Adenohypophysis , Pars Intermedia and Neurohypophysis) - Characteristics, structural organization , biosynthesis, regulation and functions of hormones .Hypothalamic regulation for release of pituitary hormones. Pineal gland -hormones and their role in photoperiodic response in vertebrates. Thyroid gland -- characteristics, structural organization, synthesis and functions of hormones. Parathyroid gland- structure, synthesis and functions of hormones.	18
Unit V	Pancreas -Structure **,** hormones and their functions. Adrenal gland- Structural organizations, biosynthesis and functions of cortical and medullary hormones Gonadial gland- Structure of mammalian testis and ovary - male and female sex accessory organs - hormones of testis and ovary - estrous and menstrual cycle - hormones of pregnancy - parturition - hormonal control of lactation.	18

Text Book:

1. Arumurugam, N., Animal Physiology, Saras Publication-kanyakumari.
2. Verma, P.S., Tyagi, B.S, and Agarwal, Animal physiology, Saras Publication, S.Chand and Co., New Delhi.

Reference Books:

1. Prosser C.L, Brown, F.A. 1965. Comparative Animal physiology W.B.SandersCompany London.
2. Nagabhushnam. R, Kodarkar. M.S., and Sarojini,R. 1983. Text book of Animal Physiology, Oxford& IBH publishing co. New Delhi.
3. Bykov . K.M., 1960. Text book of physiology . Foreign languages publishing house , Moscow.
4. Hurkat, P.., Mathur. C., A book of Animal physiology. S.Chand & co (PVT) Ltd., Ram Nagar New Delhi
5. Hoar, S.W., 1978. General and Comparactive Physiology, Prentice Hall, London,

New York.
6. Malcolm.S.Gordon – Animal Physiology – principles and Adaptations- Macmillan Publishing co.
Inc _ Newyork..
1. Haris, G.W. and B.T. Donovan. 1968. The Pituitory Gland. S. Chand and Co.,
1. Bentley, P.J. 1985. Comparative vertebrate endocrinology, Second Edition, Cambridge University Press. Cambridge.
2. Mac Hadley. 1992. Endocrinology, 3rd Edition. Prentice – Hall Inc. A Simon & Schuster Company, Englewood Cliffs, New Jersey. USA.
3. Ingleton, P.M. and J.T. Bangara. 1986. Fundamentals of comparative vertebrate endocrinology, Kluwer Academic Publishers
4. Turner, C.D. and J.T. Bangara. 1986. General endocrinology. Saunders International Student edition. Toppan Company Limited. Tokyo.
5. Prakash S Lohar Endocrinology, Hormones and Human Health.
6. Ashoke Kumar Boral – Mammalian endocrinology – New central Book Agency(P) ltd – London.
7. Rao.C.V. A Text book of Immunology Narosa Publishing house – Chennai.
8. Peter Wood – Understanding Immunology – Pearson Education ltd – Chennai.

Web Resources:

1.https://nptel.ac.in/courses/102/104/102104042/
2.http://unaab.edu.ng/funaab-ocw/index.php/animal-physiology-67467/lecture-notes-73565
3.http://www.sci.utah.edu/~macleod/bioen/be6000/notes/L01-intro.pdf

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Have enhanced knowledge of mammalian physiology
CO 2:	Understand the function of physiological systems such as respiratory, circulatory and metabolic system.
CO 3:	Understand the physiological response to that environment.
CO 4:	Able to analyze and report on experiments in physiology
CO 5:	Understand the endocrine organs structure and functions.

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	S	M	M
CO5	S	S	S	M	M	S	S	S	M	M

S – Strongly Correlated

M – Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-II / Course Course - V	Title of the Course **CC- V – WILDLIFE BIOLOGY**	Course Code:
Instruction Hours: 6	Credits: 4	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

:**Cognitiv eLevel**	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• To study about wildlife biologists and zoologists. • To understand research & development, carry out in wildlife management. • To know the conservation plans that combat these threats, and protect our natural resources. • Understand the importance of wildlife censes • Know the wild life protection Act And its importance	
UNITS	**CONTENT**	**HOURS**
Unit I	Definition of wildlife: Causes of wildlife depletion- need for wildlife conservation – IUCN Categories – endangered species of birds and mammals in India.	18
Unit II	Wildlife sanctuaries, National park and Biosphere reserves – Definition and importance. Sanctuaries: Vedanthangal Bird sanctuary – Mudumalai Wildlife Sanctuary – Point Calimere Wildlife Sanctuary. National parks: Corbett National Park, Guindy National Park, Biosphere reserves – Gulf of Mannar	18
Unit III	Importance of Wildlife Censes – Censes Techniques: Direct methods –Line Transect Method –Block count method. Indirect Method: Pugmark techniques and pellet methods.	18
Unit IV	Zoos and their Importance – types of enclosures – food and	18

	feeding of Zoo animals – Veterinary care of Zoo animals – Zoo education. Case study of Aringar Anna Zoological Park.	
Unit V	Wildlife (Protection) Act 1972: Introduction – Schedule – Declaration of Wildlife Sanctuary and National parks. Human wildlife conflicts with reference to Elephant.	18

Text Book:

1. **Saharia.V.B** 1982 Wildlife in India, Nataraj Publishers, Dehradum.
2. **Goutam Kumar Saha and Subhendu Mazumdar**- Wildlife Biology: An Indian Perspective

Reference Books:

3. **Dasman.R.F** 1964 Wildlife Biology, Jhon and Wildy and sons New York. Pp231
4. **Giles R.H.J** (Ed) 1984 Wildlife Management Techniques 3rd Edition. The Wildlife Society, Washington, D.C. Natraj Publishers, Dehradum, India.
5. **Sesharri.B** 1986 India's Wildlife reserves, Sterling Pup'rs pvt Ltd,. New Delhi.
6. A. R. E. Sinclair, Graeme James Caughley, and John M. Fryxell
7. John M. Fryxell, A. R. E. Sinclair and Graeme James Caughley
8. **Anthony R.E.. Sinclair, John M. Fryxell, Graeme Caughley**. – 2nd ed. p. cm. Rev. ed

Web Resources:

1. http://www.jnkvv.org/PDF/06042020101735WILDLIFE%20BIOLOGY.pdf
2. https://www.slideshare.net/Bikramsingh106/conservation-biology-note-pdf
3. https://rajusbiology.com/biodiversity-and-conservation-notes-pdf/

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Have enhanced knowledge of mammalian physiology
CO 2:	Understand the endangered species of birds and mammals in India.

