Annexure-II

Avinashilingam Institute for Home Science and Higher Education for Women
(Deemed to be University under Category 'A' by MHRD, Estd. u/s 3 of UGC Act 1956)
Re - accredited with A++ Grade by NAAC. Recognised by UGC Under Section 12B
Coimbatore – 641043, Tamil Nadu, India
B.Sc. Zoology
(With Language & English for 4 Semesters)

Programme Outcome:

1. Attain strong fundamental knowledge on practical background in basic concepts of Zoology.
2. Capability to express theories and concepts to propose ideas to address the community.
3. Apply accurate identification of the problem and suggest appropriate mitigation strategies.
4. Develop interrogative capacity to analyse the problems and suggest solutions to counteract issues.
5. Work as an individual or as team to observe the variety of animal species, characteristics and organization, behavior and evolution.
6. Acquire skills for identification of appropriate resources for managing a specific task.
7. Ability to access digital technology for the creation of biological database
8. Imbibe ethical values recognize the need for research ethics and implementation
9. Implementation of acquired knowledge in life sciences for lifelong learning
10. Promote the individual's entrepreneurial skills in life sciences.

Programme Specific Outcome:

1. Have a comprehensive knowledge of Zoology, able to identify and classify major groups of organisms
2. Understand the cellular and genomic level of organization in organisms.
3. Explain the origin, ancestory and ecological adaptation of animals.
4. Have a wide knowledge on the embryonic development, cellular differentiation and reproduction in organisms.
5. Promote the individual's ability and skills to pursue entrepreneurship.

Scheme of instruction and examinations
(For students admitted from 2021-2022 onwards)

Part	*Subject Code*	*Name of paper/component*	*Hours of instructions/week*		*Scheme of Examination*				
			Theory	*Practical*	*Duration of Exam*	*CIA*	*CE*	*Total*	*Credit*
First Semester									
I	21BLT001/ 21BLH001 21BLF001	Tamil- IlakkiamI-IlakkanamIlakkiyaVaralaru / Hindi–Prose & Non detailed Texts/French I	5	-	3	50	50	100	4
II	21BLE001	English Language for Communication – I	5	-	3	50	50	100	4
III		**Core Course**							
	21BZOC01	Invertebrata I	4	-	3	50	50	100	3
	21BZOC02	Invertebrata II	5	-	3	50	50	100	3
	21BZOC03	Practicals I- Invertebrates	-	3	3	50	50	100	2
III		**Discipline Specific Elective (DSE) Course**							
	21BZOI01	DSE I –Chemistry theory for Zoology	4	-	3	50	50	100	3
	21BZOI02	DSE I – Chemistry Practicals for Zoology	-	3	3	50	50	100	2
		Games	-	1		-	-	-	-
Second Semester									
I	21BLT002/ 21BLH002/ 21BLF002	Tamil- IlakkiamII-IlakkanamIlakkiyaVaralaru / Hindi-Grammar, Translation & General Essay/ French II	5	-	3	50	50	100	4
II	21BLE002	English Language for Communication – II	5	-	3	50	50	100	4
III		**Core Course**							
	21BZOC04	Chordata I	4	-	3	50	50	100	3
	21BZOC05	Chordata II	5	-	3	50	50	100	3
	21BZOC06	Practicals II-Chordates	-	5	3	50	50	100	2
		Discipline Specific Elective (DSE)Course							
	21BZOI03	DSE II- Computer Applications in Zoology	2	3	3	50	50	100	4
		Games	-	1	-	-	-	-	-

Third Semester									
I	21BLT003/ 21BLH003/ 21BLF003	Tamil- Ilakkiam III - IlakkanamIlakkiyaVaralaru / Hindi-Ancient & Modern Poetry/ French III	5	-	3	50	50	100	4
II	21BLE003	English Language for Communication – III	5	-	3	50	50	100	4
III		**Core Course**							
	21BZOC07	Cell Biology	4	-	3	50	50	100	3
	21BZOC08	Molecular Biology	4	-	3	50	50	100	3
	21BZOC09	Practicals III- Cell and Molecular Biology	-	5	3	50	50	100	2
		Discipline Specific Elective (DSE)Course							
	21BZOI04	DSE III Diversification of Plants (Botany)	4	-	3	50	50	100	3
	21BZOI05	DSE III Practicals I - Diversification of Plants (Botany)	-	3	3	50	50	100	2
Fourth Semester									
I	21BLT004/ 21BLH004/ 21BLF004	Tamil- Ilakkiam IV- IlakkanamIlakkiyaVaralaru / Hindi-Introduction to Functional Hindi & Journalism/ French IV	5	-	3	50	50	100	4
II	21BLE004	English Language for Communication – IV	5	-	3	50	50	100	4
III		**Core Course**							
	21BZOC10	Genetics	4	-	3	50	50	100	3
	21BZOC11	Evolution	4	-	3	50	50	100	3
	21BZOC12	General Entomology	3	-	3	50	50	100	3
	21BZOC13	Practicals IV-General Entomology	-	2	3	50	50	100	2
		Discipline Specific Elective (DSE)Course							
	21BZOI06	DSE IV –Diversity of Angiosperms(Botany)	4	-	3	50	50	100	3
	21BZOI07	DSE IV –Practicals II - Diversity of Angiosperms (Botany)	-	3	3	50	50	100	2

Fifth Semester									
III		**Core Course**							
	21BZOC14	Biochemistry	5	-	3	50	50	100	3
	21BZOC15	Animal Physiology	5	-	3	50	50	100	3
	21BZOC16	Biostatistics	5	-	3	50	50	100	3
	21BZOC17	Aquaculture	4	-	3	50	50	100	3
	21BZOC18	Practicals V - Biochemistry and Animal Physiology	-	5	3	50	50	100	2
	21BZOC19	Sericulture and Apiculture (Self study course)	1	-	-	100	-	100	4
	21BZOC20	Zoology (Computer based test)	-	-	1	-	100	100	2
	21BZOC21	Project	-	3	-	100	-	100	4
		Generic Elective (GE) Course	2	-	3	100	-	100	2
Sixth Semester									
III		**Core Course**							
	21BZOC22	Microbiology	5	-	3	50	50	100	3
	21BZOC23	Immunology	5	-	3	50	50	100	3
	21BZOC24	Developmental Biology	5	-	3	50	50	100	3
	21BZOC25	Environmental Biology	5	-	3	50	50	100	3
	21BZOC26	Practicals VI– Microbiology and Immunology	-	5	3	50	50	100	2
	21BZOC27	Practicals VII– Developmental and Environmental Biology	-	5	3	50	50	100	2
Total Credits									**128**

Semester	*Subject code*	*Name of paper/component*	*Hours of instruction/ week/Course*	*Credit/ Course*	*Total Credits*
PART IV Components					
	A. Ability Enhancement Courses				
I	21BAES01	Environmental Studies (Foundation Course)	4		4
II	21BAFU01	Fundamentals of Research	2		2
V	21BSCS01	Communication Skills	3	Remarks	2
VI	21BSSS01	Soft Skills	3	Remarks	2
	II. Skill Enhancement Courses (SEC)				
III		**Value added course (from a basket of choice offered)**	40 hrs. Duration	Remarks	2
IV		**Co-curricular Course** Add on Certificate/ Quantitative Aptitude/ Certificate Courses- Gandhian Studies/ Women's Studies/ Ambedkar Studies/ Verbal and Non-verbal Reasoning / General Awareness/others as per list	Varied duration	Remarks	2
	B. Extra- curricular Course				
I-VI	21BXNC01-06	**NCC/**	- -	Remarks	24 Credits*
	21BXNS01-06	**NSS/**			6 Credits
	21BXSP01-06	**Sports/**			6 Credits
				Total credits	**20**

For NCC Students alone 38 credits for Part IV Components.
Total credits to earn the degree

1. Part I, II and III components - 128
2. Part IV components - 20

Total credits - 148credits

Other courses offered by the Department

❖ **Discipline Specific Elective**	DSE I -21BBOI01 Nonchordates and Chordates- Semester I
(For Botany Students)	DSE I- 21BBOI02 Practicals I - Nonchordates and Chordates - Semester I
	DSE II -21BBOI03 Developmental Zoology and Animal Physiology – Semester II
	DSE II -21BBOI04 Practicals II -Developmental Zoology and Animal Physiology - Semester II
Generic Elective Course	21BZOO01 Ornamental fish culture
Value added Course	21BZOV01 Vermicomposting

Invertebrata I

Semester I **Hours of Instruction/week: 4**
21BZOC01 **No. of credits: 3**

Objectives:

1. To study the principles of animal classification
2. To learn the salient features of invertebrates
3. To know the economic importance of various invertebrates.

Unit 1. **Introduction to Invertebrates and Phylum Protozoa** 12 hrs

Introduction - Principles of classification, outline classification of animal kingdom, Protozoa - General characters and major classes of Phylum Protozoa with examples, Type study - Paramecium, locomotion, nutrition and reproduction in protozoa, protozoan parasites.

Unit 2. **Phylum Porifera** 12 hrs

General characters and major classes of Phylum Porifera with examples, Type study - Leucosolenia, origin of metazoa, canal system and economic importance of sponges.

Unit 3. **Phylum Coelenterata** 12 hrs

General characters and major classes of Phylum Coelenterata with examples, Type study - Obelia, polymorphism in hydrozoa, symmetry in metazoans, corals and coral reefs.

Unit 4. **Phylum Platyhelminthes** 12 hrs

General characters and major classes of phylum Platyhelminthes with examples, Type study –*Fasciola hepatica*

Unit 5. **Phylum Aschelminthes** 12 hrs

General characters of Phylum Aschelminthes with examples

Type study – Ascaris, nematode parasites of man, parasitic adaptations of helminth parasites

Total hours : 60

Text Books :

1. Kotpal, R.L., (2014).Modern text book of Zoology- Invertebrates, Eleventh edition, Rastogi Publications, Meerut, India.
2. M. EkambaranathaAyyar and T.N. Ananthakrishnan (2016).A Manual of Zoology, Volume 1 Part I(Invertebrata), Sixth Edition, S. Viswanathan (Printers and Publishers) Pvt.Ltd., Chennai.
3. Jordan, A.L and Verma, P.S. (2014). Invertebrate Zoology, Fifth Edition, S. Chand & Publishing company Pvt. Ltd., New Delhi.

