ST. MARY'S COLLEGE (Autonomous)

(Re-accredited with 'A$^+$' Grade by NAAC)

Thoothukudi-628001, Tamil Nadu

(Affiliated to Manonmaniam Sundaranar University)

Syllabus

B.Sc. Zoology

School of Biological Sciences

Outcome Based Curriculum

(W.e.f.2018)

Preamble

Zoology is a vital stream of science, it gives an insight into the essence of life. It helps for the betterment of human race through various fields. It unravels the magic of co-existence and ecological balance by creating awareness of conservation of biodiversity. After completing the graduate degree the candidates have tremendous opportunities for higher studies and lots of job opportunities both in public and private sectors.

Vision: To prepare young women face the challenges of life through education, an ideal weapon for empowerment.

Mission: To impart knowledge and skills in zoology through specialization in recently emerging technologies and thereby to produce quality graduates capable of contributing to the development of knowledge based society.

Programme Outcome

PO.No	Upon completion of B.Sc. Degree programme , the graduates will be able to
PO - 1	apply the acquired knowledge of fundamental concepts in the field of science and to find solutions to various problems.
PO - 2	inculcate innovative skills and team – work among students to meet societal expectations.
PO - 3	perform analysis to assess, interpret, and create innovative ideas through practical experiments.
PO - 4	facilitate to enter multidisciplinary path to solve day-to-day scientific problems.
PO - 5	carry out fieldworks and projects, both independently and in collaboration with others, and to report in a constructive way.
PO - 6	improve communication ability and knowledge transfer through ICT aided learning integrated with library resources.
PO - 7	transfer the knowledge to the other stakeholders through extensive community development programme.
PO - 8	attain competency in job market / entrepreneurship.

Course Structure (w.e.f. 2018)

Semester –I

Part	Components	Sub. Code	Title of the Paper	Hrs/ Week	Credits	Max.Marks		
						CIA	ESE	Total
I	Tamil French	18ULTA11 18ULFA11	இக்கால இலக்கியம்: செய்யுள், இலக்கணம், உரைநடை,சிறுகதை, இலக்கியவரலாறு Preliminary French Course	6	4	40	60	100
II	General English	18UGEN11 (Stream A/B/C)	Prose, Poetry, Extensive reading & Language study- I	6	4	40	60	100
III	Core I	18UZOC11	Invertebrata - I	4	4	40	60	100
	Core II Core Practical I	18UZOC12 18UZOCR1	Invertebrata - II **18UZOC11** **18UZOC12**	4 2	4 1	40	60	100
	Allied I Allied Practical I	18UCHA11 18UCHAR1	Chemistry for Biological Sciences- I	4 2	3 1	40	60	100
IV	Ability Enhancement Course	18UAVE11	Value Education	2	2	20	30	50
Total				**30**	**23**			

Semester II

Part	Components	Sub. Code	Title of the Paper	Hrs/ Week	Credits	Max.Marks		
						CIA	ESE	Total
I	Tamil French	18ULTA21 18ULFA21	சமய இலக்கியங்களும், நீதி இலக்கியங்களும்: செய்யுள், இலக்கணம், உரைநடை, வாழ்க்கை வரலாறு,இலக்கியவரலாறு Basic French Course	6	4	40	60	100
II	General English	18UGEN21 (Stream A/B/C)	Prose, Poetry, Extensive reading & Language study- II	6	4	40	60	100
III	Core III	18UZOC21	Chordata -I	4	4	40	60	100
	Core IV Core Practical II	18UZOC22 18UZOCR2	Chordata- II **18UZOC21** **18UZOC22**	4 2	4 1	40	60	100
	Allied I Allied Practical I	18UCHA21 18UCHAR1	Chemistry for Biological Sciences -II	4 2	3 1	40	60	100
IV	Ability Enhancement Course	18UAEV21	Environmental Science	2	2	20	30	50
Total				**30**	**23**			

Semester III

Part	Components	Sub. Code	Title of the Paper	Hrs/ Week	Credits	Max.Marks		
						CIA	ESE	Total
I	Tamil French	18ULTA31 18ULFA31	காப்பிய இலக்கியம்: செய்யுள், இலக்கணம், உரைநடை, சிறுகதை, இலக்கியவரலாறு Advanced French Course	6	4	40	60	100
II	General English	18UGEN31	Prose, Poetry, Extensive reading & Language study -III	6	4	40	60	100
III	Core V Core Practical III	18UZOC31 18UZOCR3	Developmental Biology and Evolution 18UZOC31	4 2	4 1	40	60	100
	Allied II Allied Practical II	18UBOA31 18UBOAR2	Plant Diversity	4 2	3 1	40	60	100
	Core Skill Based	18UZOS31	Fishery Products	4	4	40	60	100
	NME I	18UZON31	Basic Biotechnology	2	2	20	30	50
IV	Ability Enhancement Course	18UAWS31	Women's Synergy		2	20	30	50
	Self Study or On-line Course / Internship (Optional)	18UZOSS1	Dairy Management		+2		50	50
Total				**30**	**25+2**			

Semester IV

Part	Components	Sub. Code	Title of the Paper	Hrs/ Week	Credits	Max.Marks		
						CIA	ESE	Total
I	Tamil French	18ULTA41 18ULFA41	சங்க இலக்கியம்: செய்யுள், இலக்கணம், உரைநடை, வாழ்க்கைவரலாறு, இலக்கிய வரலாறு Language through literature	6	4	40	60	100
II	General English	18UGEN41	Prose, Poetry, Extensive reading &Language study- IV	6	4	40	60	100
III	Core VI Core Practical IV	18UZOC41 18UZOCR4	Biochemistry 18UZOC41	4 2	4 1	40	60	100
	Allied II Allied Practical II	18UBOA41 18UBOAR2	Angiosperm Taxonomy and Plant Physiology	4 2	3 1	40	60	100
	Core Skill Based	18UZOS41	Clinical Laboratory Technology	4	4	40	60	100
	NME II	18UZON41	Applied Biotechnology	2	2	20	30	50
IV	Ability Enhancement Course	18UAYM41	Yoga and Meditation		2	20	30	50
	Self Study / Online Course (Optional)	18UZOSS2	Aquarium Fish Keeping		+2		50	50
	NCC, NSS & Sports				1			
	Extension Activities CDP				+1			
Total				**30**	**26+3**			

Semester V

Part	Components	Sub. Code	Title of the Paper	Hrs/ Week	Credits	Max.Marks		
						CIA	ESE	Total
III	Core VII (Common Core)	18UBCC51	Biotechnology	4	3	40	60	100
	Core VIII	18UZOC52	Animal Physiology	5	4	40	60	100
	Core IX	18UZOC53	Cell Biology and Genetics	5	4	40	60	100
	Core Integral I	18UZOI51	Marine Biology	4	4	40	60	100
	Core Integral II	18UZOI52	Commercial Aquaculture	4	4	40	60	100
	Common core Practical V	18UBCCR1	18UBCC51	2	1			
	Core Practical VI	18UZOCR5	18UZOC52, 18UZOC53	4	2	40	60	100
IV	Common Skill Based Core	18UCSB51	Computer for digital era and soft skills	2	2	20	30	50
	Self Study / On-line Course (Compulsory)	18UZOSS3	Vermitechnology	--	2		50	50
Total				**30**	**26**			

Semester VI

Part	Components	Sub. Code	Title of the Paper	Hrs/ Week	Credits	Max.Marks		
						CIA	ESE	Total
III	Core X	18UZOC61	Immunology and Microbiology	5	4	40	60	100
	Core XI	18UZOC62	Biostatistics and Bioinformatics	5	4	40	60	100
	Core XII	18UZOC63	Ecology and Biodiversity	4	4	40	60	100
	Core Integral III	18UZOI61	Sericulture	4	4	40	60	100
	Core Practical VII	18UZOCR6	18UZOC61 18UZOC62 18UZOC63	6	3	40	60	100
IV	Project	18UZOP61		6	3	40	60	100
Total				**30**	**22**			
Total				**180**	**145+5**			

Semester	Hours	Credits	Extra Credits
I	30	23	---
II	30	23	---
III	30	25	2
IV	30	26	3
V	30	26	--
VI	30	22	--
Total	**180**	**145**	**5**

Courses	Number of Courses	Hours / week	Credits	Extra Credits
Tamil	4	24	16	--
English	4	24	16	--
Core	12T+7P	52T+20P	47T+10P	--
Core Skill Based	2	8	8	--
Core Integral	3	12	12	--
Group Project	1	6	3	--
Allied	4T+2P	16T+8P	12T+4P	--
NME	2	4	4	--
Ability Enhancement Course	4	4 + (4 Extra Hours)	8	--
Common Skill Based	1	2	2	--
NCC, NSS & Sports		--	1	
Extension Activities		--		1
Self Study Papers (Optional)	2	--		4
Self Study Papers (Compulsory)	1	--	2	--
Total		**180**	**145**	**5**