CO 3:	Understand the National park and Biosphere reserves – Definition and importance
CO 4:	Able to analyze and report on experiments in biology
CO 5:	Understand the Wildlife (Protection) Act 1972:

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	S	M	M
CO5	S	S	S	M	M	S	S	S	M	M

S – Strongly Correlated

M – Moderately

CorrelatedW-Weakly

Correlated

N – No Correlation

Semester-II / Core Course -VI	Title of the Course **CP - VI Practical II**	Course Code:
Instruction Hours: 6	Credits: 4	Exam Hours: 3
Internal Marks -40	External Marks-60	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
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 Temperatureand pH. 4. Identification of Nitrogenous waste products 5. Enumeration of RBCs/WBCs by haemocytometer	18
Unit II	**Spotters:** 1. Haemoglobinometer, 2. Kymograph, 3. Sphygmomanometer. 4. Models of Amino acids, Haemoglobin, ATP, Steroids. 5. Muscles: Cardiac muscle, Striated muscle, Non striated muscle	
Unit III	Insect ecology, Environment and Its Components, Systamatics, Taxonomy of any 5 insects	18

Unit IV	Recent method of pest control, repellents, antifeeds. Application techniques of formulation of insecticide. , honey bee care and management of bee hive.	18
Unit V	Identification of Wildlife conservation and bird census , Case study of A Zoological Park. Censes Techniques:–Block count method.Pugmark techniques and pellet methods.	18

Text Book:

1. **Giles R.H.J** (Ed) 1984 Wildlife Management Techniques 3rd Edition. The Wildlife Society, Washington, D.C. Natraj Publishers, Dehradum, India.
2. **Sesharri.B** 1986 India's Wildlife reserves, Sterling Pup'rs pvt Ltd,. New Delhi.

Reference Books:

2. Daly, H.V., J.T. Doyen and P.R. Ehrlich. 1978. Introduction to Insect Biology and Diversity. Mc Graw-Hill Kogakusha Ltd., Tokyo, pp-564.
3. Hill, D.S. 1974. Agricultural Insect Pests of the Tropics and Their Control. Cambridge University Press, New York, pp-746.
4. Krishnaswami, S. 1973. Sericulture Manual, Vol. I & II, Silkworm rearing, FAO Agricultural Science Bulletin, Rome.
5. Mani, M.S. 1982. General Entomology. Oxoford & IBH Publishing Co., pp-912.

Wigglesworth, V.B. 1972. The Principles of Insect Physiology, ELBS & Chapman and Hall, London, pp-827.

Web Resources:

1. .https://nptel.ac.in/courses/102/104/102104042
2.http://www.sci.utah.edu/~macleod/bioen/be6000/notes/L01-intro.pdf
.https://www.cusb.ac.in/images/cusb-files/2020/el/cbs/MCCOM2003C04%20(Business%20Research%20Methods)Research_Methodology_C_R_Kothari.pdf
4..https://prog.lmu.edu.ng/colleges_CMS/document/books/EIE%20510%20LECTURE%20NOTES%20first.pdf

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Have enhanced knowledge of mammalian physiology

CO 2:	Understand the endangered species of birds and mammals in India.
CO 3:	Understand the National park and Biosphere reserves – Definition and importance
CO 4:	Able to analyze and report on experiments in biology
CO 5:	Understand the Wildlife (Protection) Act 1972:

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 Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester -II / **Core Choice Course II**	Title of the Course **CCC II - ECONOMIC ENTOMOLOGY**	Course Code:
Instruction Hours: 6	Credits: 4	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create
Course Objectives	• Students should acquire a fairly good understanding about the life of insects and their classification.
	• To study the Beneficial insects
	• To learn about Biology of the insect pests
	• To know about the Development and uses of pest resistant plant varieties
	• Students should know basic concepts of Vector biology

UNITS	CONTENT	HOURS
I	Overview of insects and insect taxonomy: Insects and their biologicalsuccess - Man and insects; Basic concepts in Insect Taxonomy and classification.	12
II	Beneficial insects: Silkworms - types, life history, disease management and rearing methods - Types of honey bees, life history, social organization (colonies and caste system), honey bee care and management of bee hive - Lac insects-life history, lac cultivation; Pollinators, predators, parasitoids, scavengers, weed killers, soil-builders.	12
III	Destructive insects: Insect pests - definition - Categories of pests - Types ofdamage to plants by insects - Causes of pest outbreak - Economic threshold level - Biology of the insect pests - Pests of paddy, cotton, sugarcane,vegetables, coconut and stored grains cereals.	12
IV	Pest management/Control strategies: Methods and principles of pest control - Natural control, Artificial control, Merits and demerits or limitations ofthese methods in pest control - Development and uses of pest resistant plant varieties - Integrated pest management - Concepts and practice.	12
V	Vector biology: Vectors of veterinary and public health importance - Mosquitoes as potential vectors of human diseases-control measures	12

Text Book:

1. Ayyar, L.V. R. 1936. Hand book of Economic Entomology for South India. Narendra Publishing House. New Delhi, pp- 528.
2. Vasantharaj David, B. and V.V. Ramamurthy. 2016. Elements of Economic Entomology, Eighth Edition, Brillion Publishing, New York, pp-400.