Reference Books :

1. Kohli, K. S., Trigunayat,M. M and KavithaSahani. (2008).Invertebrates (Structure & function),First Edition, Ramesh Book Depot Publishers, Jaipur, India.
2. Edward E.Ruppert., Richard S.Fox. and Robert D. Barnes.(2003). Invertebrate Zoology: A Functional Evolutionary Approach, First edition, Brooks Cole, USA.
3. R.P. Karyakarte and A. S. Damle(2003).Medical Parasitology, First edition, Books and Allied (P) Ltd., Kolkatta, India.

Course Outcomes:

1. Understand common and distinctive features of invertebrate organisms including protozoan.
2. Explain specific characteristics of the phyla
3. Recognize and describe salient features of invertebrates
4. Describe important biological processes in invertebrates
5. Discuss the parasitic, ecological adaptation and economic importance of invertebrates

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	L	H	H	H	M	H	H	H	L
CO 2	H	H	H	H	H	M	H	H	H	H
CO 3	H	H	L	H	H	L	H	H	H	M
CO 4	H	H	H	H	M	M	H	H	H	L
CO 5	H	H	H	H	H	M	H	H	H	L

Invertebrata II

Semester I **Hours of Instruction/week : 5**

21BZOC02 **No. of credits : 3**

Objectives :

1. To learn the salient features of invertebrates
2. To know the economic importance of various invertebrates.
3. To study the larval forms of invertebrates

Unit 1. Phylum Annelida I 15hrs

General characters and major classes of Phylum Annelida with examples, Type study- Megascolex

Unit 2. Phylum Annelida II 15hrs

Type study- Hirudinaria, metamerism, coelom and excretory systems in annelids, tube dwelling polychaetes

Unit 3. Phylum Arthropoda 15 hrs

General characters and major classes of Phylum Arthropoda with examples, Type study- Penaeus, larval forms of crustacean, Peripatus and its affinities, Limulus as living fossil, respiratory organs in arthropoda, economic importance of arthropods.

Unit 4. Phylum Mollusca 15hrs

General characters and major classes of Phylum Mollusca with examples,

Type study- Pila, torsion and detorsion in gastropods, economic importance of Mollusca.

Unit 5. Phylum Echinodermata 15hrs

General characters and major classes of Phylum Echinodermata with examples, Type study- Star fish, larval forms in Echinodermata.

Total hours : 75

Text Books :

1. Kotpal, R.L., (2014). Modern text book of Zoology- Invertebrates, Eleventh edition, Rastogi Publications, Meerut, India.
2. M. EkambaranathaAyyar and T.N. Ananthakrishnan (2016). A Manual of Zoology, Volume 2 Part II (Invertebrata), Sixth Edition, S. Viswanathan (Printers and Publishers) Pvt. Ltd., Chennai
3. Jordan, A.L and Verma, P.S (2014). Invertebrate Zoology, Fifth edition, S. Chand & Publishing company Pvt. Ltd., New Delhi

Reference Books :

1. K. S. Kohli, M. M.Trigunayat and KavithaSahani.(2008).Invertebrates (Structure & function), First Edition, Ramesh Book Depot, Jaipur.
2. Edward E.Ruppert, Richard S.Fox. and Robert D. Barnes (2006). Invertebrate Zoology: A Functional Evolutionary approach, First edition, Brooks Cole Publishers, USA.
3. Barnes, R.S.K., Calow, P. Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, Third Edition, Blackwell Science Publishers, USA.

Course Outcomes:

1. Gain knowledge on the basic organization of annelids
2. Recognize the structure and function of invertebrates
3. Understand the functional morphology of various groups of invertebrates
4. Understand the ecological adaptations and economic importance of invertebrates
5. Compare the structural organization of invertebrates and their larval forms

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	M	H	H	H	M	H	H	H	L
CO 2	H	H	H	H	H	M	H	H	H	H
CO 3	H	H	L	H	H	L	H	H	H	M
CO 4	H	H	H	H	M	M	H	H	H	L
CO 5	H	H	H	H	H	M	H	H	H	L

Practicals I - Invertebrates

Semester I **Hours of Instruction/week : 3**
21BZOC03 **No. of credits : 2**
Objectives :

1. To identify museum specimen
2. To develop skills in animal dissections
3. To give exposure to virtual dissections

Dissections

Prawn Mounting of appendages 12 Hrs
Nervous system

Salient features and biosystematics, adaptive features and biological significance of the following

Amoeba, Paramecium, Plasmodium, Euglena 21 Hrs
Leucosolenia, Spicules and Gemmule of Sponges
Hydra, Obelia colony and medusa, Sea anemone, Madrepora,
Favia,Tubifora, Fasciola, Ascaris,
Neries, Megascolex, Arenicola,Hirudinaria
Naupilus, Cyclops, Daphnia, Centipede, Millipede, Peripatus
Freshwater mussel, Mytilus, Octopus, Sepia , Pearl oyster, Pila
Starfish, Sea Urchin

Anatomy of Earthworm

Earth worm dissection (CD); Sources: http://neosci.com 6 Hrs

Live Zoology Paramecium culture 3 Hrs
Examination of zooplankton from a pond 3 Hrs

Total hours : 45

Course Outcomes:

1. Able to dissect and examine various organ systems in situ.
2. Acquire basic skills in animal dissections.
3. Be familiar with the external morphology of animals by observing the preserved specimens.
4. Know how to culture some protozoans
5. Gain knowledge on virtual dissections

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	H	H	M	M	M	H	H	H	L
CO 2	H	H	M	H	H	M	H	H	M	H
CO 3	H	H	L	H	H	L	H	H	H	M
CO 4	H	H	H	H	M	M	H	H	H	L
CO 5	H	H	M	H	H	M	H	L	H	M

Chordata I

Semester II **Hours of Instruction/week: 4**

21BZOC04 **No. of credits : 3**

Objectives

1. To learn the salient features, biosystematics and biological significance of chordates
2. To study the anatomy of higher organisms
3. To understand the economic importance of higher animals

Unit 1. Introduction to Chordata 12 hrs

General characters and outline classification of chordates, origin and ancestry of chordates

Unit 2. Prochordata 12 hrs

General characters and classification of prochordates with examples, Amphioxus, Ascidia and Balanoglossus as type study

Unit 3. Pisces I 12 hrs

General characters and outline classification with examples, Type study - Scoliodon

Unit 4. Pisces II 12 hrs

Accessory respiratory organs, parental care, migration and economic importance of fishes, Dipnoi and affinities

Unit 5. Amphibia 12 hrs

General characters and outline classification with examples, Frog as type study, origin of amphibians, metamorphosis in frog, parental care in amphibians

Total hours : 60

Text Books :

1. M. EkambaranathaAyyar and T.N. Ananthakrishnan (2016). A Manual of Zoology, Volume 1 – Part I (Chordata), Sixth Edition, S. Viswanathan (Printers and Publishers) Pvt. Ltd., Chennai
2. Kotpal, R.L. (2002). Modern text book of Zoology Vertebrates (Animal Diversity -II), Fourth Edition, Rastogi Publication, Meerut, India.
3. Jordan, E.J and Verma, P.S. (2014). Chordate Zoology, Second Edition, S. Chand & Company Ltd, New Delhi.

Reference Books :

1. Singh, B.D. (2018). An introduction to Chordata, First Edition, KedarNath Ram Nath Publishers, Meerut (U.P).
2. H.V. Bhaskar (2010). Chordates (Volume 2), First edition, Campus book international, New Delhi.
3. Philip, P.T. and George, T.V. (2005). Text Book of Zoology Animal Diversity – II, | First edition, Leo Publications, Thiruvananthapuram

Course Outcomes:

1. Portray comprehensive knowledge on origin, ancestry and basic principles of chordate classification
2. Gain knowledge on fundamentals of chordate characters
3. Understand interrelationship of primitive pro-chordates with invertebrates and vertebrates
4. Gain knowledge on significance and economic importance of higher animals
5. Understand the patterns of migration and parental care among animals

CO / PO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	H	H	H	H	H	H	H	H	L
CO 2	H	H	H	H	H	H	H	H	H	L
CO 3	H	H	H	H	L	H	H	H	H	L
CO 4	H	H	H	H	H	H	H	H	H	H
CO 5	H	H	L	H	H	L	H	H	H	H

Chordata II

Semester II **Hours of Instruction/week : 5**

21BZOC05 **No. of credits: 3**

Objectives:

1. To learn the salient features, biosystematics and biological significance of chordates
2. To study the anatomy of higher organisms
3. To understand the economic importance of higher animals

Unit 1. Reptiles 15hrs

General characters and outline classification with examples, Type study - Calotes, Poisonous and non poisonous snakes of South India, key to identification of poisonous snakes, poison apparatus and bitting mechanisms, snake venom and first aid.

Unit 2. Aves I 15 hrs

General characters and outline classification with examples, Pigeon - Type study.

Unit 3. Aves II 15hrs

Archaeopteryx, Ratitae, bird migration, flight adaptations in birds, Types of beaks and feets in birds, Economic Importance of birds

Unit 4. Mammals I 15 hrs

General characters and outline classification with examples, Rabbit - Type study

Unit 5. Mammals II 15hrs

Origin of mammals, aquatic mammals, flying mammals, adaptive radiation in mammals, economic importance of mammals.

Total hours : 75

Text Books :

1. M. EkambaranathaAyyar and T.N. Ananthakrishnan (2016). A Manual of Zoology, Volume 1 – Part I (Chordata), Sixth Edition, S. Viswanathan (Printers and Publishers) Pvt. Ltd., Chennai
2. Kotpal, R.L. (2016). Modern text book of Zoology Vertebrates (Animal Diversity -II),Fourth Edition,Rastogi Publication, Meerut, India.
3. H.S.Bhamrah and KavithaJuneja (2001). An introduction to birds, First edition, Anmol Publications Private Ltd., New Delhi.

Reference Books :

1. H.S.Bhamrah and KavithaJuneja (2001). An introduction to reptiles, First edition, Anmol Publications Private Ltd., New Delhi.
2. Jordan, E.J and Verma, P.S. (2014). Chordate Zoology, Second Edition, S. Chand & Company Ltd, New Delhi.
3. H.V. Bhaskar (2010). Chordates (Volume 2), First edition, Campus book international, New Delhi.