Programme Specific Outcome

PSO No	Upon completion of B.Sc. Zoology Degree programme, the graduates will be able to:
PSO1	Acquire the knowledge about the characteristics common to all animals and understand their unique features , significances & systematic positions .
PSO2	Understand the basic concepts of biology. Compare and contrast various developmental processes in organisms.
PSO3	Explore fundamental ecological principles from populations to communities through ecosystems and interactions between biotic and abiotic factors, employ technical and analytical skills to quantify the environmental toxicants
PSO4	Institute a thorough understanding of the function of biological molecules through the study of their structure and determine and connect the role of DNA in regulating cell activity to its importance as the basis of inheritance, evolution and biotechnology
PSO5	Demonstrate updated knowledge of Sericulture, Aquaculture, Apiculture Vermitechnology, Economic Zoology, value added fishery products for rural development and self employment
PSO6	Demonstrate the proficiency in basic methods of instrumentation and quantitative analytical skills used to conduct biological research including fundamental methods of microscopy and cell and molecular biology
PSO7	Identify the structure, function, and characteristics of immune system, find suitable vaccines for infections / immunological problems. Assess the modes of transmission and the mechanisms of microbial pathogenesis, treatment and control measures to microbial infection.
PSO8	Evolve critical thinking skills/lab techniques so as to be capable of designing, carrying out and interpreting scientific experiments

SEMESTER I			
Core I Invertebrata I			
Code :18UZOC11	**Hrs / Week : 4**	**Hrs/ Sem : 60**	**Credits: 4**

Vision: To impart knowledge on invertebrate animals- up to phylum Platyhelminthes

Mission: To elaborate the organization, functional morphology, anatomy and taxonomic position of representative invertebrates.

Course Outcomes:

CO.No	Upon completion of this course, students will be able to	PSO addressed	CL
CO - 1	understand the basic concepts of animal taxonomy	1	Un
CO - 2	know the distinctive features of taxonomic classes within the phyla covered	1	Re
CO -3	recognize the common members of each phylum and of selected classes and orders	1	Re
CO - 4	analyze the important concepts in invertebrate body structure and organization, including body symmetry, body cavity, gut formation, Segmentation	2	Un
CO - 5	examine the important biological processes in invertebrates, including locomotion, body support, reproduction, development, feeding, digestion, excretion, osmoregulation, circulation, respiration, sensory perception, behavior etc.	2	Un
CO - 6	impart information on the ecological and economic importance of invertebrates.	1	Un
CO - 7	aware of the importance and diversity of invertebrates.	1	Un
CO - 8	develop basic laboratory skills including microscopy, dissection and careful observation.	8	Cr

SEMESTER I			
Core I	Invertebrata I		
Code :18UZOC11	**Hrs / Week : 4**	**Hrs/ Sem : 60**	**Credits: 4**

Unit I General Principles of Animal Taxonomy

Taxonomy - Definition, systems of classification. Nomenclature – Binomial nomenclature - rules of nomenclature. Taxonomic hierarchy and categories. Salient features of invertebrates.

Unit II Phylum Protozoa

General characters and classification up to classes with examples. Type study – *Paramecium* - morphology, nutrition, osmoregulation, excretion, reproduction- binary fission, conjugation. General topic: Life cycle and pathogenecity of *Plasmodium*

Unit III Phylum Porifera

General characters and classification up to classes with examples. Type study - *Leucosolenia*- structural organization, reproduction- asexual and sexual development. General topics: Canal system and spicules in sponges.

Unit IV Phylum Coelenterata

General characters and classification up to classes with examples. Type study – *Obelia* – structure and life history. General topics: Polymorphism in coelenterates, corals and coral reefs.

Unit V Phylum Platyhelminthes

General characters and classification up to classes with examples. Type study – *Taenia solium* – structure, reproductive system life history and pathogenecity. General Topics: Parasitic adaptations in Platyhelminthes.

Text Books

1. Nair, N.C., Leelavathi, S. and N.A. Soundara Pandian. 2006. *Text book of Invertebrates*. Saras Publication, Nagercoil.
2. Murugan, T. and N. Arumugam. 2006. Saras Publication, Nagercoil.

Books for Reference

1. Jordan, E.L. and P.S. Verma. 2007. *Invertebrate Zoology.* S.Chand, New Delhi.
2. Mary, S. Gardiner 1972 .*The Biology of Invertebrates*. Mc Graw-Hill Book Company.
3. Robert, D Barnes 1982. *Invertebrate Zoology*. Holt Saunders, International Editions
4. Kotpal, R. and L. Rastogi. 1972. *Zoology Phylum Series.* Subhash Bazar, Meerut.
5. Ekambaranatha Iyer, M. and T.N. Ananthakrishnan. 1977. *A Manual of Zoology* – Vol.I. S.Viswanathan, Pvt Ltd.
6. Arumugam. N. 2017. *Animal Diversity Invertebrata and Chordata*. Saras Publication, Nagercoil.

Websites for Reference:

http://www.enchantedlearning.com/subjects/invertebrates/index.shtml
http://animalkingdom.net/category/invertebrates/

http://animaldiversity.org/

SEMESTER I			
Core II	Invertebrata II		
Code:18UZOC12	**Hrs / Week : 4**	**Hrs/ Sem : 60**	**Credits: 4**

Vision: To impart knowledge on invertebrate animals up to phylum Echinodermata

Mission: To elaborate the organization, functional morphology, anatomy and taxonomic position of representative invertebrates.

Course outcome:

CO.No	Upon completion of this course, students will be able to	PSO addressed	CL
CO – 1	identify common members of each phylum and of selected classes and orders	1	Un
CO- 2	understand the distinctive features of taxonomic classes within the phyla covered.	1	Un
CO -3	acquire knowledge on the importance, and diversity of the invertebrates	1	Un
CO – 4	analyze the important concepts in invertebrate body structure and organization, including body symmetry, cephalization, body cavity, gut formation, segmentation	2	Un
CO – 5	learn important biological processes in invertebrates, including locomotion, body support, reproduction, development, feeding, digestion, excretion, osmoregulation, circulation, respiration, sensory perception, behavior.etc.	2	Re, Kn
CO – 6	aware of the ecological and economic importance of invertebrates	1	Un
CO – 7	develop basic laboratory skills including microscopy, dissection and careful observation.	8	Cr
CO – 8	use knowledge in invertebrates as basic course for further subjects on higher level study.	1	Ap

SEMESTER I			
Core II	Invertebrata II		
Code:18UZOC12	**Hrs / Week : 4**	**Hrs/ Sem : 60**	**Credits: 4**

Unit I Phylum Aschelminthes

General characters and classification up to classes with examples. Type study – *Ascaris* – structure, reproduction, life cycle and pathogenecity. General topic: Life history, pathogenecity and control measures of *Wuchereria*

Unit II Phylum Annelida

General characters and classification up to classes with examples. Type study – Earthworm- structure, locomotion, digestive system, circulatory system, excretory system, nervous system and reproductive system. General topics: Biological significance of earthworm – bait, food, agriculture, medicine, laboratory and research purpose.

Unit III Phylum Arthropoda

General characters and classification up to classes with examples. Type study – *Penaeus*- structure, circulatory system, digestive system, excretory system, nervous system, sense organs, reproductive system and life history. General topics: Beneficial (honey bee, silk moth) and harmful insects (*Leptocorisa, Oryctus rhinocerous*)

Unit IV Phylum Mollusca

General characters and classification up to classes with examples. Type study – *Pila* – structure, digestive system, respiratory system, circulatory system, excretory system, nervous system, sense organs and reproductive system. General topic: Cephalopods are advanced molluscs.

Unit V Phylum Echinodermata

General characters and classification up to classes with examples. Type study – Star fish– structure and water vascular system. General topic: Larval forms of Echinoderms

Text Books

1. Nair, N.C., Leelavathi, S. and N.A. Soundara Pandian. 2006. *Text book of Invertebrates, Saras Publication,* Nagercoil.
2. Murugan.T. and N. Arumugam. 2006. *Invertebrates,* Saras Publication, Nagercoil.

Books for Reference

1. Jordan, E.L. and P.S. Verma. 2007. *Invertebrate Zoology.* S.Chand, New Delhi.
2. Mary. S. Gardiner. 1972. *The Biology of Invertebrates.* Mc Graw-Hill Book Company.
3. Robert. D. Barnes. 1982. *Invertebrate Zoology.* Holt Saunders, International Editions.
4. Kotpal, R. and L. Rastogi. 1972. *Zoology Phylum Series*, Subhash Bazar, Meerut.
5. Ekambaranatha Iyer, M. and T.N. Ananthakrishnan. 1977. *A Manual of Zoology – Vol.I.* S.Viswanathan, Pvt Ltd.
6. Arumugam. N. 2017. *Animal Diversity Invertebrata and Chordata*. Saras Publication, Nagercoil

Websites for Reference

http://www.enchantedlearning.com/subjects/invertebrates/index.shtml
http://animalkingdom.net/category/invertebrates/

http://animaldiversity.org/

PRACTICALS

Hrs / Week – 2 **Credit : 1**

I. Dissections

Cockroach : Digestive and Nervous system

II Mountings

Cockroach : Mouth parts, Trachea

Earthworm: Body setae and Pineal setae

Prawn : Appendages

III Spotters

a) Studies of the animals with special reference to systematic position up to orders habit, habitat, characteristic features and economic importance of -Paramecium, Euglena, Sycon, Obelia, Physalia, Fungia, *Taenia solium*, *Fasciola hepatica*, Ascaris (male& female), Earthworm, Nereis, Prawn, Peripatus, Pila, Sepia, Asterias, Sea cucumber

b) Observation of the following permanent slides
Tapeworm scolex, Larval forms of *Fasciola hepatica* (redia, cercaria) Larval forms of crustacea (nauplius, zoea, megalopa), Larval forms of Echinoderms (bipinnaria, auricularia)

IV Collection and submission of any five specimens (Photograph / Specimen)

Books for Reference

1. Nair, N.C., Arumugam, N., Leelavathi, S., Soundara Pandian, N., and T. Murugan.

   2013. *Practical Zoology Vol. 1 Invertebrata.* Saras Publication, Nagercoil.