Reference Books:

1. Chapman, R.F., S.J. Simpsonand A.E.Douglas. 2012. The Insects: Structure and Function, Fifth Edition, Cambridge University Press, pp-959.
2. Imms, A.D., O.W.Richards and R.G. Davies (Eds.) IMMS' General Textbook of Entomology, Volume I: Structure, Physiology and Development, pp-418; Volume 2: Classification and Biology, pp-934, Springer Netherlands.
3. Daly, H.V., J.T. Doyen and P.R. Ehrlich. 1978. Introduction to Insect Biology and Diversity. Mc Graw-Hill Kogakusha Ltd., Tokyo, pp-564.
4. Hill, D.S. 1974. Agricultural Insect Pests of the Tropics and Their Control. Cambridge University Press, New York, pp-746.
5. Krishnaswami, S. 1973. Sericulture Manual, Vol. I & II, Silkworm rearing, FAO Agricultural Science Bulletin, Rome.

Course Outcome

On the successful completion of the course, student will be able to

CO : 1	Understand taxonomy, classification and life of insects in the animal kingdom.
CO : 2	Know the life cycle, rearing and management of diseases of beneficial insects.
CO : 3	Know the type of harmful insects, life cycle, damage potential and management of pests including natural pest control
CO : 4	Recognize insects which act as vectors causing diseases in animals and human.
CO : 5	Overall understanding on the importance of insects in human life.

Mapping of Cos with Pos & PSOs

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

S- Strongly correlating, M-Moderately Correlating W-Weakly Correlating

N-No Correlation

Semester-II / **Elective Course II**	Title of the Course **EC II -DAIRY FARMING**	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	• 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 heifer.	6
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. Chantalakhana, C. and Skunmun, P. (2002). Sustainable Smallholder Animal Systems in the Tropics. Kasetsart University Press, Bangkok.
2. Cook, B.G., Pengelly, B.C., Brown, S.D., Donnelly, J.L., Eagles, D.A., Franco, M.A., Hanson, J., Mullen, B.F., Partridge, I.J., Peters, M. and Schultze-Kraft, R. (2005)

Reference Books:

1. 15. James. N. Marner, 1975. Principles of dairy processing, wiley easternlimited, New Delhi.
2. Baradach, JE. Ryther. JH. and, MC larney WO., 1972. Aquaculture. Thefarming 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 CorrelatingW-Weakly Correlating
N-No Correlation

Semester-II / **Elective Course II**	Title of the Course **EC II - BIOINSTRUMENTATION**	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. 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-II / Skill Enhancement Course-I	Title of the Course **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	
UNITS	**CONTENT**	**HOURS**
Unit I	**History and Scope of Bee keeping**:Systematics - Species diversity - Types of Honeybees in India; Biology and life-history.	**6 Hours**
Unit II	**Honey bee colony** :Caste polymorphism, Bee keeping equipments-Newton's Bee hive. Honey extracting equipments - Honey extracter, Smoker, Queen excluder, Drone. Excluder and Bee veil.	**6 Hours**
Unit III	**Apiary Management**: Selection of Apiary site - Supplementary feeding in dearth season - Protective measures against Bee predators - Economics of Bee keeping - Cost benefit analysis – Promotional Institution for Apiculture.	**6 Hours**
Unit IV	**Bee products**: Bee Products and benefits - Honey - Chemical nature and use. Bee wax, propolis, Royal Jelly, Bee Pollen, Bee pollination and advantages.	**6 Hours**
Unit V	**Honey bee diseases**: Protozoan- Mites - Viral-causes and control.	**6 Hours**

Text Book:

1. NAGARAJA.N&RAJAGOPAL.D–Honey Bees, Disease, Parasites, Pests, Predators and their Management – MJP Publishers – Chennai
2. RARE, S. 1988 – Introduction to Bee keeping, Vikas Publishing house
3. MAHINDRU.S.N – BeeKeeping – APH Publishing Corporation – New Delhi.

Reference Books:

1. SINGH, S. 1992 – Bee Keeping – ICA
2. SHARMA, P. and SINGH, L. 1987 – Hand book of Bee keeping, controller printing and stationery, Chandigar.
3. .RARE, S. 1988 – Introduction to Bee keeping, Vikas Publishing house.
4. SHUKLA, G.S. and UPADHYAY V.B (1997) Economics zoology, RastogiPublication, Meerut.
5. MORSE, R.A. 1990. The ABC and XYZ of Bee culture 40th edition A.1 Root & co., Ohio.
6. MANJU YADAV – Economic zoology – Discovery Publishing house – New Delhi.
7. RAVINDRANATHAN K.R. – A Text book of Economic Zoology.
8. SATHE T.V. – Fundamentals of Bee Keeping –Daya Publishing House – Delhi.

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 well the theoretical aspects taught besides learning techniques for gathering data in the field .
CO 4:	Be aware of a broad array of career options and activities in human medicine,
CO 5:	Analyses a biological problem, derive testable hypotheses and then design experiments and put the tests into practice

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	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

E-resources

1. https://agritech.tnau.ac.in/farm_enterprises/fe_api_careandmanagement.html

2.https://blog.superbeehoney.com/apiary-management-placement-inspection-provision-of-fresh-water-of-colonies-in-apiary-and-care-in-migration/

Semester-III / Core Course-VII	Title of the Course **CC VII- DEVELOPMENTAL BIOLOGY**	Course Code:
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives :	1. To introduce the concepts and process in developmental biology 2. To understand the genetic mechanisms and the unfolding of the same during development 3. To expose the learner to the new developments in embryology and its relevance to Man. 4. To study the cell differentiation and tissue interactions in organ development 5. To know the health care and advanced technology in fertilization	
UNIT	CONTENT	HOURS
Unit I	Gametogenesis – Spermatogenesis – Cells in seminiferous tubules, spermiogenesis, structure and types of sperm Egg**:** Origin of egg - growth of oocyte - synthesis and accumulation of macromolecules in the oocyte – vitellogenesis -nuclear activities during oocytes growth. Hormonal and nervous control of ovulation Egg as a developmental system**:** Organization of egg, cytoplasm before and after fertilization - polarity and symmetry of egg. Egg cortex**:** Nature and role in amphibian development.	18
Unit II	Fertilization: Bio-chemical aspects of egg activation - molecular event fertilization. Polyspermy. Fertilization : Events of fertilization- acrosome reaction in sperm – cortical reaction in egg - recognition of egg and sperm, physiological changes infertilization, theories of fertilization.	18
Unit III	Cleavage :Plan and Patterns - Chemical changes - role of nucleus and cytoplasm in cleavage - totipotency - Nuclear transplantation –	18