Course Outcomes:

1. Knowledge on mechanism of adaptation of animals to environment
2. Understand the salient features of major groups within phylum chordata
3. Understand the anatomical features of chordates
4. Differential knowledge on the anatomy of chordates
5. Illustrate the economic significance of reptiles, birds and mammals

CO / PO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	H	H	H	H	H	H	H	H	L
CO 2	H	H	H	H	H	H	H	H	H	L
CO 3	H	L	H	H	M	H	H	H	H	L
CO 4	H	L	H	H	H	H	H	H	H	L
CO 5	H	H	M	H	H	L	H	H	H	H

Practicals II - Chordates

Semester II **Hours of Instruction/week : 5**

21BZOC06 **No. of credits : 2**

Objectives:

1. To identify and classify museum specimens and to study their salient features.
2. To observe animals in their natural habitat
3. To get trained in virtual dissections

A. Dissections (Demonstration only) 10hrs

Teleost fish – Digestive system
Reproductive system

B. Study of the following specimens by observing its salient features and biological significance 15hrs

a. Amphioxus and Salpa
b. Scoliodon, Mugil, Arius, Hippocampus and Electric ray
c. Frog, Alytes and Icthyophis15
d. Calotes, Chelone, Chameleon, Crocodile,Viper and Cobra
e. Pigeon, Woodpecker and Kingfisher
f. Rat , Anteater and Porcupine

C. 15 hrs

a. Identification of locally available fishes
b. Study of ornamental fishes
c. Study of scales of fishes
d. Study of different types of feathers of birds
e. Study of different types of beaks and feets of birds

D. Osteology

Frog : Pectoral girdle, pelvic girdle, fore limb, hind limb and typical vertebrae 10 hrs

E. Supplementary sources for laboratory exercise 10 hrs

Anatomy of frog

a. The dissection works(CD)
Source: http://www.scienceclass.com 10

b. Prodissector – Frog (CD)
Source: http://www.prodissector.com

F. Field work

a. Report on visit to Gauss museum
b. Report on visit to SACON 15 hrs
c. Report on visit to National park / Zoological park/ Sanctuary

Total hours : 75

Course Outcomes:

1. Identify visceral organs of fishes in situ
2. Able to identify marine and fresh water, food and ornamental fishes
3. Gain basic training in virtual dissections
4. Know about museum specimens and their salient features
5. Assess the adaptive features of beak and feet of bird

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	M	H	M	H	M	H	M	H	L
CO 2	H	H	H	M	H	M	H	H	H	H
CO 3	H	M	L	H	H	L	H	H	H	M
CO 4	H	H	H	H	M	M	H	H	H	L
CO 5	H	H	H	L	H	M	M	H	H	L

Cell Biology

Semester III **Hours of instruction / week : 4**

21BZOC07 **No of credit: 3**

Objectives:

1. To learn various cytological techniques to understand ultra structure of cellular organelles
2. To understand the structure and function of cellular organelles
3. To understand the principles of membrane transport

Unit 1. **Introduction to cell and cytological techniques** 12 hrs

Concepts of a modern cell, cell theory, prokaryotic and eukaryotic organization. Light, transmission and scanning electron microscopes, preparation of materials for light and electron microscopes, cell fractionation methods, homogenization and centrifugation.

Unit 2. **Plasma membrane** 12 hrs

Chemical composition, structure, fluid mosaic model, membrane transport, cell adhesion, cell junction

Unit 3. **Cell organelles** 12 hrs

Morphology, ultrastructure and functions of mitochondria, golgi complex, endoplasmic reticulum, ribosomes, lysosomes, centrosomes

Unit 4. **Nucleus** 12 hrs

Nuclear envelope, nucleolus, organization and functions of nucleus, morphology and ultrastructure of chromosome, euchromatin, heterochromatin, polytene and lamp brush chromosomes

Unit 5. **Cytology of cancer** 12 hrs

Difference between normal and cancer cells, membrane and biochemical changes, nuclear and chromosomal changes, tumour viruses, oncogenes, environmental factors inducing cancer, hormones in relation to cancer cells

Total hours : 60

Text Books:

1. Verma, P.S. and Agarwal, V.K. (2014). Cytology, Third edition, S.Chand& Company Ltd., New Delhi.
2. Prakash S. L. (2007). Cell and Molecular Biology, First edition, MJP Publishers, Chennai.
3. Ajoy Paul (2007). Text book of Cell and Molecular Biology, Second edition, Books and Allied (P) Ltd, Kolkata

References Books:

1. Veer BalaRastogi (2010). Introduction to Cytology, Revised edition, Kedarnath Ram Nath Publishers, Meerut (UP)
2. Verma, P.S. and Agarwal, V.K. (2006). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S.Chand& Company Ltd. Publishers, New Delhi.
3. Cooper, G.M. (2007). The cell – A Molecular Approach. Second edition. ASM press, The American Society for Microbiology, USA.

Course Outcomes:

1. Evaluate and apply knowledge of modern scientific techniques in cellular biology functions
2. Describe the structure and functions of the plasma membrane, transport across cell and cell-cell communication
3. Portray the intricate relationship between various cellular structures and their corresponding
4. Be able to describe the structure and functions of nucleus with special reference to chromosomes
5. Describe the intricate relationship between the normal and the pathological state of tumor cell

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	M	H	H	H	H	H	H	H	H
CO 2	H	H	M	M	M	H	H	H	H	L
CO 3	H	M	M	M	H	M	H	M	H	H
CO 4	H	H	H	H	H	H	M	M	H	H
CO 5	H	H	H	M	L	H	H	H	H	M

Molecular Biology

Semester III **Hours of instruction / week: 4**
21BZOC08 **No of credit: 3**

Objectives:

1. To elucidate central dogma of molecular biology
2. To know the types and structure of nucleic acids
3. To understand synthesis and processing of RNA, DNA and protein

Unit 1. **Introduction to molecular biology** 12 hrs

Nature of genetic material,evidences for DNA as genetic material, bacterial transformation, bacterial conjugation, bacteriophage infection, transduction evidences for RNA as genetic material

Unit 2. **Molecular structure of DNA** 12 hrs

Constituents of nucleic acid, structure of DNA , types of DNA, alternative forms of DNA, supercoiling of DNA, repeated and unusual structures of DNA sequence, properties of DNA

Unit 3. **Replication of DNA** 12 hrs

Basic requirements for DNA synthesis, semi conservative mode of DNA replication, enzymology and proteins associated with DNA replication, mechanism of DNA replication in prokaryotes

Unit 4. **Ribonucleic acid and transcription** 12 hrs

Structure of RNA, types of RNA, basic features of RNA synthesis , steps in the synthesis of RNA, post transcriptional modifications of RNA

Unit 5. **Genetic code and translation** 12 hrs

Features and deciphering of genetic code, requirements and steps involved in protein biosynthesis, post translational modifications

Text Books:

1. Verma, P.S. and Agarwal, V.K. 2009. Molecular Biology. Fourth Edition, S.Chand and Company Ltd., New Delhi.
2. VeerBalaRastogi .2007. Molecular Biology. Second Edition, KedarNath Ram Nath Publishers, Meerut (UP)
3. Jeyanthi, G.P. 2009. Molecular Biology. First Edition, MJP Publishers, Chennai.

References Books:

1. Watson. J. D, Baker. T. A, Bell. S. P, Gann. A, Levine. M, Losick. R. 2008.Molecular Biology of Gene. 6th Edition; The Benjamin / Cummings Pub. Co. Inc,
2. Karp, G., Iwasa, J., Marshall,W.2015. Cell and Molecular Biology: Concepts and Experiments, 8th Edition.John Wiley & Sons, Inc.,
3. Darnell, Lodish and Baltimore. 2000. Molecular Cell Biology, Scientific American Publishing Inc,

Course Outcomes:

1. Be able to explain how DNA provides a mechanism for heredity
2. Understand structure of nucleic acids and basic concepts of protein synthesis
3. Describe the molecular mechanisms behind DNA replication in prokaryotes and eukaryotes
4. Comprehend RNA synthesis and processing, and protein synthesis
5. Understand and apply general concepts of cell and molecular biology to relevant, specific problems.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO 10
CO 1	H	H	M	M	H	L	H	M	M	M
CO 2	H	M	H	M	M	L	H	L	H	L
CO 3	M	M	H	M	H	L	H	M	M	L
CO 4	H	H	M	H	M	L	H	L	H	L
CO 5	H	H	M	H	H	L	H	L	H	M

Practicals III - Cell and Molecular Biology

Semester III **Hours of instruction / week: 5**

21BZOC09 **No of credit: 2**

Objectives:

1. To be able to perform experiments using the common tools of cell and molecular biology, including light microscopy, cellular fractioning and leucocyte culture
2. To list the fundamental features of prokaryotic and eukaryotic cells and methods used to examine them
3. To learn techniques for the isolation and separation of biomolecules

	Cell Biology	
1.	Principles of light microscope	2 hrs
2.	Homogenization and centrifugation of tissue samples	3 hrs
3.	Haemolysis	5 hrs
4.	Cell division in grass hopper / cockroach testis	5 hrs
5.	Squash preparation of onion root tip	5 hrs
6.	Buccal smear test	5 hrs
7.	Examination of live Paramecium to study streaming movement of cytoplasm	5 hrs
8.	Measurement of cell size using micrometer	5 hrs
9.	Mounting of polytene chromosome	5 hrs
10.	Human peripheral leucocyte culture	5 hrs
	Molecular Biology	
11.	Isolation and estimation of DNA from onion	5 hrs
12.	Isolation and estimation of DNA from goat liver	5 hrs
13.	Isolation of DNA from Bacteria	5 hrs
14.	Plasmid DNA isolation	5 hrs
15.	Separation of DNA by agarose gel electrophoresis	5 hrs
16.	Preparation of competent cells	5 hrs
	Total hours :	75

Course Outcomes:

1. Acquire practical skills in undertaking simple immunological experiments that mimic those undertaken in diagnostic and research laboratories.
2. Coherently report in a written document using the appropriate language of the field
3. Understand the principle and operation of relevant laboratory equipment.
4. Evaluate laboratory test outcomes and determine the validity of the test results obtained.
5. Perform experiments using techniques for isolation and separation of biomolecules

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	H	H	H	H	H	L	H	H	H
CO 2	L	H	M	M	M	M	L	M	M	H
CO 3	H	H	H	H	H	M	L	H	H	M
CO 4	H	H	H	H	H	H	M	H	H	H
CO 5	H	H	H	H	H	H	M	H	H	H

Genetics

Semester IV **Hours of Instruction / week : 4**

21BZOC10 **No. of credits : 3**

Objectives :

1. To learn the genetic principles in animals.
2. To understand the inheritance of genetic disorders in man.
3. To know about the applied aspects of genetics

Unit 1: Introduction

Mendelism, Mendels's work, mono hybrid, dihybrid, back cross, test cross. Mendels's laws- Law of dominance, segregation and independent assortment, Incomplete dominance. 12 hrs

Unit 2: Gene interactions 12 hrs

Complementary, supplementary, epistatic, lethal and cumulative genes, Characters of multiple alleles with examples, ABO blood groups, Rh factor.