2. Richard A. Boolootain and Donald Heyneman. 1977. *An Illustrated Laboratory Text in*

   Zoology. Holt, Rinehart and Winston U S A.

SEMESTER I			
Allied	**Allied Chemistry - I**		
Code : 18UCHA11	**Hrs/Week : 4**	**Hrs/ Sem : 60**	**Credits : 3**

Vision : Develop an appreciation of Chemistry and its application in daily life

Mission

- Understand the importance of atomic structure and the gradation in properties of elements
- Know the fundamental concepts in organic chemistry
- Recognize the significance of biomolecules in biochemical processes
- Develop skills to separate the plant materials using Chromatographic technique

Course Outcomes

CO No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO 1	account for the filling of electron in orbitals and to inscribe the electronic configuration of elements	1, 3	Re, Ap
CO 2	recognize conductors, insulators and semiconductors	1, 3	Re
CO 3	adapt a method to purify organic compounds and to estimate the amount of Carbon, Hydrogen and sulphur in a sample	1,2, 3,7	Un
CO 4	evaluate molecular weight of a chemical compound	6	Cr
CO 5	correlate the importance of colloids in day to day life and to develop a basic understanding of emulsions	1, 5	An
CO 6	reframe glucose into fructose and vice versa and to identify protein by their colour reactions	1	Cr, An
CO 7	record the steps involved in Hoffmann's exhaustive Methylation	6	Re
CO 8	explain isoprene rule and its significance	1	Un

SEMESTER I			
Allied - I	**Allied Chemistry - I**		
Code : 18UCHA11	**Hrs/Week : 4**	**Hrs/ Sem : 60**	**Credits : 3**

Unit I Atomic Structure and Chemical Bonding

Quantum numbers and their significance- Pauli's exclusion principle – Aufbau principle – Hund's rule – Electronic configuration of elements (atomic number 1 to 36)

Lattice energy – Born-Harber cycle–Factors affecting the dissolution of ionic compounds – M.O. Theory of covalent bond – Bonding, antibonding and non bonding orbital – M.O. Configuration of H_2, N_2 ,O_2 - Bond order – Band theory of metallic bond- Conductors, insulators, semi conductors- Hydrogen bonding – types and effects – Vander Wall's London forces.

Unit II Introduction to Organic Chemistry

Definition and importance-Sources of organic compounds-purification of organic compounds-Crystallisation- Fractional crystallisation-Sublimation-Solvent extraction-Soxhlet extraction

Elemental analysis-qualitative analysis of Carbon, Hydrogen, nitrogen, Sulphur and halogen-estimation of Carbon, Hydrogen, Nitrogen-Calculation of empirical formula-Determination of molecular weight by Victor meyer's method, silver salt, Chloroplatinic salt method-Calculation of molecular formula

Unit III Colloids and Emulsions

Definition- Classification of Colloids –comparison of lyophilic and lyophobic colloidsPreparation of sols-Dispersion method(Bredig's Arc method) –Aggregation method(oxidation , reduction, double decomposition)-Properties – Optical(Tyndall effect) – kinetic(Brownian movement) Electrical (electrical double layer) – Coagulation of colloids – Hardy Schulze law- Hoff meister series – protective colloids – gold number – Gels – classification, preparation , properties(imbibition,synerisis and thixotropy). Emulsion – types and their distinction. Emulsifiers – surfactants– applications of colloids-food, medicine, thixotropic paints, clarification of municipal water, formation of delta.

Unit IV Biomolecules

Carbohydrates- classification- configurations of D-glucose, D-fructose, D-mannose and D-galactose (structures only) – interconversions of glucose and fructose- interconversions of arabinose and glucose-epimerisation- muta rotation- general study of starch and cellulose

Amino acids - classification-essential amino acids-isolation from proteins- peptide linkage-polypeptides. Proteins- classification- colour reactions- structure

Unit V Chromatography

Chromatography-Classification-Adsorption Chromatography- Principle –Adsorbents-Characteristics of good Adsorbents- Principle, Experimental method and applications of Column Chromatography- -Thin layer Chromatography- Ion Exchange Chromatography

Text Books:

1. Arun Bahl and B.S. Bahl. 2005. *Advanced Organic Chemistry.* S.Chand and Company Ltd., Reprint.
2. Puri, B.R., Sharma, L.R. and K.C.Kalia, 2010. *Principles of Inorganic Chemistry*. Milestone Publishers and Distributers, Delhi.
3. Arun Bahl, B.S. and Bahl, G.D.Tuli. 2008. *Essentials of Physical Chemistry*. S.Chand &Company Ltd., New Delhi.

Books for Reference :

1. Jerry March. 2013. *Advanced Organic Chemistry, Reactions Mechanisms and Structure*. 4th Edition.
2. Tewari, K.S., Vishnoi, N.K. and S.N.Mehrotra. 1998. *A Text Book of Organic Chemistry.* 2nd Revised Edition.
3. Puri, B.R., Sharma, L.R. and Madan S. Pathania. 2008. *Principles of Physical Chemistry*. Vishal Publishing Co.
4. Jain, M.K. and S.C.Sharma, 2012. *Modern Organic chemistry.* Vishal Publishing Co.

SEMESTER II			
Core III	**Chordata - I**		
Code: 18UZOC21	**Hrs/Week:4**	**Hrs/Sem: 60**	**Credits:4**

Vision

To provide knowledge on the organization and diversity of chordates up to class Amphibia.

Mission

To impart information on the anatomy and morphology of chordates from evolutionary point of view.

Course Outcomes:

CO.No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	acquire knowledge on the fundamental organization of chordates.	1	Un
CO-2	understand the functional organization and taxonomic position of animals	2	Un
CO-3	impart information on the basic concepts of chordate diversity	1	Un
CO-4	analyse the characters of different classes	2	An
CO-5	learn and identify the major groups within the phylum chordate	1	Un
CO-6	reason out the inclusion of different representative animals in particular class	8	An
CO-7	recognize the different structural organizations from evolutionary point of view	8	Ev
CO-8	compare the anatomy of different functional systems in chordate.	2	Ap

SEMESTER II			
Core III	**Chordata – I**		
Code: 18UZOC21	**Hrs/Week:4**	**Hrs/Sem: 60**	**Credits:4**

Unit I **Protochordates**

Introduction - General characters of Chordates and Prochordates, classification upto Classes with examples

Prochordata: General characteristics and classification upto orders with examples.

Type study- *Amphioxus*- external morphology-digestive and excretory system

Anscidia -Solitary and Colonial. External feature and retrogressive Metamorphosis

Unit II **Cyclostomata and Agnatha**

General characters, Type study- *Petromyzon,* Agnatha – General characters and Classification, Representative types

Unit III **Pisces**

General characters And classification upto sub-classes with examples, Detailed study – Shark (excluding endoskeleton), General topic: Migration of fishes

Unit IV **Amphibia:**

General characteristics and classification upto orders with examples, Type study: Frog –External morphology, skin, digestive, respiratory, circulatory and nervous systems, reproductive system, General topic: Parental care in Amphibia

Unit V **Comparative Anatomy**

Circulatory system – Evolution of heart and aortic arches, venous system and lymphatic system

Text Books

1. Thangamani. A., PrasannaKumar, S., Narayanan, L.M. and N.Arumugam. 2006. *Chordata.* Saras Publication.
2. Jordan E.L. and P.S. Verma. 2006. *Chordate Zoology.* S.Chand & Co Ltd, NewDelhi.

Books for Reference

1. Ekambaranatha Iyer, M. and T.N S. Ananthakrishnan. 1969. *Manual of Zoology Vol II* Viswanathan Pvt Ltd.
2. Newman, H.H. 1987. *The Phylum Chordata.* Satish Book Enterprise, Motikala.
3. Prasad, S.N. 2005 .*Vertebrate Zoology.* Kitab Mahal Private Ltd, Allahabad.
4. Vishwanath.1967. *A Text Book of Zoology Volume II* [Chordates]. S.Chand & Co. Madras.

SEMESTER II			
Core IV	**Chordata - II**		
Code: 18UZOC22	**Hrs/Week:4**	**Hrs/Sem: 60**	**Credits:4**

Vision

To provide knowledge on the organization and diversity of Chordates from the class Reptilia to Mammalia.

Mission

To impart information on the anatomy and morphology of chordates from evolutionary point of view.