	nuclear clones.Mechanisms and significance of Blastulation and Gastrulation, Morphogenetic movements**:** selective affinity of cells - metabolism and gene activity during gastrulation.formation of germ layers in animals; embryogenesis.	
Unit IV	Organizer concept:Primary and secondary organizers - nature of induction - mechanism - gradients in the determination. Tissue interactions: Lens development. Cell differentiation **:** Chemical and cellular factors-differential gene activity. Ageing and alteration in developmental potentials**:** Gene regulation of aging. Scenescence.	**18**
Unit V	Precaution and health care during pregnancy and gestation. Impotency: Causes of Impotency and sterility male and infertility in female – Concept of test-tube baby - Artificial Insemination in humans - In Vitro Fertilization (IVF) and Gamete-Intra-Fallopian Transfer (GIFT) – Advantages and disadvantages. Teratogenesis- Developmental Mechanism of teratogenesis. Contributions of teratology to Developmental biology. Teratogens and induced birth defects.	18

Text Book:

1. Verma and Agarwal (2006) Developmental Biology
2. Veera Bala Rastogi, M.S.Jayaraj – Developmental Biology – Kedar Nath, Ram Nath

Reference Books:

1. Balinsky, B.I. 1975. An Introduction to Embryology. Saunders, Philadelphia.
2. Beril, N.J. 1974. Developmental Biology. Tata McGraw –Hill Publishing Company Ltd. New Delhi.
3. Ebert, J.D., 1966. Interacting systems in Development. Holt, Rinehart and Winston, New York.
4. McEwen, R.S. 1969. Vertebrate Embryology. Oxford & IBH Publishing Co., New Delhi.
5. Nelson, O.E. 1953. Comparative Embryology of the Vertebrates. The Blackston Company, New York.
6. Patten, B..M. 1958. Foundations of Embryology. McGraw – Hill Book Company Inc., New York.
7. Waddington, C.H. Principles of Development and Differentiation. The Mac Millan Company, New York.

8.. Twyman,R.M.-Developmental Biology – Viva Books pvt., New Delhi, Chennai,Mumbai.

Web – Resources:

https://www.khanacademy.org/science/biology/developmental-biology
https://plato.stanford.edu/entries/biology-developmental/
https://www.ncbi.nlm.nih.gov/books/NBK9983/
https://biology.duke.edu/research/developmental-biology

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Understand the concepts and process in developmental biology
CO 2:	Understand the genetic mechanisms and the unfolding of the same during development
CO 3:	Expose the learner to the new developments in embryology and its relevance to Man
CO 4:	Job offer: IVF laboratory, Embryologists in O&G department in Medical College and Research
CO 5:	Centre, Research Assistant in Veterinari College and Research centre. Animal care taker

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	M	S	S
CO2	S	M	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	M	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 Correlated

M – Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-III / Core Course- VIII	**CC VIII -EVOLUTION**	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	• 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.	
	• This course helps to understand the important processes, principles, and concepts on evolution.	
	• To provide adequate information on the Lamarckism - Neo Lamarckism – Darwinism, Neutral Theory of Molecular Evolution, and Human Genome Project.	
	• 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.	
	• 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	**CONTENT**	**HOURS**
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.	15
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.	15
III	Isolating mechanisms - Modes of speciation-Hybridization is an evolutionary catalyst- Law of Adaptive Radiation- Adaptive	15

	radiation in reptiles and mammals - Convergence and parallelism - Evolutionary constancy.	
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.	15
V	Natural selection in action in man- level of selection- Eugenics, Euphenics and Euthenics- Adaptation- Human Genome Project – Evolution and ethics.	15

Text Books

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

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

3.Minkoff, E. C. (1983). Evolutionary biology. Reading, MA: Addison-Wesley Publishing Company

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.

Resources

https://bit.ly/3nPD09m

https://bit.ly/3CHOdgL

https://bit.ly/2XvcCXl

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-III / Core Couse -IX	Title of the Course **CP - IX Practical III (CC V & CC VI)**	Course Code:
Instruction Hours: 6	Credits: 4	Exam Hours: 3
Internal Marks -40	External Marks-60	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Unit I	**Developmental Biology** 1. Preparation of sperm suspension in frog/bull and observation of the spermatozoa. 2. Observation of live spermatozoa and study of rate of motility of sperm in frog /bull semen. 3.Vaginal smear preparation in rat / mouse to study the stages of oestrous cycle.	18
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..	
Unit III	**Evolution** Spotters: stick insect, leaf insect, fossil records, Archaeopteryx,.. Chameleon Hippocampus, Pepper moth	18
Unit IV	Mimicry: Monarch and Viceroy butterfly. Quantum evolution; Bat, Pteropus. Student activity: observation on the locomotion of earthworm in different places and has to submit a case study report	18

		18
Unit V	**Research Methodology** Primary data collection and submission Secondary data collection and submission Document preparation and submission (topic selection is own interest)	18

Text Book:

1. Verma and Agarwal Developmental Biology, (2006)
2. Veera Bala Rastogi, M.S.Jayaraj – Developmental Biology – Kedar Nath, Ram Nath.

Reference Books:

2. KOTHARI,C.R.2006. Research Methodology & Research Techniques .New Age Int.Pub.
3. SUNDAR RAO,P.S.S & J.RICHARD.2006.Introduction to Biostatistics and Research Methods(4^{th}) .Prentice Hall,New Delhi.

Web Resources:

1. .https://nptel.ac.in/courses/102/104/102104042
2.http://www.sci.utah.edu/~macleod/bioen/be6000/notes/L01-intro.pdf
.https://www.cusb.ac.in/images/cusb-files/2020/el/cbs/MCCOM2003C04%20(Business%20Research%20Methods)Research_Methodology_C_R_Kothari.pdf
4..https://prog.lmu.edu.ng/colleges_CMS/document/books/EIE%20510%20LECTURE%20NOTES%20first.pdf
5.https://www.researchgate.net/publication/329736173_Research_Methodology_Msc_notes_of_Dr_Judu_illavarasusvyasa_univhttps://faculty.franklin.uga.edu/dhall/sites/faculty.franklin.uga.edu.dhall/files/lec1.pdf

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Understand the concept and principle of quantitative analysis of

	physiological enzymes.
CO 2:	Learn the estimation method of protein and metabolic activity of fish
CO 3:	Hands on training in preparation of histological slide.
CO 4:	Develop skill in problem solving related to biological sample data
CO 5:	Efficient with big data analysis software package-SPSS.