Unit 3: Linkage and crossing over 12 hrs

Definition, types of linkages in drosophila, definition, types of crossing over, mechanism of crossing over, cytological evidence for crossing over, factors affecting crossing over, chromosome mapping.

Unit 4: Sex linked inherentance and Sex determination 12 hrs

Definition, X and Y linked inherentance, haemophilia and colour blindness in man, sex influenced and sex limited genes in man, chromosomal theory, quantitative theory (Lyons hypothesis and dosage compensation), environmental theory, hormonal theory of sex determination, primary and secondary chromosomal non disjunction

Unit 5: Human genetics 12 hrs

Pedigree analysis, Mendelian traits, human karyotype, autosomal and sex chromosomal abnormalities, inbreeding, out breeding and hybrid vigour, genetic counseling

Total hours : 60

Text Books:

1. Verma, P.S. and Agarwal, V.K. (2007), Genetics S. Chand and Company Ltd., New Delhi.
2. Veer BalaRastogi (2008), Elements of Genetics, Eleventh edition, KedarNath Ram Nath Publishers, Meerut (U.P).
3. Miglani. G.S. (2011). Advanced Genetics. N.K. Mehra for Narosa publishing House, 2nd edition, Delhi, Chennai, Mumbai, Kolkata.

Reference Books:

1. S.V. Sawardekar., S.S. Sawant., S.G. Bhave(2010). Principles of Genetics. International Book House Pvt. Ltd. 1st edition, Mumbai, India.
2. G.S. Miglani. 2011. Advanced Genetics. N.K. Mehra for Narosa publishing House, 2nd edition, Delhi, Chennai, Mumbai, Kolkata.
3. Alice Marcus. 2010. Human Genetics. Narosa publishing House, 1st edition, Delhi, Chennai, Mumbai, Kolkata.

Course Outcomes:

1. Understand and describe the mechanism that underpins biological inheritance
2. The knowledge required to design, execute and analyze the results of genetic experimentation in animal and plant model systems
3. Insights into the inheritance of linked genes and the contribution of recombination of genes in evolution
4. Assess the role of chromosomes in sex determination and inheritance of X and Y linked genes
5. Construct personal and family pedigrees and integrate genetic testing options in genetic counseling practices

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	H	H	H	H	L	H	H	H	-
CO 2	H	H	H	H	H	H	H	H	H	H
CO 3	H	H	H	H	H	H	H	H	H	L
CO 4	H	H	H	H	H	M	H	H	H	M
CO 5	H	H	H	H	H	H	H	H	H	H

Evolution

Semester IV **Hours of Instruction / week : 4**
21BZOC11 **No. of credits : 3**

Objectives:

1. To learn the origin of life.
2. To understand the principles and mechanism of evolution.
3. To know the types of fossil and its significance.

Unit 1. **Introduction** 12 hrs

History, theories of evolution, origin of life, Evidences for evolution – morphological, anatomical, embryological, physiological, taxonomical and paleontological evidences

Unit 2. **Mechanism of Evolution** 12 hrs

Lamarckism, Neo-Lamarckism, Darwinism, Neo-Darwinism and Mutation theory

Unit 3. **Isolation and speciation** 12 hrs

Isolation - Premating and postmating isolation mechanism and their significance, Speciation - modes of speciation- allopatric, sympatric and parapatric speciation

Unit 4. **Fossils** 12 hrs

Fossil formation, types of fossils, dating of fossils, significance of fossil record, Indian fossils, living fossils and geological time scale.

Unit 5. **Evolution of man** 12 hrs

Evolution of man, biological aspects (with fossils record) and cultural evolution of man.

Total hours : 60

Text Books:

1. MeenakshiChakraborty (2012).A Text book of Organic Evolution. Wisdom press,India
2. Verma, P.S. and Agarwal, V.K. (2010). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand and Company Ltd., New Delhi
3. Veer BalaRastogi (2000). Evolution, KedarNath Ram Nath, Meerut.

Reference Books:

1. Monroe W. Strickberger (2005). Evolution, Fourth edition, Jones and Bartlett Publications, Massachusetts.
2. Mark Ridley (2004). Evolution, Third edition, Blackwell Science Ltd and Publishing company, UK.
3. Franklin, S.A (2000). Evolution, J V Publishing House, Jodhpur.

Course Outcomes:

1. Understand the history and development of evolutionary thoughts.
2. Able to trace the evidence of evolution and its required corollaries
3. Elucidate the mechanism and significance of evolution
4. Knowledge about the evolutionary information of the fossils
5. Investigate the evolutionary basis of behavior in primates and man.

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	H	H	M	H	M	H	L	M	L
CO 2	H	H	H	L	H	M	H	L	H	L
CO 3	H	H	H	H	H	M	M	L	L	L
CO 4	H	H	H	L	H	M	H	L	M	L
CO 5	H	H	H	M	H	M	H	L	M	L

General Entomology

Semester IV **Hours of Instruction/week: 3**
21BZOC12 **No. of credits: 3**

Objectives:

1. To enable the students to know about the various types of insects,
2. To know about the types of pests and their control.
3. To understand the social life of insects

Unit 1. **Classification of insects-Introduction**

Introduction, principles underlying classification, classification up to orders with examples. 8 hrs

Unit 2. **Structure and functions of insects** 9 hrs

External characters, integument, head, mouth parts, thorax, wings and legs, andabdomen

Unit 3. **Physiology of insects** 10 hrs

Digestion, respiration, circulation, excretion, nervous, sensory, and reproductive systems – Hormones in metamorphosis

Unit 4. **Insect pests** 10 hrs

Pests of major crops - Paddy – *Tryporyza*and*Spodoptera*

Sugarcane – *Chilo and Pyrilla*

Stored grain pests – *Sitophilusoryzae*, *Triboliumcastaneum*, *Callosobruchusmaculatus*and*Sitotrogacereallela*

Pests of medical importance - Mosquitoes – Culex, Anopheles and Aedesspecies,Housefly

Unit 5. **Pest Control Measures** 8 hrs

Primary control measures – physical, cultural, chemical control – insecticides – Classification of a mode of action - Biological control – Integrated Pest Management (IPM)

Total hours : 45

Text Books :

1. Tembhare, D.B. (2015). Modern Entomology, Second Edition, Himalaya Publishing House Pvt. Ltd., Chennai
2. Vasanthara David, B., and Kumaraswamy, T. (1982). Element of Economic Entomology. Popular Book Depot, Madras.
3. Anand Prakash, Jagadiswari Rao, Sahoo B.K. and Asangla Jamir, I. T (2016). Pests of stored grains and their management Applied Zoologists Research Association (AZRA), Bhubaneswar, Odisha.

Reference Books :

1. Choudhary, V. (2008). Entomology and Part Management. Navayag Publishers, New Delhi.
2. LarryP.Pedigo, Marlin E. Rice. (2009) Entomology and Pest Management, 6th edition. Prentice-Hall, New Jersey.
3. Vincent H. Resh. and Ring T. Carde (2009). EncyCOpedia of Insects, 2nd edition. Elsevier Science, Munksgaard, Copenhagen

Course Outcomes:

1. Attain a solid foundation of the various types of insects
2. Knowledge of the structure and functions of insect anatomy
3. Explicate the functioning of the organ system of insects
4. Identification of pests of agricultural and medical importance
5. Attain skills in the various types of pest control practices

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	M	M	L	M	M	H	M	H	L
CO 2	H	M	M	L	M	H	H	L	M	M
CO 3	H	H	M	M	H	H	H	M	M	M
CO 4	H	H	H	H	H	H	H	M	H	L
CO 5	H	H	H	H	H	H	H	L	H	M

Practicals IV - General Entomology

Semester IV **Hours of Instruction/week : 2**
21BZOC13 **No. of credits : 2**

Objectives:

1. To enable the students to dissect out an invertebrate
2. To know about the insect research institutions.
3. To identify the insects of agricultural and medical importance

I Dissections

Cockroach – Mouth parts
Digestive system
Nervous system
Reproductive system — 14 hrs

II Visits to — 6 hrs

Sugar cane Breeding Institute for survey of sugar cane pests
Tamilnadu Agricultural University for survey of agricultural pests
Institute of Forest Genetics and Tree Breeding

III Identification of stored grain pests from house hold — 4 hrs

IV Male and female identification in cockroach, drosophila and mosquito — 6 hrs

Total hours : 30

Course Outcomes:

1. Understand the internal and external features of cockroach
2. Knowledge on the structure and functions of insect body parts
3. Acquiring information on research institutions through field visits
4. Identification of pests of agricultural and medical importance
5. Develop the keys for the identification of different types of insects

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	M	H	H	H	L	L	H	M	L
CO 2	H	M	M	H	H	M	L	H	H	L
CO 3	H	H	H	H	H	H	M	H	H	H
CO 4	H	M	H	H	H	H	H	H	H	H
CO 5	H	M	H	H	H	H	H	H	H	H

Biochemistry

Semester V **Hours of instruction / week : 5**

21BZOC14 **No of credit : 3**

Objectives :

1. To facilitate the students to understand the key principles of biochemistry
2. To enable the students to know about the structure of the biomolecules
3. To understand the metabolism of biological molecules

Unit 1. **Introduction to Biochemistry** 15 hrs

Atoms, chemical bonds, acids and bases, hydrogen ion concentration, concept of pH, maintenance of blood pH, bicarbonate, phosphate and protein buffers

Unit 2. **Carbohydrates** 15 hrs

Classification, structure and function of carbohydrates

Metabolism - Glycolysis, TCA cycle, Glycogenesis and Glycogenolysis

Unit 3. **Amino acids and Proteins** 15 hrs

Structure, classification and properties of amino acids and proteins

Metabolism - Transamination and Deamination of amino acids

Unit 4. **Lipids** 15 hrs

Classification, structure of fatty acids, triacylglycerol, phospholipids, steroids and properties of lipids

Metabolism - β-oxidation of palmitic acid and valeric acid

Unit 5. **Enzymes** 15 hrs

Types, general properties, classification, active site, mechanism of enzyme action, factors affecting enzyme activity, enzyme inhibition

Total hours : 75

Text Books:

1. Satyanarayana, U. and Chakrapani, U. (2013). Biochemistry, Seventh Edition, Books and Allied Pvt. Ltd., Kolkatta and Elsevier, New Delhi.
2. Jain, J.L., Sunjay Jain, Nithin Jain (2005). Fundamentals of Biochemistry, Sixth Edition, S. Chand Publishing Company, New Delhi.
3. Albert L. Lehninger, David L. Nelson, Micheal M. Cox (2008). Principles of Biochemistry, Fifth edition, CBS Publishers and Distributors, New Delhi.