Course Outcomes:

Co.No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	know the chordate diversity	1	Un
CO-2	aware of the origin of chordates	2	Un
CO-3	learn and recognize the major characteristics of chordates	1	Un
CO-4	analyse the morphology of major classes of chordate	2	An
CO-5	understand the various systems in the body of chordates	2	Un
CO-6	analyse the advancement of functional organization of chordates	8	An
CO-7	examine and understand the comparative anatomy of the functional systems in chordates	8	Ev
CO-8	apply the knowledge of representative animals to understand the evolution	2	Ap

SEMESTER II			
Core IV	**Chordata - II**		
Code: 18UZOC22	**Hrs/Week:4**	**Hrs/Sem: 60**	**Credits:4**

Unit I Introduction to Chordates , Reptilia

Origin of Chordates, General characteristics and classification upto orders.Type study – *Calotes* – External morphology, circulatory system and nervous system. Identification of poisonous and non-poisonous snakes of South India,

Unit II Aves

General characteristics and classification up to subclasses, Type study - *Columba livia* – External characters, exoskeleton, flight muscles, respiratory system, synsacrum. General topic:Migration in birds

Unit III Mammalia

General characteristics and classification up to sub – classes with examples.

Type study: Rabbit – Morphology – dentition – digestive system – respiratory system – structure of heart, urino-genital system. General topic: Adaptations of aquatic mammals.

Unit IV Comparative Anatomy

Respiratory system – skin, gills, lungs, air sacs, air bladder and accessory respiratory organs in fish. Mechanism of breathing.

Unit V Sense Organs

Classification of receptors, structure and working of mammalian eye and ear

Text Books

1. Thangamani, A., PrasannaKumar, S., Narayanan, L.M. and Arumugam.N 2006. *Chordata.,* Saras Publication.
2. Jordan E.L. and P.S. Verma. 2006. *Chordate Zoology.* S.Chand & Co Ltd, NewDelhi.

Books for Reference

1. Ekambaranatha Iyer, M. and T.N S.Ananthakrishnan. 2000. *Manual of Zoology Vol II* ViswanathanPrinters & Publishers Pvt Ltd, Chennai.
2. Newman, H.H. 1987. *The Phylum Chordata*. Satish Book Enterprise, Motikala.
3. Prasad S.N. 2005 .*Vertebrate Zoology.* Kitab Mahal Private Ltd, Allahabad.
4. Vishwanath. 1967. *A Text Book of Zoology.* Volume II [Chordates] S.Chand & Co. Madras.

PRACTICALS

Hrs / Week – 2 Credit-1

1. **Dissections and mountings:**

Fish - Digestive system

Frog - Arterial system (Chart)

Frog - Venous system (chart)

Shark - Placoid scales

Teleost fish - Ctenoid and cycloid scales

Frog - Brain (Chart)

Feathers - Observation of barbs and barbules

2. **Museum specimens: slides/models/charts.**

Prochordata - *Amphioxus, Balanoglossus*, Ascidian

Agnatha - *Petromyzon*

Pisces - Shark, Eel, *Narcine, Hippocampus,*

Amphibian - *Rhacophorus,* Salamander, *Ichthyophis*

Reptilia - *Draco, Typhlops*, Cobra, *Krait, Dryophis,* Chameleon

Aves - Pigeon, Quill feather, Kingfisher, *Archaeopteryx*

Mammal - Bat, Rabbit, Platypus

Osteology – Pigeon- Synsacrum, Rabbit- Pectoral and Pelvic girdles

3 **Collection of any five locally available fishes.**

Books for Reference

1. P.S.Verma. 2008. *A Manual of Practical Zoology-Chordates*. S.Chand & Company Ltd., Ramnagar, New Delhi.

2. Jeyasurya, L.M. Narayanan,Thangamani and Prasanna Kumar. 2013. *Practical Zoology- Vol-2 Chordata ,* Saras Publication, Nagercoil.

3 Richard A., 1997. Boolootian/ Donald Heyneman, *An illustrated laboratory text in Zoology.* Holt, Rinehart and Winston, U.S.A.

SEMESTER II			
Allied II	**Allied Chemistry - II**		
Code :18UCHA21	**Hrs/Week : 4**	**Hrs/ Sem : 60**	**Credits : 3**

Vision : Acquire an appropriate knowledge and understanding in Chemistry underlying in metallurgical process and industrial fuels

Mission :

- Knowledge on steps involved in metallurgical process
- Know the important industrial fuels and its uses
- Significance of micro and macro nutrient in plant growth
- Importance of lipids in biochemical process

Course Outcomes

CO No.	**Upon completion of this course, students will be able to**	**PSO addressed**	**CL**
CO 1	explain the methods of purification of ores and to differentiate ores and minerals	1	An
CO 2	know the extracting methods , properties and uses of titanium, vanadium ,thorium and their compounds	1	Re,Un
CO 3	synthesise some industrially important organic compounds such as Freon , rayon , polyester , nylon , thiokol Dacron	1, 5	Ev
CO 4	classify fuels and know its industrial uses	1, 4	Ap
CO 5	identify the techniques for sterilising water for domestic use	1, 4	An
CO 6	know the basics of abrasives	1,4	Re
CO 7	describe the role of micro and macro nutrients in plant growth and Identify the implication of biofertilizers on soil	1,5	Un
CO 8	classify fatty acids and analyse Cholesterol and know its biochemical significance	1	Ap, An

SEMESTER II			
Allied II	**Allied Chemistry II**		
Code :18UCHA21	**Hrs/Week : 4**	**Hrs/ Sem : 60**	**Credits : 3**

Unit I Metallurgy

Ores and Minerals- types of ores – methods of ore dressing- roasting –calcination-reduction(aluminothermic)-smelting-purification by electrolysis and ion exchange method-oxidative refining- zone refining- Kroll process- types of furnaces. Extraction , properties and uses of titanium-vanadium –thorium. Preparation of Titanium tetrachloride, Vanadium pentoxide and Thorium nitrate

Unit II– Preparation and Uses of Some Important Organic Compounds

Preparation and uses of Formalin , choloroform , Freon , rayon , polyester , nylon , thiokol Dacron , silicone, Bakelite , polythene , urethane , Teflon , PVC , BHC

Unit III Industrial Chemistry

Fuels-classification-gaseous fuels like water gas ,producer gas, liquefied petroleum gas, gobar gas, compressed natural gas.

Water-Hardness of water-temporary and permanent hardness, disadvantages of hard water-softening of hard water-zeolite process, demineralization process and reverse osmosis-sterilisation of water for domestic use by chlorine, ozone and UV light.

Abrasives-Types of electric furnaces-Manufacture and uses of carborundum, calcium carbide, alundum-Industrial uses of lamp black, carbon black, activated charcoal, wood charcoal, animal charcoal, coke, artificial diamond

Unit IV Agricultural Chemistry

Fertilizers – role of micro and macro nutrients in plant growth – characteristics and importance of manures – preparation and uses of urea, ammonium sulphate, CAN, DAP, super phosphate and mixed fertilizers – biofertilizers.

Pesticides – insecticides – fungicides – rodenticides – bactericides and herbicides – preparation and uses of lead arsenate, Bordeaux mixture, zineb, epsam and aluminium phosphide.

Unit V Lipids

Definition and classification of lipids- Types of fatty acids- saturated, unsaturated, unusual and essential fatty acids- triacyl glycerol number-acid number- RM value-acetyl value-Chemistry of phospholipids-lecithin-cephalin- Cholesterol-tests-structure- (structural elucidation not required)-Biochemical functions of cholesterol-physiological significance

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Text Books

1. Arun Bahl and B.S.Bahl. 2005. *Advanced Organic Chemistry.* S.Chand and Company Ltd., Reprint.
2. Puri B.R. , Sharma, L.R and K.C. Kalia. 2010. *Principles of Inorganic Chemistry*, Milestone Publishers and Distributers, Delhi,
3. Arun Bahl, B.S.Bahl and G.D.Tuli, 2008. *Essentials of Physical Chemistry*, S.Chand &Company Ltd., New Delhi.

Books for Reference

1. Tewari, K.S., Vishnoi, N.K. and S.N. Mehrotra. 1998. *A Text Book of Organic Chemistry.* 2nd Revised *Edition.*
2. Puri, B.R., Sharma, L.R and Madan S. Pathania. 2008. *Principles of Physical Chemistry.* Vishal Publishing Co.
3. Jain, M.K. and S.C. Sharma. 2012. .*Modern Organic chemistry,* Vishal Publishing Co.

SEMESTER II			
Allied Chemistry Practicals			
Code:18UCHAR1	**Hrs/Week : 2**	**Hrs/ Sem : 30**	**Credits : 1**

Organic analysis

Analysis of simple organic compounds

a) Nature of the compound- Aromatic / Aliphatic

b) Test for Saturation/ unsaturation.

c) Element present/absent

d) Characterization of functional groups (Acid, phenol (solid), aldehyde, ester, amide, primary amine, carbohydrates).

Volumetric Analysis

I. Acidimetry — Alkalimetry

1. Estimation of H_2SO_4 /HCl using standard oxalic acid .

2.Estimation of sodium hydroxide using standard sodium hydroxide.