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 Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-III / Core Choice Courses -III	**CCC III- RESEARCH METHODOLOGY**	Course Code :
Instruction Hours: 6	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	• Students understand the basic principle, methodology and applications of widely used instruments in biological sciences.
	• To learn the working mechanism of instruments
	• To study the Principles and Applications of various techniques
	• Basic concepts of research
	• Components of a thesis writing

UNITS	CONTENT	HOURS
I	Good laboratory practice (GLP) - pH, Electrodes and pH meter - Colorimeter and Spectrophotometry. Histology, Histochemistry, Bioinformatics and Electron microscopy	12
II	Light Microscopy, Bright field, Phase contrast, DIC & Fluorescence microscopy, wide field and Confocal microscopy.	12
III	Centrifuges, Chromatography, Electrophoresis, ELISA and blotting. Principles and Applications of tracer techniques in biology, Animal cell culture techniques.	12
IV	Basic concepts of research – Meaning, Objectives, Motivationand Approaches. Types of Research – Descriptive / Analytical, Applied/ Fundamentals, Quantitative/Quantitative, Conceptual/Empirical. Research Methods versus Methodology, Research and scientific method.	12
V	Importance of literature reviewing in defining a problem, Critical literature review, Identifying gap areas from literature review. Hypothesis – Null and Alternate Hypothesis and testing of hypothesis. Components of a dissertation writing - Introduction, material and methods, presenting the results, writing the discussion, citing the references, tables and figures, bibliography.	12

Text Books

1. Pearse, A.G. 1968. Histochemistry: Theoretical and Applied, Vol. I, Third Edition, J & A Churchill Ltd, pp-758.
2. Lillie, R.D. 1954. Histopathologic Technic and Practical Histochemistry, Second Edition, Blakiston, New York, pp-715.

References Books

1. Engelbert, B. 1960. Radioactive Isotopes in Biochemistry, Elsevier Applied Science, pp-376.
2. Wolf, G. 1964. Isotopes in Biology, Academic Press, pp-173.
3. Srivastava, B. B. 2005. Fundamentals of Nuclear Physics, Rastogi Publications, pp-500.
4. Pantin, C. F. A. 1948. Microscopical Techniques, Cambridge University Press, London.
5. P.RAMADASS & A.WILLSON ARUNI,2009. Research and writing. MJP Pub.Chennai.
6. Hoppert, M. 2003. Microscopic Techniques in Biotechnology, Wiley-VCH GmbH, Weinheim, Germany, pp-330.

Course Outcome

On the successful completion of the course, student will be able to

CO : 1	Understand the implications of GLP
CO : 2	Learn the working principles of different instruments
CO : 3	Gain the knowledge on techniques of histology and histochemistry
CO : 4	Acquire knowledge on the basic principle and application of various modules of light and electron microscopy
CO : 5	Study about the hypothesis

Mapping of Cos with Pos & PSOs

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

S- Strongly correlating

M-Moderately Correlating

W-Weakly Correlating

N-No Correlation

Semester-III/ Industrial Based Course	Title of the Course **IBC -ANIMAL BIOTECHNOLOGY**	Course Code:
Instruction Hours: 4	Credits: 4	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	1. To give an intensive and in-depth learning in the field of biotechnology 2. To understand the modern biotechnology practices and approaches with an emphasis in 3. technology application, medical, industrial, environmental and agricultural areas 4. To familiarize the students with public policy, biosafety, and intellectual property rights issues 5. To understand the commercial protection of organic compound using microbes. 6. To learn the process of bioremediation.	
UNITS	**CONTENT**	**HOURS**
Unit I	Hybridoma technology: Production and Application of monoclonal and polyclonal antibodies – Gene Therapy — Cell bank – Animal bioreactor and molecular pharming. Transgenic animals – transgenic animal model development – Transgenic mouse – embryonic stem cell method and pronucleus method – Transgenic fish and sheep. Bioethics in animal genetic engineering.	**18**
Unit II	Agricultural Biotechnology: Genetically Modified Microorganisms – Phytoremediation. Bacterial Biofertilizers –Rhizobium, Acetobacter, Azospirillum inoculants –Nitrogen fixing,Phosphate	**18**

	solubilizing, Mobilizing- VAM fungi. Green manuring – Cyanobacterial inoculants –Azolla, Anabaena. Benefits of biofertilizers – Biopesticides in pest management.	
Unit III	Industrial and Microbial Biotechnology – Fermentation technology: Fermentors, Selection of microbes, Fermentation medium – Production of Penicillin, Vitamin B^{12}, Amino acids and Proteases – Production of organic compounds by microbial fermentation – Ethanol and acetone production - Antibiotics – microbes used – commercial production of antibiotics – Single Cell Protein (SCP) production and their advantages- Spirulina.	18
Unit IV	Medical Biotechnology – Applications of r-DNA technology in human health Recombinant DNA proteins and their uses: i) Interferon, ii) Interleukin, iii) Factor VIII, iv) Urokinase and v) Tissue plasminogen activator – Recombinant vaccines: Hepatitis-B, Rabbies and FMD Vaccine – Commercial production of penicillin – DNA finger printing and its use in Forensic science .	**18**
Unit V	Environmental Biotechnology – Bioremediation – *In-situ*, and *Ex-situ.* Bioremediation of Xenobiotics- dyes, havy metals, coal waste through VAM fungi, Effluent treatment using genetically modified microbes. Intellectual Property Rights–copy right, trade marks, patents, industrial design rights and trade secrets.	**18**

Text Book:

1. Abbasi (SA) Ramasami E(1999), Biotechnology methods of pollution control.
2. Bahadur (Bir),ED , Essential of biology & biotechnology
3. Dubey, R.C (2014) A text book of biotechnology. S. Chand and Company, New Delhi.