Reference Books

1. Victor W. Rodwell, David A. Bender, Peter J. Kennelly, Kathleen M. Botham (2012). Harper's Illustrated Biochemistry, 29th edition. Lange Medical Publications, Maruzen, Asia.
2. Donald J. Voet, Judith G.Voet (2010). Biochemistry, Fourth edition, John Wiley and Sons Inc., United States
3. Rodney Boyer (2006). Concepts in Biochemistry, Third Edition, John Wiley and Sons Inc., United States

Course Outcomes:

1. Gain knowledge on the basic principles of chemistry to biological systems
2. Comprehend the chemical nature and functions of biomolecules
3. Ability to relate various interrelated physiological and metabolic events.
4. Firm foundation in the fundamentals and application of biomolecules
5. Acquire fundamental knowledge on enzymes and their importance in biological reactions.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	H	H	M	L	M	M	M	M	M
CO 2	H	H	H	H	H	H	M	H	H	M
CO 3	H	H	H	H	H	H	M	H	H	M
CO 4	H	H	H	H	H	H	M	H	H	M
CO 5	H	H	H	H	H	H	M	H	H	M

Animal Physiology

Semester V **Hours of instruction/week : 5**

21BZOC15 **No of credits : 3**

Objectives:

1. To enable the students to understand the physiological aspects of life.
2. To apply the knowledge in day to day life.
3. To know the anatomy of different organ system and their specific functions.

Unit 1. Introduction 15 hrs

Scope of physiology, nutrition, types of nutrition, digestion and absorption in a mammal.

Unit 2. Respiration and Circulation 15 hrs

Respiration - Organs of respiration, respiratory pigments, transport of gases Circulation - Heart types, structure of mammalian heart, properties of heart muscle, origin and conduction of heart beat, composition and functions of blood

Unit 3. Excretion and Nervous system 15 hrs

Excretion:Excretory organs and excretory products of animals, structure of mammalian kidney, urine formation, composition of urine

Nervous system: Structure of neuron, conduction of nerve impulses, synapses, reflexes, autonomic nervous system

Unit 4. Receptors and Effectors 15 hrs

Receptors - Photoreceptors, mechanoreceptors and chemoreceptors of a mammal.

Effectors - Structure and physico-chemical properties of skeletal muscles, theories, physiology and muscle contraction

Unit 5. Reproduction 15 hrs

Reproductive organs and physiology of reproduction in a mammal, Sexual cycles, Pregnancy, Menopause, Hormones in reproduction.

Endocrine Glands of a mammal, Pituitary, Thyroid, Parathyroid, Adrenal, Islets of Langerhans

Total hours : 75

Text Books:

1. Verma,P.S., Tyagi,B.S., Agarwal,V.K.(2015). Animal Physiology, Chand Publishing, India
2. Goel, K.A and Sastry, K.V.(2014). Animal Physiology, 6th edition, Rastogi Publication, Meerut.
3. Agarwal, R.A., Anil K. Srivastava, Kumar, K. (2007). Animal Physiology and Biochemistry, S. Chand and Company Ltd., New Delhi

Reference Books:

1. Richard Hill, Gordon, Wyse, A. and Margaret Anderson(2016). Animal Physiology, Fourth edition, Sinauer Associates
2. Sobti, R.C., (2008). Animal Physiology, Narosa Publishing House Pvt. Ltd., New Delhi.
3. Bhaskar, H.V., (2008). Animal Physiology, Campus Books International, New Delhi.

Course Outcomes:

1. Understand the physiological processes that regulate body function and their regulation.
2. Know about the structure and functions of respiratory and circulatory organs
3. Gain knowledge on the anatomy of different physiological system and their functions.
4. Able to describe the different types of receptors and muscle contraction.
5. Comprehend the physiology of reproduction and hormonal regulation

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	H	H	M	H	M	H	H	H	L
CO 2	H	H	H	M	H	M	H	H	H	L
CO 3	H	H	H	L	H	L	H	H	H	L
CO 4	H	M	L	L	H	M	H	H	H	L
CO 5	H	H	H	M	H	M	H	H	H	L

Biostatistics

Semester V **Hours of instruction/week : 5**
21BZOC16 **No of credits : 3**

Objectives:

1. To study the fundamentals of biostatistics
2. To study the application of biostatistics for testing hypothesis
3. To communicate the results of statistical analysis accurately and effectively.

Unit 1. Introduction to biostatistics 15 hrs

Introduction, collection, types, methods of collection of data, sources of data, census and sampling, laws of sampling, probability and nonprobability, sampling methods, sampling and non-sampling errors.

Unit 2. Presentation of data 15 hrs

Classification, types of classification, tabulation, parts of a table, types of tables, diagrammatic and graphic presentation, bar, pie diagram, line graph, graph of frequency distribution

Unit 3. Measures of central tendency 15 hrs

Objectives, mean, medium, mode, merits and demerits, geometric mean and harmonic mean

Unit 4. Measures of dispersion 15 hrs

Objectives mean deviation and standard deviation, merits and demerits, variance, standard error, coefficient of variation.

Unit 5. Correlation and regression analysis 15 hrs

Objectives, types of correlation, Karl Pearson's coefficient of correlation, regression types, regression line, regression equations, regression coefficients

Total hours : 75

Text Books:

1. Annadurai. B (2007). A text book of Biostatistics, New age International publications, Fifth edition, New Delhi.
2. Sharma, A.K.,(2005).Text book of Biostatistics, First edition, Discovery Publishers, New Delhi.
3. Naren K R. Dutta (2004).Fundamentals of Biostatistics: Practical approach, First edition, Kanishka publications and Distributors, New Delhi.

Reference Books:

1. Rajeev Goswami (2009).Biostatistics and computer applications, First edition, MD publications (P)Ltd, New Delhi
2. Wayne W, Daniel (2007). Biostatistics: A foundation for analysis in the health sciences, Seventh edition, Wiley India (P) Ltd, New Delhi.
3. Gupta,S.P.(1979). Statistical methods, Third edition, Sultan Chand & Sons, New Delhi.

Course Outcomes:

1. Understand the basic concept of data collection and techniques of sampling.
2. Describe the process of classification, tabulation and diagrammatic and graphic presentation of data
3. Acquire the knowledge to calculate the different measures of central tendency
4. Illustrate the properties of variance and standard deviation.
5. Choose the best logistic model that describes the relationship between variables

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	H	H	M	M	H	H	H	M	M
CO 2	H	H	H	M	L	H	H	H	L	L
CO 3	H	H	M	L	M	H	H	H	M	L
CO 4	H	H	M	L	M	H	H	H	L	L
CO 5	H	H	H	M	L	H	H	H	M	M

Aquaculture

Semester V **Hours of instruction / week: 4**

21BZOC17 **No of credit: 3**

Objectives:

1. To enable the students to understand the importance and applications of aquaculture.
2. To know the commercially important species and its culture practice.
3. To demonstrate the design, construction and maintenance of aquaria.

Unit 1. **Introduction to fisheries and aquaculture** 9hrs

History of aquaculture, Fishing gear and conventional fishing methods, Different types of nets (Seines, trawls, gill nets, trap nets, dip nets, casting net and blankets net), Hook and line gear

Unit 2. **Construction and management of fish farms** 15 hrs

Structure of fish ponds (bundhs, slope, berm), types of fish ponds, nursery ponds, Rearing ponds, Production pond. Fish culture in fresh water, Objectives of fish culture, Types of cultivable fishes, Breeding habits of cultivable fishes.

Practical 1: Analysis of morphometric and meristic characters of fish

Practical 2: Gut content analysis

Unit 3. **Composite fish culture** 12hrs

Sewage fed fisheries in carp culture, Brackish water fish culture, Integrated fish farming. Hormonal and genetic approach to fisheries, Cryopreservation of gametes, Hybridization, Transgenic fish, Inbreeding cross breeding and selective breeding.

Practical 3: Fish feed formulation using probiotics, fish waste and vegetable waste

Unit 4. **Setting and fabrication of aquarium tanks** 15 hrs

Accessories used in aquarium tank (aerators, filters, nets, gravels and ornamental objects), common ornamental fishes, and aquarium plants.

Practical 4: Setting up of an aquarium

Unit 5. **Taxonomy and biology of some popular ornamental fishes** 9 hrs

Live bearers (ovoviviparous), red sword tail, platy, guppy and molly. Egg layers (oviparous), Gold fish, Siamese fighting fish, gourami, angel fish, Oscar, breeding and spawning of liver bearers and egg layers.

Practical 5: Identification of ornamental fishes

Total hours : 60

Text Books:

1. Parker, R.O. (2012), Aquaculture Science, 2nd edition, Delmar Thomson Learning Publishers, Australia.
2. Chakrabaty, N.M., Chakrabaty P.P. and Mondal, S.C. (2010). Biology, breeding and farming of important food fishes, 1st edition, Narendra pub. House, Delhi.
3. Agarwal,S.C. (2007). A handbook of fish farming. 2ndedition.,Narendra publishing House, Delhi.

Reference Books:

1. Ranga and Shammi, (2003). Fish Biotechnology, Agrobios, India.
2. Gupta S. K. And Gupta P. C (2006). General and applied Ichthyology (Fish and Fisheries),S. Chand & Company, India.
3. Parker.R.O (2002). Aquaculture industry, 2nd edition, Delmar Thomson Learning Publishers, Australia.