3.Estimation of sodium carbonate using standard sodium carbonate.

4.Estimation of oxalic acid using standard oxalic acid

II. Permanganometry

5. Estimation of ferrous ion using standard ferrous ammonium sulphate.
6. Estimation of sodium oxalate /oxalic acid using standard oxalic acid.

III. Complexometry

7. Estimation of Zinc using standard Zinc sulphate.

Books for Reference

1. Vogel's *Textbook of Quantitative Chemical Analysis*. 2004. sixth Edition.
2. Raghupati Mukhopadhyay. 2007. Advanced Practical Chemistry - Pratul Chatterjee Books and Allied (P) Ltd. Third Edition.

SEMESTER III			
Core V: Developmental Biology and Evolution			
Code: 18UZOC31	**Hrs/Week: 4**	**Hrs / Sem: 60**	**Credits: 4**

Vision

To acquire a greater appreciation of life and its developmental and evolutionary processes

Mission

To understand the complexity of developmental processes and the underlying mechanism.

To provide an understanding of central ideas underpinning evolution by patterns and processes

Course Outcome

CO.No	Upon completion of this course, students will be able to	PSO addressed	CL
CO - 1	acquire knowledge about the developmental process and the sequential changes from cellular grade of organization to organ grade of organization in multi-cellular organisms.	1,2	Un
CO- 2	compare and contrast developmental processes in different model organisms.	8	Un
CO-3	analyse the ultimate and penultimate causes of human female and male sub fertility.	6	Un, An
CO-4	provide an detailed explanations of the theories and processes of evolution.	7	Un
CO-5	examine and apply the major genetic and ecological processes underlying evolution and selection.	3	Un, An
CO-6	list and describe the evidences for evolution and its required corollaries.	1,7	Un
CO-7	recognise and explain the processes driving speciation	1,3	Un
CO-8	outline the evolution of the modern humans of the processes of social and cultural change through time	2,3	Un

SEMESTER III			
Core V: Developmental Biology and Evolution			
Code: 18UZOC31	**Hrs/Week: 4**	**Hrs / Sem: 60**	**Credits: 4**

Unit I **Gametogenesis and Fertilization**

Gametogenesis – spermatogenesis, oogenesis
Structure and types of sperm & egg - sperm and egg of chick and man.
Fertilization – physical, chemical, cytological, and physiological events

Unit II **Development and Organogenesis**

Development of chick – cleavage, gastrulation and fate map
Placentation in mammal
Development of heart and brain in mammal

Unit III **Morphogenetic Field and Reproductive Technology**

Morphogenetic field, gradient hypothesis Regeneration: types, regeneration in amphibians.
Infertility, Poly Cystic Ovarian Disease (PSOD), artificial insemination, test-tube babies, cryopreservation, amniocentesis.
Birth control- contraceptive devices, gamete specific antigen- antibody mediated fertilization block.

Unit IV **Theories and Evidences of Evolution.**

Origin of life ,Theories of Evolution and their modern concepts - Lamark, Darwin and De Veries. Evidences- morphological , embryological, biochemical and paleontological – geological, fossils and fossilization – geological time scale - chart

Unit V **Forces of Evolution and Evolution of Man**

Variation, sexual selection-evolutionary significance
Mimicry and animal colouration.
Speciation : species concept, types; allopatric, sympatric and parapatric. Isolating mechanisms.
Evolution of man: Biological and cultural

Text Books

1. Arumugam. N. 2006. *Developmental Zoology*, Saras Publication
2. Mohan P. Arora. 1991. *Organic Evolution*. Himalaya Publishing House.

Books for Reference

1. Berril, M.J. 1982. *Developmental Biology*. Tata McGraw- Hill Publishing Company Ltd. New Delhi.

2. Verma, P.S. and V.K. Agarwal. 2006. *Chordate Embryology*. S. Chand & Company Ltd, New Delhi.
3. Balinsky, B. I. 1981. *Introduction to Embryology*. Saunders College, Philadelphia.
4. Jay M Savage. 1998. *Evolution*. Amerind Publishing House Co, New Delhi.
5. Paul Amos Moody. 1997. *An Introduction to Evolution*. Kalyani Publishers, Ludhiyana.
6. Arumugam, N. 2001. *Evolution.* Saras publication, Kottar, Nagercoil.

PRACTICALS – Sub. Code: 18UZOCR3

Hrs / Week – 2 **Credit:1**

1. Types of eggs (alecithal, telolecithal and centrolecithal)
2. Observation of developmental stages of an insect
3. Temporary mounting of chick embryo and observation of permanent slides of chick embryo 24,48 ,72, and 96 hours.
4. Museum specimens/ slides/ models and charts:
   Sperm of vertebrate, egg of frog and mammal, frog tadpole,
   Contraceptive devices – condom, copper T, pills (Mala D).
   Placenta in mammals – diffuse, discoidal, zonary and cotyledenary placenta.
5. Animals of evolutionary importance -Peripatus, Limulus and Archaeopteryx.
6. Mimicry: leaf insect, monarch and viceroy butterfly.
7. Adaptive colouration – chameleon, lycodon.
8. Fossils-*Nautilus pompilius, Physaprincepii*

Books for Reference

1. Verma, P. S. 1992. *A Manual of Practical Zoology – Chordates*. S. Chand and Company Ltd, New Delhi.
2. Balinsky B.1976. *An Introduction To Embryology*. Fourth edition, B.W. Saunders Company, U.S.A and Toppan Company Ltd, Japan.
3. Paul Amos Moody. 1970. *Introduction to Evolution*. III Edition, Harper and Row Publishers, New York.

SEMESTER - III			
Allied II	**Plant Diversity**		
18UBOA31	**Hrs / Week: 4**	**Hrs / Semester: 60**	**Credits: 3**

Vision:

- To learn about the diversity of primitive plant groups.

Mission:

- To understand the structure, pigmentation, food reserves and mode of reproduction of primivite plants.
- To learn about the economic importance of cryptogams

CO. NO	Upon completion of this course ,students will be able to	PSO addressed	CL
1.	distinguish between diverse groups of algae, fungi, and bryophytes using their characteristic features	1, 2	An
2.	discuss different life cycle patterns in different groups	1, 2	Cr
3.	apply the practical knowledge to identify a particular group from a mixed group in the laboratory or in the field	1, 6	Ap
4.	know the basic skills and techniques in micropreparation and formulate methods to identify different groups	6	Ap
5.	understand the status of cryptogams are unique in plant kingdom	1, 2	Un
6.	infer pteridophytes are pioneer in the evolution of seed habit	1, 2	Re
7.	compare and contrast the origin and evolution of steles, foliage, seed and seedless plants.	1, 2	An
8.	understand the phylogenetic relationship between the different groups	1, 2	Un

SEMESTER - III			
Allied II	**Plant Diversity**		
18UBOA31	**Hrs / Week: 4**	**Hrs / Semester: 60**	**Credits: 3**

Unit I : **Algae**

General characteristics, Classification of algae by F.E.Fritsh (1954). Occurrence, mode of reproduction and life cycle of *Caulerpa and Sargassum.* Economic importance of algae.

Unit II : **Fungi**

General characteristics, .Classification of Fungi by Alexopoulos and Mims (1979). Economic importance of fungi. Occurrence, somatic structure, mode of reproduction and life cycle of *Aspergillus*.

Unit III : **Bryophyta**

General characteristics, .Classification of Bryophytes by Rothmaler (1951). Economic importance of Bryophytes. Occurrence, somatic structure, mode of reproduction and life cycle of *Funaria*.

Unit IV : **Pteriodophyta**

General characteristics. Classification of Pteridophytes by Smith (1955). Economic importance of pteridophytes Morphological, anatomical structure, asexual and sexual reproduction of *Selaginella.*

Unit V : **Gymnosperms**

General characteristics. Classification of Gymnosperms by K.R.Sporne (1965). Economic importance of gymnosperms. Morphological, anatomical structure and reproduction of *Pinus.*

Text book

1. Pandi, S.N., Trivedi, P.S. and S.P. Misra. 2006. A text Book of Botany. Vol. I and II. Vikas Publishing House Pvt. Ltd.

Books for Reference:

1. Alexopoulos and Mim's, 1983. Introductory mycology. Wiley Eastern Ltd. Hyderabad.
2. Fritsch, F.E. 1972. *The structure and reproduction of algae*. Vol. I & II. Cambridge University Press.
3. Rashid, A. 1999. *An introduction to Bryophyta*. Vikas Publishing House Pvt. Ltd.
4. Vashishta, P.C., Sinha A.K. and Anil Kumar. 2008. *Botany for degree students*. S. Chand & Co., New Delhi.

Practicals: 2Hrs/week

1. **Algae**: *Caulerpa* and *Sargassum* thallus and thallus with cystocarp – Section
2. **Fungi:** *Aspergillus- Slide*
3. **Bryophytes**: *Funaria* thallus, VS of archegoniophore and VS of Sporophyte (Slide)

4. **Pteridophytes**: Selaginella – Habit, Sectioning of rhizophore, stem and cone.
    i. Permanent slides: stem and cone.
5. **Gymnosperms**: Pinus- sectioning of stem and needle
    i. Permanent slides: Mature male and female cone
6. Submission of Record notebook.