Reference Books:

1. Bains, W. (1998). Biotechnolgy from A to Z. Oxford University Press, Oxford.

2. Dubey, R.C. (2014). Text book of Biotechnology, S.Chand & Company Ltd. Ram agar, New Delhi

3. Lydell Norris,(2016),Text Book of Biotechnology. Publisher – Syrawood Publishing

4. Ranga, M.M. (1999). Animal Biotechnolgy. Agrobios (India) Jodhpur.

5.Trevan, M.D, Boffery, S. Goulding, K.H. &Stanbury, P. (1984). Biotechnology: The BiologicalPrinciples. Tata McGraw Hill Publishing company Limited, New Delhi.

6..Wiley,(2017), A Text Book of Biotechnology. Editor H.K.Das.

Web Resources:

1. https://appliedbiotechnology.wisconsin.edu/what-is-applied-biotechnology/
2. https://iubmb.onlinelibrary.wiley.com/journal/14708744
3. https://fbns.ncsu.edu//extension_program/documents/biotech_applications.pdf

Course Outcomes:
On completion of the course the learner will be able

CO 1:	Understand advance technique and its application in the field of biotechnology
CO 2:	Understand the modern biotechnology practices and approaches with an emphasis in
CO 3:	technology application, medical, industrial, environmental and agricultural areas
CO 4:	Familiarize the students with public policy, biosafety, and intellectual property rights issues
CO 5:	Job offer: BCG vaccine Laboratory Chennai. Pasteur Institute Ooty, Clinical laboratory, Medical Research Centre, IVF laboratory, Research Assistant/ JRF/SRF/ in the Research Institute of ICAR, ICMRE, VCRC, TIFR, CCMB, Fisheries University and Research centre

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	M	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	S

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

Semester-III / **Skill Enhancement Course**	Title of the Course **SEC – II- POULTRY FARMING**	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 .
	• To learn the Systems of poultry farming
	• To know the Feed formulation and Methods of feeding
	• Study the symptoms, control and management;
	• Students should know basic Knowledge of Selection, care and handling of hatching eggs Poultry Farming.

UNITS	**CONTENT**	**HOURS**
I	General introduction to poultry farming - Definition of Poultry - Past and present scenario of poultry industry in India - Principles of poultry housing - Poultry houses - Systems of poultry farming	6
II	Management of chicks - growers and layers - Management of Broilers. - Preparation of project report for banking and insurance.	6
III	Poultry feed management-Principles of feeding, Nutrient requirements for different stages of layers and broilers - Feed formulation and Methods of feeding.	6
IV	Poultry diseases-viral, bacterial, fungal and parasitic (two each); symptoms, control and management; Vaccination programme.	6
V	Selection, care and handling of hatching eggs - Egg testing. Methods of hatching.- Brooding and rearing -. Sexing of chicks. - Farm and Water Hygiene - Recycling of poultry waste.	6
	Total	**30**

Text Book:

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

Books, New Delhi

Reference Books:

1. Hurd M. Louis, 2003. Modern Poultry Farming. 1st Edition. International Book Distributing Company, Lucknow."
2. Life and General Insurance Management"
3. Ismail, S.A., 1997. Vermitechnology, The biology of earthworms, Orient Longman, India.

Web Resources:

1. http://www.asci-india.com/BooksPDF/Small%20Poultry%20Farmer.pdf
2..https://nsdcindia.org/sites/default/files/MC_AGR-Q4306_Small-poultry-farmer-.pdf
3.. http://ecoursesonline.iasri.res.in/course/view.php?id=335

Course Outcome

Upon completion of this course, Students would have

	To understand the various practices in Poultry farming. To know the needs for Poultry farming and the status of India in global market.
	To be able to apply the techniques and practices needed or Poultry farming.
	To know the difficulties in Poultry farming and be able to propose plans against it.
	To understand the Poultry diseases
	To know the Recycling of poultry waste

Mapping of Cos with Pos & PSOs

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

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

Semester-IV / Core Course - X	**CC X- ENVIRONMENTAL 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	• To understand the structure and functions of the ecosystem.	
	• To explain the relationship between biotic and abiotic factors in an ecosystem.	
	• To know the causes and effects of climate change and habitat loss.	
	• To bring awareness about the impact of socio-economic development on the environment and the solutions put forward by the government to reduce environmental damage.	
	• To learn about the Biodiversity Conservation	
UNIT	**CONTENT**	**HOURS**
I	**Ecosystem** : Concept of an ecosystem-Structure and function of an ecosystem- Producers, consumers and decomposers-Energy flow in the ecosystem-Ecological succession-Food chains, food webs and ecological pyramids-Introduction, types, characteristic features, structure and function of the following ecosystem : Forest ecosystem-Grassland ecosystem-Desert ecosystem-Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).	12
II	**Population And Biological Cycles :** Structure and distribution – Growth curves - Groups, natality, Mortality -Density indices, Life study tables - factors affecting population growth -Carrying capacity. Population regulation and human population control. Complete and incomplete biogeochemical cycles - Sedimentary cycle.	12
III	**Environmental Stresses and Management** :Global climatic pattern, global warming, atmospheric ozone, acid and nitrogen deposition. Uptake, biotransformation, elimination and accumulation of toxicants. Factors influencing bioaccumulation from food and trophic transfer. Pesticides and other chemical in agriculture,	12

	industry and hygiene and their disposal. Bio indicator and biomarkers of environmental health. Biodegradation and bioremediation of chemicals.	
IV	**Environmental Pollution**: Definition- cause, effects and control measures of: -Air pollution - Water pollution -Soil pollution - Marine pollution - Noise pollution - Thermal pollution -Nuclear hazards.	12
V	: Biodiversity crisis – habitat degradation, poaching of wild life. - Socio economic and political causes of loss of biodiversity. - In situ and ex situ conservation of biodiversity -Hot spots of Biodiversity. Green peace movement - Chipko Movement - Role of government agencies: Central and State Pollution Control Boards - Ministry of Environment and Forests- National Biodiversity Authority. Awareness, Programme, NGOs, Natural Disaster Management, Legislations for environmental Protection, Bio villages – sustainable utilization and development, Environmental ethics.	12