Course Outcomes:

1. Identify significant operational and management practices in aquaculture systems.
2. Conceptualize, design, develop and manage commercial aquaculture farm units.
3. Acquire technical knowledge in applied genetics in aquaculture and composite fish culture systems.
4. Fundamental insights to start-up an ornamental fish culture unit
   Identify the different types of ornamental fishes.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	H	H	H	H	M	M	H	H	H
CO 2	H	M	H	H	H	M	H	M	H	H
CO 3	H	M	H	H	H	M	M	L		H
CO 4	H	H	H	H	H	H	H	L	M	H
CO 5	H	H	H	H	H	L	H	M	L	H

Practicals V – Biochemistry and Animal Physiology

Semester V **Hours of instruction/week: 5**
21BZOC18 **No of credits : 2**

Biochemistry

1.	Quantitative estimation of carbohydrates	5
2.	Quantitative estimation of lipids	5
3.	Quantitative estimation of proteins	5
4.	Effect of enzyme activity at different pH	5

Animal Physiology

5.	Human Blood smear preparation	5
6.	Erythrocyte and Leucocyte count using Haemocytometer	5
7.	Estimation of Haemoglobin	5
8.	Estimation of excretory products of animals	5
9.	Analysis of digestive enzymes in cockroach	5
10.	Ciliary activity of fresh water mussel in relation to temperature	5
11.	Estimation of Oxygen consumption in an aquatic animal	5
12.	Slides – Striped, Unstriped and Cardiac muscle	5
13.	Human Anatomy - Integument, digestive, respiratory circulatory, excretory system (from models)	15

Total hours : 75

Course outcomes:

1. Demonstrate the common laboratory techniques used in biochemistry.
2. Infer the biochemical constituents in food samples.
3. Knowledge on the fundamental of tissue and blood.
4. Know the structure and function of human anatomy.
5. Ability to identify the models and slides.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	H	H	H	H	H	H	H	H	H
CO 2	H	H	H	H	M	M	H	M	M	H
CO 3	H	H	H	H	M	M	H	M	M	H
CO 4	H	H	H	H	H	M	M	H	H	M
CO 5	H	M	M	M	M	M	L	L	L	H

Sericulture and Apiculture (Self Study course)

Semester V **Hours of instruction / week : 1**

21BZOC19 **No of credit : 4**

Objectives :

1. To enable the students to learn the basics of silk worm rearing techniques
2. To understand the economic importance of sericulture and apiculture
3. To obtain knowledge on the basic facts about bees and bee keeping

Unit 1.	**Introduction** History of sericulture , economic importance of sericulture , varieties of silk worms, mulberry, tassar, eri and muga silkworms, life cycle of *Bombyxmori*	3hrs
Unit 2.	**Silk worm rearing** Rearing house, facilities, rearing equipments, optimum environmental conditions, spacing, chawki, shelf-floor and shoot rearing , mounting and harvesting, cocoon marketing	3 hrs
Unit 3.	**Silkworm diseases** Pebrine, flacherie, grasserie, muscardine, methods of prevention, pests of silkworms	3 hrs
Unit 4.	**Types of honey bees and Bee colony** Rock bee, Indian bee, European bee, Little bee, Dammer bee and their identification, bee colony, its members, life cycle of honey bee	3 hrs
Unit 5.	**Apiary** Types of bee hives, accessories of apiculture, enemies of bees Honey - extraction, properties, chemical composition, preservation and storage, nutritive and medicinal value	3 hrs
	Total hours :	15

Text Books:

1. Pradip, J. V., (2005). Text Book of Applied Zoology: Vermiculture, Apiculture, Sericulture and their controls, First Edition, Discovery Publishers, New *Delhi*.
2. Ahsan, J. and Sinha, S.P. (2010). A Handbook of Economic Zoology, Fifth Edition, S.Chand Publishing Company, New Delhi.
3. Bhargav, B K. (2016). Text Book of Economic Zoology, Omega Publications, Fifth Edition, New Delhi.

Reference Books:

1. Singh, T., Bhat, M.M., Khan, M.A. (2009). Sericulture Extension – Principles and Management, MotilalBanarsidas Publishers Private Limited.
2. Philips, E.F. (2003). Bee keeping, International Books & Periodicals Supply Services, New Delhi.
3. Chakravorty, D. and Pandey P.N. (2005). Silkworm Crops, APH Publishing Corporation, New Delhi.

Course Outcomes:

1. Acquire the fundamental knowledge of silkworm and honey bee
2. Comprehend the methodologies involved in silkworm rearing
3. Asses self employment in sericulture and apiculture
4. Apply different strategy of bee keeping techniques and its byproducts
5. Understand the control of pests of silkworm and honey bee

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	H	H	H	H	H	H	M	H	H
CO 2	H	H	H	H	H	H	H	M	H	H
CO 3	H	H	H	H	H	H	L	M	H	H
CO 4	H	H	H	H	H	H	H	M	H	H
CO 5	H	H	H	H	M	H	H	M	H	M

Ornamental fish culture (Generic Elective Course)

Semester V **Hours of instruction/week: 2**

21BZOO01 **No. of credits: 2**

Objectives:

1. To demonstrate to design, construct and maintain home aquaria.
2. To provide self-employment
3. To educate the students on the importance and relevance of recreational fisheries in the society

Unit 1.	**Fresh water aquarium** Introduction, definition, origin, history of aquarium, types of aquarium, nature of aquaria, space and setting of aquarium tank.	6 hrs
Unit 2.	**Taxonomy and biology of some popular ornamental fishes** Live bearers (ovoviviparous),red swordtail, platy, guppy and molly. Egg layer (oviparous), gold fish, siamese fighting fish, gourami, angel fish, koi carp, oscar and neon tetra. Breeding and spawning of live bearers and egg layers.	6 hrs
Unit 3.	**Accessories used in aquarium tank and its maintenance** Accessories used in aquarium tank (aerator, filters, nets, gravel, ornamental objects). Maintenance of water quality, (temperature, ammonia, pH, O_2 / CO_2) control of snail and algal growth.	6 hrs
Unit 4.	**Nutritional requirements of ornamental fish** Different kinds of feeds- Live feed, culture of live feed organisms, infusoria, chironomous, tubifex, rotifers cladocerans and brine shrimp. Artificial feed, feed formulations, uses of natural and synthetic feed additives, balanced diet.	6 hrs
Unit 5.	**Marine ornamental fishes and diseases** Important marine ornamental fishes, purchase and transport of ornamental fishes, other ornamental organisms. Common diseases- protozoan, fungal, bacterial and nutritional diseases, their diagnosis and treatment.	6 hrs

Total hours : 30

Text Books:

1. Jagtap, H.S., Mukherjee, S.N. and Garad, V.K., (2009). A Text Book of Pisiculture and Aquarium Keeping, Daya Publishing House, New Delhi.
2. AmitaSaxena (2003). Aquarium management. Daya publishing House, New Delhi.
3. Pandey and Shukla (2005). Fish and Fisheries, 1st edition, Rastogi Publication.

Reference Books:

1. Venkataramani, V.K., (2004), Biodiversity and Stock Assessment of Marine Ornamental Fishes, Department of Fisheries Biology and Capture Fisheries, Fisheries College and Research Institute, TNAUVAS, Tuticorin.
2. S.C.Agarwal (2007). A handbook of fish farming. Narendra pub. House, Second edition, New Delhi.
3. Srivastava.B.B.L. (1999) A Text book of fishery science and Indian Fisheries, Allahabad.

Course Outcomes:

1. Acquire knowledge on the importance of aquaculture.
2. Assess the systematic and importance of ornamental fishes.
3. Develop the construction techniques of aquarium and its maintenance
4. Gain capability to design novel formulated feeds for ornamental fishes.
5. Identify the fish diseases, diagnosis and treatment

Microbiology

Semester VI **Hours of instruction / week : 5**
21BZOC22 **No of credit : 3**

Objectives :

1. To enable the students to know about the aspects of microorganisms
2. To know the pathogenesis of microorganisms
3. To gain knowledge on the applications of microbes and its significance in various fields.

Unit 1. **Introduction** 15hrs

History and scope of microbiology, Classification of bacteria, fungi and virus

Unit 2. **Microbial culture and growth** 15 hrs

Sterilization, media types and preparation, sample collection, isolation, maintenance of microbes, bacterial growth pattern, factors affecting growth, measurements of growth.

Unit 3. **Food Microbiology** 15 hrs

Food spoilage, Food borne diseases - Food borne infections - Salmonellosis, Bacillary dysentery, Q fever, Food borne intoxications– Botulism, Staphylococcal poisoning, Aflatoxins, Food preservation

Unit 4. **Industrial and Environmental Microbiology** 15hrs

Fermentor design, microbial selection, ethanol and penicillin production, water analysis, sewage treatment.

Unit 5. **Medical Microbiology** 15 hrs

Bacterial Diseases – Tuberculosis, Leprosy, Syphilis, Cholera.

Fungal Diseases – Cutaneous and systemic mycoses.

Viral Diseases – Chicken pox, Influenza, Rabies, Hepatitis, Poliomyelitis, AIDS.

Total hours : 75

Text Books:

1. Dubey, R.C. and Maheswari, D.K. (2000). A text book of Microbiology. Fourth Edition, S. Chand and Company Ltd, New Delhi.
2. Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton (2014). Prescott's Microbiology, 9th edition, McGraw Hill Education, New York.
3. Anthanthanarayanan, R. and JayaramPaniker (2009). Text book of Microbiology, Eighth Edition, Universities Press (India) Private Ltd., Hyderabad.

Reference Books:

1. Powar, C.B. and Daginawala, H.F. (2001). General Microbiology. Fourth Edition, Himalaya publishing house, New Delhi.
2. Jeffrey Pommerville (2014). Alcamo's Fundamentals of Microbiology, First Edition, Jones and Bartlett India Pvt. Ltd., New Delhi.
3. Talaro, K.P and Talaro, A. (2002). Foundations in Microbiology, Fourth Edition, McGraw Hill Education, New York.