Books for Reference:

1. Srivastava, H. N. 1987. *Practical Botany Volume I*, Pradeep Publications, Jalandhar

SEMESTER – III			
Core Skill Based : Fishery Products			
Code : 18UZOS31	**Hrs/Week :4**	**Hrs/Sem : 60**	**Credits: 4**

Vision
Towards proper usage of the products and by-products of the fisheries industry.

Mission
To obtain knowledge on value addition of products of fisheries industry and their preservation processes.

Course Outcome

CO.No.	Upon completion of this course, the graduates will be able to	PSO addressed	CL
CO -1	acquire knowledge on products and by-products of fisheries.	1	Un
CO - 2	interpretation of the various processing and preservation of fisheries products.	7	Ap
CO - 3	attain information on the usage of fish by-products for industrial and domestic purposes.	7	Un
CO - 4	carry out study on seaweeds and their various usages in pharmaceutical and therapeutic industries.	7	Ev
CO - 5	practice the processing and preservation of various fish products.	1	Cr
CO - 6	implementation of sanitation and quality control techniques.	7	Cr
CO - 7	use the knowledge of preservation and processing techniques in day to day life.	7	Ev
CO- 8	comprehend and synthesize advanced knowledge on the outcomes of fisheries.	8	Un

SEMESTER – III			
Core Skill Based : Fishery Products			
Code : 18UZOS31	**Hrs/Week :4**	**Hrs/Sem : 60**	**Credits: 4**

Unit I **Processing and Preservation of Fish products**

Fish pickles and sauce, fish cutlets, fish balls, fish noodles, fish soup powder, fish sausage and fish protein concentrate. Battered and braided products-fish finger, fish cutlet, fish wafer.

Unit II **Processing and Preservation of Fish Byproducts**

Fish glue – isinglass – chitosan – pearl essence – shark fins – fish leather – fish maws.

Unit III **Seaweed Products**

Preparation of agar, algin and carrageenan. Use of seaweeds as food for human consumption and disease treatment –Preparation of therapeutic drugs

Unit IV **Techniques of Preservation and processing**

Freezing - Canning – Smoking – Pickling – Fermentation – Drying – Salting.

Unit V **Quality Control and Sanitation**

Quality control of fish and fishery products – pre-processing control, control during processing and control after processing - Sanitation in processing – Environmental hygiene and personal hygiene in processing.

Text Book

Dr. Surekha Gupta,2010. Textbook of Fishery, Ane Books Pvt. Ltd., New Delhi.

Books for Reference

1. Gopakumar, K. 2002. *A Textbook of Fish Processing Technology.* ICAR, New Delhi.
2. Gupta, S.K. and P.C Gupta. 2006. *General and Applied Ichthyology* [*Fish and fisheries*] S.Chand and Company Ltd.Ram nagar,New Delhi
3. K.R .Ravindranathan 2013. *A Textbook of Economic Zoology.* Wisdom press, New Delhi.
4. Ayyapar, S. 2010. *Handbook of Fisheries and Aquaculture*. ICAR, New Delhi.
5. Srivastava, C.B.L. 2006. *A Textbook of Fishery Science- Indian Fisheries.* KitabMahal, New Delhi.

SEMESTER - III			
NME I - Basic Biotechnology			
Code :18UZON31	**Hrs /Week: 2**	**Hrs/ Sem : 30**	**Credits : 2**

Vision:
To impart a comprehensive understanding of Biotechnology for successful career in industry and research institutes.

Mission:
To develop basic concepts of modern Biotechnology with an emphasis on tools, techniques for manipulation of genes and molecules.

Course Outcome

CO. No	Upon completion of this course, students will be able to	PSO addressed	CL
Co-1	understand the basic principles of Biotechnology	1	Un
CO-2	distinguish between prokaryotic and eukaryotic cells from their structural studies	2	An
CO-3	understand the restriction enzymes and cloning vectors and assess their use in genetic engineering.	4	Un, Ev
CO-4	demonstrate the structure of DNA, its replication, amplification and separation of fragments	4, 5	Un
CO-5	analyse different culture media and techniques to cater the need for cell culture.	6	An
CO-6	evaluate techniques of gene delivery and cloning to adapt in manipulation of genes	5	Ev
CO-7	discuss the preparation and characterization of appropriate nano materials in the field of nanotechnology	7	Cr
CO-8	develop proficiency in aseptic laboratory techniques and standard procedures for cell culture.	8	Cr

SEMESTER - III			
NME I - Basic Biotechnology			
Code :18UZON31	**Hrs /Week: 2**	**Hrs/ Sem : 30**	**Credits : 2**

Unit I Cell

General structure - prokaryotic eukaryotic cells. Structure of DNA, RNA and replication of DNA. (Practical- Spotters - Structure of Bacteriophage, DNA model, tRNA)

Unit II Tools of Recombinant DNA Technology

Restriction Modification Systems – enzymes - polymerase I, II, III, DNA ligase and Type II restriction enzymes in genetic engineering. Cloning vectors - *E. coli* – Plasmid vectors – pBR 322 and M13 and Cosmids. (Practical- Spotters - Southern blotting, pBR322)

Unit III Animal Cell Culture

Cell culture media – natural and synthetic. Cell culture – primary culture, secondary culture, continuous cell lines, cryopreservation of cultures.(Practical:Sterilization of glass wares for cell culture & Preparation of culture media)

Unit IV Techniques and Applications of Biotechnology

Cloning – steps involved. Gene delivery – microinjection, electroporation, biolistic method (gene gun), liposome and retro viral mediated delivery. Gene amplification by PCR technique - Agarose Gel Electrophoresis.(Practical- Agarose Gel Electrophoresis& SDS -PAGE)

Unit V Nanobiotechnology

Classification of nanoparticles, synthesis of nanoparticles - RF plasma, chemical method, thermolysis. Properties and applications of nanofluids and nanocrystals. (Practical- Spotters -Dendrimer)

Text Book :

Kumaresan, V. 2012. *Biotechnology*. 6th edition, Saras publication, Kottar P.O, Nagercoil.

Books for Reference :

1. Dubey, R.C. 2009. A *Textbook of Biotechnology*. S.Chand and Company Ltd.

2. Rastogi, S.C. 2012. *Biotechnology Principles and Applications*. Reprint 2012, Narosa Publishing House. Chennai.

3. Singh, B.D. 2015. *Biotechnology*. Kalyani Publishers. New Delhi.

4. Sathyanarayana,V. 2013. *Biotechnology*. 8th Edition. Books and Allied (P) Ltd. Kolkatta.

5. Harisha S. 2007. *Biotechnology Procedures and Experiments Hand Book*. Infenity Science Press, LIC, Hinghum, Massachusett, New Delhi, India

6. Asish Verma, Surajit Das, Anchal Singh. 2008. *Laboratory Manual for Biotechnology*. S.Chand and Company, Ltd., New Delhi.

SEMESTER – III	
Self-study – Dairy Management	
Code : 18UZOSS1	**Credits : +2**

Vision

To equip the students to become entrepreneurs .

Mission

To obtain knowledge on different strategies to manage dairy farm.

Course Outcome

CO No	Upon completion of this course, the students will be able to	PSO addressed	CL
CO-1	understand general management of dairy animals.	1	Un
CO-2	explain the various management techniques of breeding and lactating cattle and goat.	1,2	Un
CO-3	analyse the different kinds of feed for dairy animals.	7	An
CO-4	aware of the various feeding practices for dairy animals	1, 2	Un
CO-5	identify the various diseases affecting dairy animals.	6	Ap
CO-6	analyse the nutritive value of milk and factors affecting quality of milk	7	An
CO-7	aware of the importance and types of milk products	2	Un
CO-8	develop skills and acquire knowledge for self employment.	6, 8	Ap

SEMESTER – III	
Self-study – Dairy Management	
Code : 18UZOSS1	**Credit : +2**

Unit I **Dairy Management**

General management practices of dairy animals : Grooming, Drying off, control of bad habits, castration, dehorning, deworming and identifications marks.

Unit II **Cattle and Goat Management**

Calf raising, heifer management, management of pregnant, parturient, lactating and dry cows. Management of lambs and kids - Management of breeding and lactating doe and Ewe.

Unit III **Food and Feeding**

Classification of feeds - balanced food ratio for dairy animals - general feeding practices with regard to management.

Unit IV **Diseases in Dairy Animals**

Diseases of calf : Pneumonia, calf scours, diarrhoea, joint ill, naval ill, worm infestation. Parasitic and protozoan diseases: theilariasis, babesiosis, trypansomiasis, trichomoniasis.

Diseases of Goat: PPR, blue tongue.

Unit V **Dairy Products**

Nutritive value of milk- pasteurization of milk - factors affecting yield of milk. Colostrum-significance. Milk products- butter, cheese, ice cream, condensed and evaporated milk, milk powder.