Text Books

1. Matthew R. Fisher, 2018. Environmental Biology.Open Oregon Educational Resources. James Madison University.

2. Asthana, D.K. and Meera, A. 2009. A text book of environmental studies, S. Chand, New Delhi.

3. Sanyal, K. Kundu, M. and Rana, s. 2009. Ecology and environment, Books and allied, Kolkata

4. Grant, W.E. and Swannack, T.M., 2008, Ecological Modelling, Blackwell.

References Books

1. Saha, T.K. 2010. Ecology and Environmental biology, Books and Allied, Kolkata

2. Odum E.P.1983. Basic Ecology, Saunders, New York

3. Wilkinson, D.M., 2007, Fundamental Processes in Ecology: An Earth system Approach, Oxford University Press, UK.

Web Resources

https://bit.ly/2VYWOM5

https://bit.ly/2VZQFiT

https://bit.ly/3kqdXYA

Course Outcomes

On completion of this course, students will be able

CO1	Understand the fundamental structure and functions of the ecosystem.

CO2	Assess the inter-relationship between organisms and between biotic and abiotic factors in an ecosystem.
CO3	Analyze the factors that cause pollution, climate change, loss of biodiversity and depletion of resources.
CO4	Evaluate the impact of human population growth and socio-economic development on the structure and function of the ecosystem.
CO5	Design plans to scientifically solve environmental problems using biological tools, technologies and government policies.

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 / Core Course-XI	**Title of the Course CC–XI – GENETICS**	Course Code:
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives:	1. To give an in-depth understanding on the principles and mechanisms of inheritance 2. To help study the fine structure and molecular aspects of genetic material 3. To provide an opportunity to learn the importance of inheritance in Ma 4. To provide an understanding on the process and theories in evolutionary biology 5. To expose students to the basics and advances in Evolution	
UNIT	**CONTENT**	**HOURS**
Unit I	Principles of Mendelian inheritance; Interaction of genes; Multiple alleles; Polygenic inheritance; Linkage and crossing over; Gene mapping in drosophila; Somatic crossing over in Drosophila. Sex determination in animals; Sex-linked inheritance in man and Drosophila	**18**
Unit II	Eukaryotes –Fine structure of gene – Cistron, muton, recon, exon, intron, Mechanism of homologous recombination. Role of recombinase and chromosome mapping. Operon concept, regulatory mechanism in eukaryotes, attenuation and antitermination – Environmental regulation of gene expression	**18**

	Genes in populations – allelic and gene frequencies – implications of Hardy-Weinberg principle – Factors affecting Hardy-Weinberg equilibrium.	
Unit III	Gene mutations – Chromosomal and point mutations, spontaneous and inducible mutations, reversible and suppressor mutations. Mutagens – Physical, chemical and biological. Teratogens and induced birth defects. Nuclear transplantation – Cell fusion : homokaryons and heterokaryons – Cytoplasts and karyoplasts Extra-chromosomal inheritance with reference to mitochondrial DNA, plastids,kappa particles, plasmids, episomes and chloroplasts.	**18**
Unit IV	Inborn errors of metabolism: disorders of amino acid metabolism – PKU, alkaptonuria and albinism; disorders of purine metabolism – Lesh-Nhyan syndrome and ADA deficiency; disorders of carbohydrate metabolism – galactosemia and G_6PD deficiency; disorders of lipid metabolism – Tay Sach's diease and Gaucher's disease.Haemoglobin disorders – Sickle cell anemia and thalassemiaHuman Karyotype preparation and chromosomal syndromes in man – Down, Turner andKleinfelter syndromes.	**18**
Unit V	Genetic engineeringin Plant & Animal**,**Genetic counseling – Hereditary disorders :Aim- Purpose- Genetic Prognosis – Family history Preventive measures – High lights of genetic counseling. Pedigree analysis – Inbreeding and Outbreeding – significance, merits and demerits of inbreeding outbreeding.	**18**

Text Book:

S.Verma and **V.K.Agrawal**, Genetics(2000),S.Chand and company Ltd.,

2) **N. Arumugam**, genetics and Evolution, Saras publication

Reference Books:

Altenburg, E. 1970. Genetics. Oxford and IBH Publishing Company, New Delhi.

2. **Burns, G.W.** 1969. The Science of Genetics. The Mac Millan Co. New York.
3. Eldon John Garden et al.,(2006) Principles of Genetics, Published by Pearson Education India
4. **Gardener, E.J.** 1972. Principles of Genetics. John Wiley & Sons. Inc. New York.
5. **Levine, R. P**. 1968. Genetics. Holt, Rinehart and Winston Inc. New York.

6. **Lewin, B.** 1986. Genes. Wiley Eastern Ltd. New Delhi.
7. **Rothwell,** N. V. 1978. Human Genetics. Printice Hall of India.
8. **Sinnott, E.W. L.C. Dunn** and **T. Dobzhansky**. 1959. Principles of Genetics. Tata McGraw Hill, New Delhi.
9. William.S, Klug et al.,(2016) Genetics, Published by Pearson Education India
10. **Winchester, A.M**. 1967. Genetics, Oxford and IBH Pub. Co., New Delhi.