Course Outcomes:

1. Describe the importance of microbial groups
2. Apply microbial techniques to solve scientific problems
3. Assess the importance of microbes in food and industrial sector
4. Suggest the strategy for pollutant decontamination
5. Communicate the roles of microbes in ecosystem and health-related issues

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	M	M	H	M	H	H	H	H	H	L
CO 2	M	M	M	H	M	M	H	M	M	H
CO 3	H	H	H	H	M	M	M	M	M	M
CO 4	H	H	H	H	H	H	M	M	H	M
CO 5	H	H	H	H	H	H	M	H	H	H

Immunology

Semester VI **Hours of instruction / week: 5**

21BZOC23 **No of credit: 3**

Objectives:

1. To identify major components of the immune system at organ, cellular and molecular levels.
2. To discuss normal functions of these components during immune responses.
3. To learn principles of transplantation immunology

Unit 1	**Introduction to Immunology** History of immunology, immunity, types of immunity, lymphoid organs, primary, thymus, bursa of fabricius, bone marrow, secondary, lymph nodes, spleen.	15 hrs
Unit 2	**Antigen and Antibody** Factors for antigenicity, epitope and paratope, major classes of antigens, Immunoglobulins, structure, classes, properties and functions. Antigen – antibody interaction, primary interaction, secondary interaction. Application of antigen - antibody interactions.	15 hrs
Unit 3	**Cells of immune system** Lymphocytes and its types, macrophages, eosinophils, basophils, neutrophils, mast cells antigen presenting cells, platelets. Immune response, types, humoral immune responses, B cell activation, cell mediated immune response.	15 hrs
Unit 4	**Complement** Complement activation, classical, alternate pathway, biological functions. Major histocompatability complex , histocompatable molecules , human leucocyte antigen, functions	15 hrs
Unit 5	**Hypersensitivity** Types, mechanism of type 1 hypersensitivity. Transplantation immunology, types of graft, graft acceptance and rejection, mechanism of allograft rejection, prevention of graft rejection.	15 hrs

Text Books:

1. Kuby, J. 2007. Immunology. 6th edition, W.H.Freeman and Co, New York.
2. Banarjee, A. and Nirmala, B.2006. Fundamentals of Microbiology and Immunology. New Book Agency, Kolkata.
3. Roitt, I.M., Brostoff, J. 2002. Immunology. Mosby Publishers, London

References Books:

1. Murphy, K., Travers, P. and Walport, M. 2008. Immunology. Garland Science, UK.
2. Benjamini, E.,Coico, R. 2000. Immunology. A short course, John Willey Inc., New York.
3. David, K. M., Jonathan, David,B.R and Ivan,M.R. 2013. Immunology, 8th Edition, Elsevier-Saunders publications

Course Outcomes:

1. Describe the basic mechanisms, distinctions and functional interplay of innate and adaptive immunity
2. Apply immunologic techniques to solve certain clinical and research problems
3. Identify the role of antigen presenting cells, lymphocytes, and phagocytic cells in immune responses
4. Elucidate the relationship between major cellular and molecular components of the immune system.
5. Describe the basic structure of the cellular receptors and discuss their interactions during an immune response.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	M	H	H	L	L	M	L	H	L
CO 2	H	M	H	H	L	M	M	M	H	M
CO 3	M	M	M	M	L	L	L	L	H	L
CO 4	M	M	H	H	L	L	L	M	H	L
CO 5	H	H	M	H	L	M	M	L	H	L

Developmental Biology

Semester VI **Hours of instruction/week: 5**
21BZOC24 **No of credits: 3**

Objectives :

1. To enable the students to understand the basic principles of growth and development
2. To understand the general concept of ontogenic development
3. To understand the application of developmental biology

Unit 1. Introduction 15 Hrs

Historical reviews, scope of embryology, gametogenesis, spermatogenesis, structure of a typical sperm, significance, oogenesis, egg types, egg membranes

Unit 2. Fertilization 15 Hrs

Mechanism and significance of fertilization, cleavage, features, planes and patterns of cleavage, morula, blastula, cleavage in frog, chick and rabbit, fate maps, construction of fate maps, fate map of frog and chick.

Unit 3. Gastrulation 15 Hrs

Features of gastrulation, morphogenetic movements, gastrulation of frog and chick, significance

Unit 4. Organogenesis 15 Hrs

Ectodermal derivatives, development of brain and eye, endodermal derivatives, development of alimentary canal and associated glands. mesodermal derivatives, development of heart and kidney, development of foetal membranes in chick

Unit 5. Embryology of the mammal 15 Hrs

Human embryo development during trimester, implantation, tubal pregnancy. placentation in mammals, structure, types, functions

Total hours : 75

Text books:

1. Gilbert, (2006), Developmental Biology, Tamil Nadu Book House Publishers, Chennai
2. Verma, P. S. and Agarwal, V. K. (2012). Chordate embryology, S Chand & Company Ltd, New Delhi.
3. Veer BalaRastogi. (2011). Chordate Embryology (Developmental biology) Edition 2011, KedarNath Ram Nath Publishers, Meerut (U.P).

Reference books:

1. Banerjee, S., (2001), A Textbook of Developmental Biology, Dominant Publishers and Distributors, New Delhi.
2. Khana, D.R., (2004), Advanced Embryology, Discovery Publishing House, New Delhi.
3. Mathur, R. and Mehta, M., (2002), Embryology, Anmol Publications Private Limited, New Delhi.

Course Outcomes:

1. Familiarize the events in process of fertilization and embryogenesis
2. Knowledge on cytological background of animal development;
3. Compare development and homeostasis in different animals models
4. Insights on the complex developmental process of organs
5. Awareness on the human foetal development and child birth.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	H	H	M	M	H	H	H	M	M
CO 2	H	H	H	M	L	H	H	H	L	L
CO 3	H	H	M	L	M	H	H	H	M	L
CO 4	H	H	M	L	M	H	H	H	L	L
CO 5	H	H	H	M	L	H	H	H	M	M

Environmental Biology

Semester VI **Hours of instruction/week : 5**
21BZOC25 **No of credits : 3**

Objectives :

1. To enable the students to understand the various factors of environment
2. To know about the interaction between organizations of environment
3. To know the effects of population and its control measures

Unit 1. **Introduction to Ecology** 15Hrs

Segments of earth- Environment, atmosphere, hydrosphere, lithosphere.

Abiotic factors - light, temperature, humidity, Biogeochemical cycles- oxygen, nitrogen, phosphorus and sulphur cycles

Unit 2. **Population ecology** 15 hrs

Definition, density, natality, mortality, population growth, population equilibrium, population fluctuations, biotic potential, dispersal, dispersion, regulation of population.

Unit 3. **Community ecology** 15 hrs

Definition, types of community, characteristics of community- community diversity, structure, community dominants, stratification, community periodicity, ecotone and edge effect, ecological niche, ecological equivalents, concepts of community, ecological succession.

Unit 4. **Animal adaptations** 15 hrs

Aquatic adaptation- primary and secondary,cursorial adaptation, desert adaptation- desert fauna and its characters,cave adaptation- origin, zonation, characters, cave fauna and flora, burrowing adaptations, arboreal adaptations, flight adaptations-passive and true flight.

Unit 5. **Environment impact assessment** 15 hrs

Steps in EIA, problems and potential solutions, methods of EIA, prospects for the future, EIS, environmental awareness, RIO summit and agenda, social forestry, Chipko movement, environmental auditing - types, methods, reporting

Total hours : 75

Text books:

1. Verma, P.S. and Agarwal, V.K. (2006), Cell biology, Genetics, Molecular Biology, Evolution and Ecology, Second edition, S. Chand and Company Ltd., New Delhi.
2. Kapoor, M. (2009), Disaster Management, First edition, MotilalBanarsidass Publishers Private Ltd., New Delhi
3. Odum, E.P. (1996). Fundamentals of Ecology Third edition, NatarajPublishers, Dehradun

Reference books:

1. Subrahmanyam, N.S. and Sambamurthy, A.V.S.S. (2006), Ecology, Second Edition, Narosa Publishing House Pvt. Ltd., New Delhi.
2. Rana, S.V.S., (2006), Environmental Pollution, Second Edition, Narosa Publishing House Pvt. Ltd., New Delhi
3. GaganMatta(2018) A text book of Environmental Science, first edition, KedarNath Ram Nath publishers , Meerut, U. P, India.

Course Outcomes:

1. Ability to express the mechanisms of interactions between different spheres of environment.
2. Knowledge on population parameters related to demography and population growth.
3. Imbibe the types and characteristics of community associated to ecosystem functions.
4. Gain knowledge on adaptations among animals for specific habitat.
5. Ability to critically observe the developmental actions with the fundamentals understanding of EIA.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	H	H	H	H	H	H	H	H	M
CO 2	H	H	H	H	M	M	H	M	H	L
CO 3	H	H	M	M	H	H	H	M	H	L
CO 4	H	H	H	M	H	M	H	L	H	L
CO 5	H	H	H	H	M	M	H	L	H	L

Practicals VI - Microbiology and Immunology

Semester VI **Hours of instruction / week : 5**

21BZOC26 **No of credit : 2**

Objectives :

1. To enable the students to isolate and identify the microorganisms using aseptic technique
2. To understand the factors that influence microbial growth.
3. To know the functions and usage of immunologic testing.

I. Microbiology

1	Isolation of microbes from soil by pour plate method	5 Hrs
2	Isolation of microbes from water by spread plate method	5 Hrs
3	Maintenance of microbial cultures by streaking methods	5 Hrs
4	Identification of bacteria by Gram staining	5 Hrs
5	Identification of bacteria by negative staining	5 Hrs
6	Identification of fungi by lacto phenol cotton blue staining	5 Hrs
7	Estimation of amylase isolated from microbial source	5 Hrs
8	Methylene blue reductase test for milk	5 Hrs
9	Bacterial growth curve	5 Hrs
10	Antibiotic sensitivity test	5 Hrs
11	Isolation of Coliforms from sewage	5 Hrs

II. Immunology

12	Demonstration of Ag – Ab interaction	5 Hrs
13	Isolation of lymphocytes on histopaque	5 Hrs
14	Precipitating ring test	5 Hrs
15	Single radial immunodiffusion	5 Hrs

Total hours : 75

Course Outcomes:

1. Identify the unknown microbes using staining techniques
2. Recognize and explain the use of common culture media
3. Assess the microbes in food samples
4. Detect possible drug resistance in common pathogens
5. Apply the immunological techniques in clinical diagnosis

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	H	H	H	L	H	M	M	M	H
CO 2	H	M	H	H	L	M	H	L	M	H
CO 3	H	H	H	H	L	H	H	M	M	H
CO 4	H	H	H	H	L	H	M	L	M	M
CO 5	H	H	H	H	L	H	M	L	M	M

Practicals VII - Developmental and Environmental Biology

Semester VI **Hours of instruction/week : 5**

21BZOC27 **No of credits : 2**

Objectives:

- Understand the developmental stages of frog and chick
- Learn the structure of embryo of various animals
- Learn the methods to estimate the physiochemical parameters of water samples