Books for Reference

1. Banerjee, G.C. 2011. *Textbook of Animal Husbandary.* Eighth edition, Oxford and IBH Publishing Co.Pvt.Ltd, New Delhi.
2. Danjyaganj, *Handbook of Animal Husbandary*. ICAR edition, Sangam Book Depot, New Delhi.
3. Prasad Jayadish, 2016. *Principle and Practices of Dairy Farm*. Kalyani Publisher, New Delhi

SEMESTER - IV			
Core IV - Biochemistry			
Code :18UZOC41	**Hrs /Week: 4**	**Hrs/ Sem : 60**	**Credits : 4**

Vision :

To gain in- depth understanding of molecular processes in Biology from chemical approach to understand the complexity of life.

Mission :

To impart fundamental chemical and biological principles to advance their understanding of living world, nutrition, better medical care, biotechniques to enhance the quality of life.

Course Outcome

CO.No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	demonstrate an understanding of the structure of biomolecules such as carbohydrate, protein and lipids	4	Un
CO-2	evaluate significance of biomolecules in the processes that occur within living cells	4	Ev
CO-3	analyse enzymes as biological catalysts and the mechanism of their action and develop the ability to comprehend life processes	4	An
CO-4	discuss the beneficial effects of vitamins and foods that contain vitamins required for the healthy functioning of the body	2	Cr
CO-5	recall, relate and deploy knowledge in identifying deficiency diseases of vitamins from symptoms and find the remedy	6	Ap
CO-6	understand the principle, working mechanism and application of standard laboratory equipments and modern instruments	6	Un
CO-7	develop proficiency in basic laboratory techniques in biochemistry and maintain records of lab activities	7	Ap
CO-8	apply appropriate biochemical techniques to plan and carryout experiments, test hypotheses and draw conclusions to conduct project works in near future	8	Ap

SEMESTER - IV			
Core IV - Biochemistry			
Code :18UZOC41	**Hrs /Week: 4**	**Hrs/ Sem : 60**	**Credits : 4**

Unit I **Carbohydrates**

Carbohydrates - outline classification, monosaccharides (glucose and fructose), glycoside linkage, disaccharides (sucrose, lactose) and polysaccharides (cellulose and glycogen), properties, biological significance and functions.

Unit II **Protein**

Classification of amino acids based on the structure of side chain, Protein - classification based on shape and structure, chemical bonds involved in structure, Linderstrom, Lang's structure of proteins, properties, biological significance and functions.

Unit III **Lipids**

Fatty acids - saturated, unsaturated fatty acids, essential, non-essential fatty acids, Lipids, classification, simple lipids (triglycerides and waxes), compound lipids (phospholipids, cerebrosides), derived lipids (steroids), properties, biological significance – functions.

Unit IV **Enzymes and Vitamins**

Enzymes - classification and nomenclature, chemical nature, properties, factors affecting enzyme activity, mechanism of enzyme action, enzyme inhibition, co-enzymes- application of enzymes.
Vitamins: fat soluble and water soluble, properties, sources, dietary requirements and deficiency symptoms.

Unit V **Instrumentation**

Principle, technique and applications of pH meter, spectrophotometer, centrifuge, Electrophoresis (agarose gel and SDS- PAGE) and chromatography (Paper, TLC).

Text Book

1. Dulsy Fatima, L., Narayanan, R.P., MeyyanPillai, K., Nallasivam, S., Prasannakumar and A. Arumugam. 2013. *Biochemistry*. Saras Publication, Nagercoil.

Books for Reference

1. Satyanarayana,V. and U. Chakrapani. 2013. *Biochemistry* - Elsivier – Division of Reed Elsivier India PVT. Ltd. and Books and Allied Pvt. Ltd.
2. Ambika Shanmugam. 2000. *Fundamentals of Biochemistry for Medical student,* Navabharat Offset Works, Chennai.
3. Denise R. Ferrier. 2011. *Biochemistry*. Wolters Kluwer / Lippincott Williams and Wilkins Philadelphia – Baltimore – Newyork – London
4. Harper, 1988 – *Review of Biochemistry.* 24th edition, Lange Medical Publications, USA.
5. Srivastava, H.S. 2006. *Elements of Biochemistry*. Rastogi Publications, Meerut.

PRACTICALS – Sub. Code: 18UZOCR4

Hrs / Week: 2 **Credit: 1**

1. Qualitative test for proteins.
2. Qualitative test for lipid.
3. Determination of iodine number, saponification number and acid value of different dietary fats.
4. Qualitative estimation of carbohydrate.
5. Spectrophotometric estimation of organic and inorganic constituents.
6. Separation of amino acid by paper chromatography / Iodine method.
7. Separation of amino acids by thin layer chromatography.
8. Measurement of pH in different biological water samples.
9. Fractionation of proteins by centrifugation technique.
10. Model / chart – Structure of amino acid, glucose, fructose, sucrose and cholesterol.

Books for Reference

1. David T. Plummer. 1992. *An Introduction to Practical Biochemistry*. Third Edition. Fifth Reprint. Tata Mc Graw - Hill Publishing Company Limited, New Delhi.
2. Jayaraman J. 2000. *Laboratory Manual in Biochemistry*. New Age International (P) Ltd. Publishers, New Delhi.

SEMESTER - IV			
Allied II	**Angiosperm Taxonomy and Plant Physiology**		
18UBOA41	**Hrs / Week: 4**	**Hrs / Semester: 60**	**Credits: 3**

Vision:

To understand the floristic description of plants and to understand the basic functional mechanism of plants

Mission:

To study the floral characters with an aim to identify the taxa.

To know the internal metabolism of plants

Course Outcome:

CO.No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	recall the botanical names	1	Un
CO-2	evaluate the distribution, evolution and phylogenetic relationship among plants.	2	Ev
CO-3	study the contribution of taxonomist in plant systamatics	1	Un
CO-4	outline and recall the natural systems of classification of angiosperms	2	Re
CO-5	explain the floristic features of families in technical terms	2	An
CO-6	understand the physiological mechanisms involved in the uptake and transfer of water	2 ,3	Un
CO-7	comment on the major effects and physiological mechanisms of growth hormones in plants	2	An
CO-8	design and conduct scientific experiments and analyse the data critically	4, 8	Cr

SEMESTER - IV			
Allied II	**Angiosperm Taxonomy and Plant Physiology**		
18UBOA41	**Hrs / Week: 4**	**Hrs / Semester: 60**	**Credits: 3**

Unit I Modification of plant parts: root, stem, leaf. Morphology of Inflorescence, flower and fruits.

Unit II Concept of classification – Natural system- Bentham and Hooker. Vegetative, floral characters and economic importance of : Annonaceae, Rutaceae, Caesalpiniaceae.

Unit III Rubiaceae , Asclepiadaceae, Euphorbiaceae, Poaceae.

Unit IV Importance of water to plants. Diffusion, osmosis, imbibition, plasmolysis and water potential. Absorption of water – soil water – mechanism of water absorption. Ascent of sap – path and mechanism – vital force theory, root pressure theory and Dixon cohesion theory. Transpiration – types – mechanism of stomatal movement – significance

Unit V Photosynthesis – electromagnetic spectrum, photosynthetic apparatus mechanism - photochemical reaction and carbon reactions, Factors affecting photosynthesis. Growth: definition, growth phases. Plant growth regulators - occurrence, physiological effects and practical applications of auxin, gibberellin and cytokinin. Photoperiodism and vernalization. Seed dormancy, physiology of seed germination.

Text books:

1. Jain, V.K. 2004. *Fundamentals of Plant Physiology*. S. Chand & Company Ltd. NewDelhi.
2. Pandey, B.P. 2005. *Taxonomy of Angiosperms*. S.Chand & Company Ltd., New Delhi.

Books for Reference:

1. John Jothi Prakash, E. 2001. *Medicinal and Aromatic Plants*, JPR Publications, Vallioor.
2. John Jothi Prakash, E. and K. Venkataraman, 2001. *The science of Medicinal Botany*, JPR Publications, Vallioor.
3. Kokate C.F., Purohit, A. P. and S.R. Gokhale. 2004. *Pharmacognosy.* Nirali Prakashan.
4. Pandey, B.P. 2000. *Economic Botany*. S. Chand & Co., New Delhi.
5. Salisbury, F.B. and C.W. Ross 2007. *Plant physiology.* Thompson. Asia. Pvt. Ltd. Singapore.

6. Shukla, P. and Misra, S.P. 1997. *An introduction to Taxonomy of angiosperms*, Vikas Pub. House Ltd., New Delhi.
7. Vashista, P.C. 1985. *Taxonomy of Angiosperms*. S. Chand & Co., New Delhi.

Practicals: 2 Hrs/week

1. Dissections and drawing of the floral parts of typical genus belonging to the families prescribed in the syllabus to bring out the salient features (Floral diagram and floral formula are expected).
2. Identification of families.
3. Identification and recording of the economically important plants prescribed in the syllabus.
4. Imbibition by direct weight method.
5. Determination of water potential by Chardakov's method
6. Estimation of auxin.
7. Estimation of starch.
8. Estimation of chlorophyll.