Web Resources:

https://www.pdfdrive.com/principles-of-genetics-d185210607.html

https://www.pdfdrive.com/biochemistry-genetics-molecular-biology-d18198970.html

Course Outcomes:

On completion of the course the learner will be able

CO 1:	Student will test and deepen their mastery of genetics by applying this knowledge in a variety of problem solving situations
CO 2:	Student learn the basic principles if inheritance at molecular level
CO 3:	Job offer: Technician in Karyotyping in Medical Research Centre
CO 4:	Research scientist in ICMR institutes
CO 5:	Research Assistant in Institute of Forest Genetics and Tree Breeding, Coimbatore

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	M	S	S	S	S	M

S - Strongly Correlated
M - Moderately Correlated
W-Weakly Correlated
N – No Correlation

Semester-IV / Core Course-XII	**Title of the Course CP- XII - Practical IV (CC VII &CC VIII)**	Course Code:
Instruction Hours: 6	Credits: 4	Exam Hours: 3
Internal Marks -40	External Marks-60	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
UNIT	**CONTENT**	**HOURS**
Course Objectives:	To learn the community structure and its functions Understand the habited ecology in different eco system Learn the advanced technical remote sensing and radar image analysis Understand the basic and modern concept of origin of life Understand the evolution process of population at molecular level	
Unit I	Report on ecological collection representing different habitats and their adaptations – sandy, muddy, rocky shores, Deep sea.	18
Unit II	Hydrological studies of water samples with special reference to pollution	18
Unit III	Water quality index (WQI) calculation using 9 parameters such as pH, Temperature, Turbidity, Conductivity, Total solids, Dissolved Oxygen, BOD, Nitrate and Phosphate.	18
Unit IV	Qualitative estimation of Marine & Freshwater plankton and Quantitative estimation of Marine & Freshwater plankton.	18
Unit V	Drosophila culture – Identifications of Normal, mutants & sexes Blood groups ABO & Rh their genetic significance. Pedigree analysis. Human karyotyping & Chromosomal abnormalities. Hardy Weinberg law & Calculation of gene frequencies for dominant, recessive & co-dominant traits and Multiple alleles.	18

Text Book:

1. BISWARUP MUKERJEE – Fundamentals of Environmental Biology –Silverline Publications – Allahabad.
2. AGARWAL – Environmental Biology – AgroBotanical Publishers (India)-New Delhi.

Reference Books:

1. ODUM, E.P. (1996) Fundamentals of Ecology (III Edn), Nataraj Publishers, Dehradun.
2. SHARMA, B.K. and KAUR, H. (1997). Environmental Chemistry, Goel Publishing House, Meerut..
3. TACCONI, L. (2000) . Biodiversity and Ecological Economics : Participation, Valuesand Resource Management. Earthscan Publications Ltd., London..
4. CASTRI, F.D. and YOUNES, T. (1996). Biodiversity : Science and Development. CAB Int., Wallingford, U.K.
5. CHAPMAN, J.L., and REISS, M.J. (1997). Ecology – Principles and Applications, CAMBRIDGE University Press, U.K.
6. CLARKE, G.L. (1963). Elements of Ecology, John Wiley and Sons, Inc., New York.
7. GHOSH, G.K. (1992). Environmental Pollution, Ashish Publishing house, New Delhi.
8. SHARMA, B.K. and KAUR, H. (1997). An Introduction to Environmental pollution, Goel Publishing House Meerut.
9. SINHA, R.K. (1996) Biodiversity (Global Concerns), Commonwealth Publishers, New Delhi.

Web Resources:

1. https://www.hzu.edu.in/bed/E%20V%20S.pdf
2. https://www.ikbooks.com/books/book/earth-environmental-sciences/textbookenvironmental-biology/9788188237876/

Course Outcomes:

On completion of the course the learner will be able

..

CO 1:	Able to demonstrate broad based knowledge of the fundamentals of environmental biology and evolution
CO 2:	Ability to demonstrate skills in the observation and experimental study of organisms using both field based and laboratory based approach..
CO 3:	Have preparation of case study report and the scientific document preparation
CO 4:	Understand in identifying analyzing, hypotheses, interpreting results and conclusions, and evaluating quality through critique..
CO 5:	Hands on training in identification of plankton .

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

S - Strongly Correlated

M - Moderately Correlated

W-Weakly Correlated

N – No Correlation

Semester-IV/ Elective Course **III**	**EC III - SERICULTURE**	Course Code:
Instruction Hours: 6	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	• 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

UNITS	CONTENT	HOURS
I	Introduction to textile fibers; types- natural and synthetic fibers; sources of silk fiber- Tasar, Muga, Anaphe, Gonometa, Fagara, spider and mussel; properties and importance of silk fiber. History, development, status, characteristics and advantages of sericulture in India.	**18**
II	Host plants; Moriculture- distribution, morphology, propagation- seedling, cutting, grafting, layering and micropropagation methods, maintenance-irrigation, manuring and pruning, pests and diseases of mulberry.	**18**
III	*Bombyx mori*- morphology, anatomy, life cycle, geographical locations, larval moults, voltinism, indigenous and commercial races. Diapause. Egg-storage and transportation.	**18**
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.	**18**
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.	**18**

Text Book:

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.
3. Singh, Amardev & Ravinder Kumar. 2013. Sericulture handbook Vol 1, Biotech.

Reference Books:

1. Anon. 1972 manual on sericulture, vol.3 silk reeling fao, agriculture service bulletin no. 2/3.
2. Byong ho kim. 1989. Filature water engineering, seoul national university press, republic of korea.
3. Huang guo rui. 1988. Silk reeling, oxford and ibh publishing co. Pvt. New delhi.
4. Mahadeveppa, d., halliyal, v.g., shankar, a.g. and bhandiwad, r. 2000 mulberry silk reeling technology, oxford and ibh publishing co. Pvt. Ltd. New delhi.
5. Song, k.e and lee, y.w. 1973. Modern silk reeling technology. Sericulture expt. Station, republic of korea
6. Sonwalker, t.n. handbook of silk technology, new age international pvt., ltd.
7. Yong woo lee. 1999. Silk reeling and testing manual, fao agricultural services bulletin no. 136, rome, italy.
8. Akira Nakamura (2000) Fiber Science and Technology. Oxford & IBH Publications, New Delhi.

E-Resource

1.https://acikders.ankara.edu.tr/mod/resource/view.php?id=91481

2. https://agritech.tnau.ac.in/sericulture/seri_silkworm2_disinfectant.html

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 M-Moderately CorrelatingW-Weakly Correlating
N-No Correlation

Semester-IV/ / Elective Course **III**	**EC-III- INTRODUCTION TO NANOBIOTECHNOLOGY**	Course Code:
Instruction Hours: 6	Credits: 4	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