Developmental Biology

Microscopic examination of slides of frog

1. V.S of ovary of frog
2. Egg of frog (2,4,8 and 32 celled stage)
3. T.S of gastrula with yolk plug
4. Frog early gastrula
5. T.S of neural plate
6. T.S of neural fold
7. T.S of neural tube
8. Tadpole larva 4mm
9. Tadpole larva 7mm
10. Tadpole larva 10 mm

15 hrs

Microscopic examination of slides of chick embryo 15 hrs

1. Hen's egg
2. 18h chick embryo
3. 24h chick embryo
4. 36h chick embryo
5. 48h chick embryo
6. 72h chick embryo
7. 96h chick embryo

Spotters – Embryos of animals

1. Embryo of Rat
2. Embryo of Rabbit
3. Embryo of Pig
4. Embryo of Sheep

5 hrs

Environmental Biology

1. Estimation of pH of different water samples using pH meter
2. Estimation of salinity of different water samples
3. Estimation of dissolved oxygen in water samples
4. Estimation of dissolved carbon dioxide in different water samples
5. Determination of total alkalinity in different water samples
6. Estimation of TDS,TSS and TS in the given water sample
7. Estimation of chloride in water samples
8. Estimation of nitrates in water samples

40 hrs

Total hours : 75

Course Outcomes:

1. Maintain accurate records of laboratory experiments.
2. Know the differentstages of development of frog and chick
3. Describe the variations of embryos of mammals
4. Identify strategies for asking good questions in biological research
5. Apply the scientific method and quantitative techniques to describe, monitor and understand environmental systems.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	L	L	M	L	M	H	L	M	H
CO 2	H	M	M	M	M	M	M	M	M	M
CO 3	H	M	M	M	M	M	M	M	M	M
CO 4	H	M	M	M	M	M	M	M	M	M
CO 5	H	M	M	M	M	M	M	M	M	M

DSE-I Nonchordates and Chordates
(for B.Sc. Botany students)

Semester I **Hours of instruction / week : 4**
21BBOI01 **No of credit : 3**

Objectives:

1. To identify the salient features of non-chordates
2. To develop skills and acquire knowledge about the biology of non-chordates and chordates
3. Learn the importance of non-chordates and chordates

Unit 1.	**Introduction to Non-chordates**	12hrs
	General characters and outline classification of non-chordates with examples,	
	Type study - Paramecium.	
	Type study - Earthworm.	
Unit 2.	**Arthropoda and Mollusca**	12 hrs
	Type study - Cockroach.	
	Type study – *Pila globosa*.	
Unit 3.	**Introduction to Chordates**	12 hrs
	General characters and outline classification of chordates,	
	Type study - Scoliodon (Endoskeleton excluded).	
Unit 4.	**Amphibia**	12 hrs
	Type study - Frog (Endoskeleton excluded) parental care in Amphibia	
Unit 5.	**Mammals**	12 hrs
	Type study - Rabbit (Endoskeleton excluded), monotremes and marsupials.	
	Total hours :	60

Text books:

1. Ekambaranatha Ayyar, (2016). Manual of Zoology, Invertebrates, Fifth edition (revised edition) Vol. I, S.Viswanathan, (Printers and publishers) Pvt. Ltd., Chennai.
2. Ekambaranatha Ayyar, (2002). Manual of Zoology, Chordates, Fourth edition (revised edition) Vol. II, S.Viswanathan (Printers and publishers) Pvt. Ltd., Chennai.
3. Jordan, A.L and Verma, P.S (2014). Invertebrate Zoology, Second edition,S. Chand Publishing company Pvt. Ltd., New Delhi

Reference books:

1. Dr. K. S. Kohli, Dr. M. M.Trigunayat and Dr.KavithaSahani., 2008,Invertebrates (Structure & function), Ramesh Book Depot, Jaipur - New Delhi.
2. Edward E.Ruppert., Richard S.Fox. and Robert D.Barnes, 2006, Invertebrates Zoology, Seventh edition, Thomson Brooks/cole, USA.
3. H.V. Bhaskar (2010), Chordates (Volume 2), First edition, Campus book international, New Delhi.

Course Outcomes:

1. Acquire knowledge about fundamental non-chordate and chordate characters and basic principles of classification.
2. Describe the distinctive features selected invertebrate organisms.
3. Discuss the characteristics and outline classification of chordates and general organization of vertebrates
4. Identification of morphological and anatomical structure of selected vertebrates.
5. Illustrate the mammalian characteristic features with its diversification.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	M	M	M	H	H	H	M	H	H
CO 2	H	H	L	M	H	H	H	M	H	H
CO 3	H	M	L	M	H	H	H	L	H	H
CO 4	H	M	M	M	H	H	H	M	H	H
CO 5	H	M	L	M	H	H	H	M	H	H

DSE I Practicals I - Nonchordates and Chordates

Semester I **Hours of instruction / week : 3**

21BBOI02 **No of credit : 2**

Objectives:

1. To make students to understand slides of non-chordates
2. To make students to identify museum specimen
3. To develop skills in animal dissections

Dissections	Cockroach - Digestive system	12hrs
	Cockroach - Nervous system	12 hrs
Spotters	Ameoba, Euglena, Paramecium, Leucosolenia, Obelia colony, Madrepora, Planaria, Ascaris, Nereies, Peripatus, Prawn, *Pila globosa*, Sea star and sea cucumber	12 hrs
Dissection	**Chordates** Fish - Visceral organs	12 hrs
Spotters	Scoliodon, Ophiocephalus, *Rana hexadactyla*, Ichthyophis, Rabbit	12 hrs
	Total hours :	60

Course Outcomes:

1. Study the external as well as internal characters of non-chordates.
2. Ability to identify external morphology of animals by observing the slides.
3. Understand and study various systems in chordates.
4. Discuss the fundamental characters and identify the groups of chordates by observing the preserved specimens.
5. Maintain accurate records of laboratory experiments

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	M	M	M	H	L	H	M	H	H
CO 2	H	H	L	M	H	H	L	M	H	H
CO 3	H	M	L	M	M	H	H	L	H	H
CO 4	H	M	M	M	H	M	H	M	H	H
CO 5	H	M	L	M	L	H	H	M	H	H

DSE-II - Developmental Zoology and Animal Physiology

Semester - II **Hours of instruction / week : 4**
21BBOI03 **No of credit : 3**

Objectives :

1. To enable the students to understand the basic principles of growth and development
2. To understand the application of developmental biology.
3. To enable the students to understand the physiological aspects of life, apply the knowledge in day to day life.

Unit 1. Gametogenesis 12 hrs

Spermatogenesis, structure of a typical sperm, spermatogenesis, oogenesis - multiplication, growth phase, maturation phase

Unit 2. Fertilization 12 hrs

Fertilization, mechanism and significance of fertilization, cleavage, planes and patterns, blastulation and gastrulation in frog, test tube baby, twins

Unit 3. Digestion and Respiration 12 hrs

Nutrition, types of nutrition, digestion and absorption in a mammal.

respiration, organs of respiration, respiratory pigments, transport of gases

Unit 4. Circulation 12 hrs

Heart types, structure of mammalian heart, origin and conduction of heart beat, composition and functions of blood, blood pressure

Unit 5. Excretion 12 hrs

Excretory organs and excretory products of animals, structure of mammalian kidney, urine formation, composition of urine, sexual cycles, pregnancy, menopause, hormones in reproduction

Total hours : 60

Textbooks:

1. Gilbert, (2006). Developmental Biology, Sixth edition, Tamil Nadu Book House, Chennai.
2. Agarwal, R.A., Anil K. Srivastava, Kumar, K., (2007). Animal Physiology and Biochemistry, S. Chand and Company Ltd., New Delhi.

3. Veer Bala Rastogi. (2011). Chordate Embryology (Developmental biology) Edition , KedarNath Ram Nath Publishers, Meerut (U.P).

Reference books:

1. Khana, D.R., (2004), Advanced Embryology, Discovery Publishing House, New Delhi.
2. Bhaskar, H.V., (2008), Animal Physiology, Campus Books International, New Delhi.
3. Verma, P.S., Thyagi, B.S and Agarwal, V.K(2000), Animal Physiology, Sixth edition, S. Chand Publishing company Pvt. Ltd., New Delhi

Course Outcomes:

1. Ability to describe the processes of gametogenesis and fertilization
2. Understand the embryonic development of frog and significance of test tube baby and twins in human
3. Understand the biological process of digestion and respiration in higher animals
4. Evaluate the interdependence of circulation and excretion
5. Study the coordination of physiological process in a systematic way

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	M	M	H	M	L	H	M	H	H
CO 2	H	H	M	H	H	M	H	H	H	H
CO 3	H	M	M	H	H	L	H	H	H	H
CO 4	H	M	H	H	H	M	H	H	H	H
CO 5	H	M	M	H	H	M	H	H	H	H

DSE-II Practicals II - Developmental Zoology and Animal Physiology

Semester II **Hours of Instruction/week : 3**
21BBOI04 **No. of credits : 2**

Objectives:

1. To study the developmental stages of frog.
2. To know the metamorphosis of frog.
3. To learn the experiments in animal physiology.

Developmental Zoology

1. Microscopic examination of slides on frog embryology 10 hrs
2. T.S.of ovary
3. Early blastula
4. Gastrula with yolk plug
5. T.S of neural fold
6. T.S of neural plate
7. T.S of neural tube
8. Tadpole larva 4mm
9. Tadpole larva 7mm
10. Tadpole larva 10 mm

Animal physiology

Human blood smear preparation	10 hrs
Estimation of excretory products of animals	5 hrs
Analysis of digestive enzymes in cockroach	5 hrs
Estimation of oxygen consumption in an aquatic animal	5 hrs
Estimation of hemoglobin	5 hrs
Enumeration of RBC by hemocytometer	5 hrs

Total hours : 45

Course Outcomes:

1. Maintain accurate records of laboratory experiments.
2. Know the different stages of developmental of frog
3. Describe the variations in different stages of metamorphosis of frog
4. Able to estimate the hemoglobin count and RBC count in man
5. Develop skills to carry experiment in physiology

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	H	M	M	H	M	L	H	M	H	H
CO 2	H	H	M	H	H	M	H	H	H	H
CO 3	H	M	M	M	L	L	H	H	L	H
CO 4	H	M	H	H	M	M	H	H	M	H
CO 5	H	M	M	H	H	M	H	H	H	H