Demonstration:

9. Determination of differential transpiration of leaf surface using cobalt chloride method.
10. Determination of growth curve by auxonometer
11. Submission of record note book

Books for Reference:

1. Ashok Bendre and Ashok Kumar. *Text Book of Practical Botany II*. Rastogi Publications, Meerut.
2. Francis H Witham, David F Blaydes and Robert N Devlin, 1970. *Experiments in Plant Physiology.* Vanmostrand Rainhold Company, New Delhi
3. Gamble, J.S. 1997. *Flora of Presidency of Madras, Volume I to III,* Adlard and Son., Ltd., London
4. Henry, A.N., Chitra, V. and Balakrishnan, N.P. 1989. *Flora of Tamil Nadu, India, Volume III.* Botanical Survey of India, Southern circle Coimbatore.
5. Henry, A.N., Kumari, G.R. and Chitra, V. 1987. *Flora of Tamil Nadu, India, Volume II.* Botanical Survey of India.
6. Mathew, K.M., 1981 to 1984. *The flora of Tamil Nadu, Carnatic. Volume I to III.* Rapinet herbarium, St. Joseph's College, Tiruchirapalli.
7. Shankar Gopal Joshi. 2008. *Medicinal Plants*. Oxford and IBH Publishing Company Pvt. Ltd. New Delhi.

SEMESTER - IV			
Core Skill Based: Clinical Laboratory Technology			
Code : 18UZOS41	**Hrs / week : 4**	**Hrs/ Sem : 60**	**Credits : 4**

Vision

- To become skilled persons for employment.

Mission

- To learn the utility and the applications of the instruments, so as to study the etiology of various diseases affecting human beings.

Course Outcome

CO. No	Upon completion of this course, students will be able to	PSO addressed	C L
CO -1	understand the laboratory practices and know how to maintain the laboratory instruments	1	Un
CO - 2	analyse and distinguish various types of blood cells	2	An
CO - 3	understand the pathological diseases and explain the test for hepatitis, AIDS and intestinal parasite	3	An
CO - 4	evaluate critical thinking of biochemical test	5	Un
CO - 5	demonstrate the proficiency in basic methods of instrumentation and quantitative analytical skills used to conduct biological research	6	Un
CO - 6	develop skills in various lab techniques	7	Cr
CO - 7	acquire knowledge to handle clinical equipments	4	Un
CO - 8	design, carry out and interpret scientific experiments	8	Ap

SEMESTER - IV			
Core Skill Based: Clinical Laboratory Technology			
Code : 18UZOS41	**Hrs / week : 4**	**Hrs/ Sem : 60**	**Credits : 4**

Unit I **Good Laboratory Practices and Instumentation**

Good laboratory practices- medical lab layout- norms to be followed in a clinical lab- record maintenance- sterilization - dry heat (hot air oven), moist heat (autoclave, pressure cooker) and UV radiation (laminar flow chamber) - laboratory equipments– incubator, autoanalyser, micro centrifuge, CT scan and MRI scan.

Unit II **Haematology**

Collection and storage of blood, composition of blood, preparation and use of blood components - blood groups (A,B,AB,O & Rh factor) and blood cross matching.

Unit III **Clinical Pathology**

Dialysis - hepatitis test – hemolytic jaundice - analysis of sputum - AIDS (ELISA and WESTERN BLOT) - diagnostic tests for intestinal parasites – Ascaris and Entamoeba – diagnosis of dengue and chikungunya.

Unit IV **Biochemical Tests**

Estimation of cholesterol, urea, uric acid, creatinine of blood - assay of enzyme alkaline phosphatase - amniotic fluid analysis- amniocentesis, chromosome banding, FISH and L/S ratio.

Unit V **Demonstration/ Charts/ Models/ Hands-on Training**

Centrifuge - stethoscope - sphygmomanometer, electrocardiogram, EEG and echocardiogram - analysis of urine -Dialyzer - routine physical examination - glucose and albumin detection - pregnancy test (detection of hCG), RBC count - WBC count- estimation of haemoglobin

Text Book

1. Ramnik Sood. 2005. *Medical Laboratory Technology*, Methods and Interpretations, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi.

Books for Reference

1. BiswajitMohanty and SharbariBasu. 2006. *Fundamentals of Practical Clinical Biochemistry.* B.I Publications Pvt. Ltd., New Delhi.
2. Estridge, B.H., Reynolds, A.P. and N.J. Walters. 2000. *Basic Medical Laboratory Techniques* 4th edition. Thomson Delmar LearingFastern press (Bangalore) Pvt. Ltd., Bangalore.
3. Kannai, L.Mukherjee. 1997. *Medical Laboratory Technology* Vol-I, Vol-II and Vol-III, Tata McGraw Hill Publishing Company Limited, Chennai.

SEMESTER - IV			
NME II Applied Biotechnology			
Code :18UZON41	**Hrs /Week: 2**	**Hrs/ Sem :30**	**Credit : 2**

Vision: To provide quality education and to construct excellent bio entrepreneurship for self reliance with societal development

Mission: To impart strong theoretical as well as practical knowledge to students in the field of Biotechnology so that they will be able to apply this multidisciplinary knowledge to field situation
To impart knowledge and skills in students to equip themselves to be ready to face the emerging challenges in the knowledge area

Course Outcome

CO.No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	understand the production of different Bio-products	1	Un
CO-2	examine the nature and feature of SCP and aerobic and anaerobic digestion	3,5	An
CO-3	apply the techniques to clean up the environment through various treatment methods	2,6	Ap
CO-4	create awareness to cure cancer	7	Cr
CO-5	understand the importance of biosafety and IPR	2	Un
CO-6	evaluate the synthesis and applications of bio-products	8	Ev
CO-7	adapt appropriate tools and techniques in biotechnological manipulation	7	Cr
CO-8	apply the experimental procedures to the spectrum of fields making use of Biotechnology	8	Ap

SEMESTER - IV			
NME II Applied Biotechnology			
Code :18UZON41	**Hrs /Week: 2**	**Hrs/ Sem :30**	**Credits : 2**

Unit I : Food and Beverage Biotechnology

Fermented food – cheese production – microbial biomass – nutritive value of Single Cell Protein and mushroom cultivation (White button mushroom) - wine and beer. (Practical- Mushroom cultivation & Microbial production of wine)

Unit II : Fuel Biotechnology

Biogas – production – applications; Biodiesel – production – applications.

Unit III : Environmental Biotechnology

Sewage treatment – primary, secondary and tertiary treatments – Bioremediation - use of immobilized microbes.

Unit IV : Health Care Biotechnology

Gene therapy methods – germline and somatic cell line – gene therapy for cancer

Unit V : Regulations in Biotechnology

Biosafety – guidelines – Intellectual Property Right

Text Book :

Kumaresan, V. 2012. *Biotechnology* - 6th edition. Saras publication, Kottar, Nagercoil.

Books for Reference :

1. Dubey, R.C. 2009. *A textbook of Biotechnology* eds, S.Chand and Company Ltd, New Delhi.
2. Rastogi, S.C. 2012. *Biotechnology, principles and applications*. Narosa Publishing House, Chennai.
3. Singh, B.D. 2015. *Biotechnology edition*. Kalyani Publishers, New Delhi.
4. Sathyanarayana, V. 2013. *Biotechnology* 8th edition. Books and Allied (P) Ltd. Kolkatta.
5. Harisha S. 2007. *Biotechnology Procedures and Experiments Hand Book*. Infenity Science Press, LIC, Hinghum, Massachusett, New Delhi, India
6. Asish Verma,Surajit Das.Anchal Singh. 2008. *Laboratory Manual for Biotechnology*, S. Chand and Company, New Delhi.

SEMESTER IV	
Self Study Course – Aquarium Fish Keeping	
Code: 18UZOSS2	**Credits : +2**

Vision

To impart knowledge on fish keeping

Mission

To provide information on setting up and maintenance of of an aquarium

Course Outcome

CO No	Upon completion of this course, the students will be able to	PSO addressed	CL
CO-1	acquire knowledge about home aquarium	1	Un
CO-2	identify common aquarium fishes	1,2	Un
CO-3	explain the different kinds of instruments used in setting up of an aquarium .	6	Un
CO-4	critically analyse the different kinds of fish feed and aquarium plants	5	Un
CO-5	examine the common diseases, symptoms and management of aquarium fishes	7	Ap
CO-6	demonstrate skills in maintenance of water quality parameters	5	An
CO-7	develop the hobby of having an aquarium at home	8	Cr
CO-8	Promote self employment opportunities	8	Ap

SEMESTER IV	
Self Study Course – Aquarium Fish Keeping	
Code: 18UZOSS2	**Credits : +2**

Unit I Construction of Home Aquarium

Construction of home aquarium - materials needed - wooden and metal frames - frameless tanks, sealants and gums - Design and construction

Unit II Setting up of an Aquarium

Setting up an aquarium - requirements - important aquarium fishes - aquarium accessories - hood and light, nets suction tube, aerators, thermostat, heater, filter, gravel, siphon tube and scrapper tool.

Unit III Maintenance of an Aquarium

Maintenance of aquarium - water quality management - pH, temperature - salinity - oxygen - carbon dioxide - waste removal.

Unit IV Fish feed and Aquarium plants

Different kinds of feed - live feed - artificial feed -feeding methods - feeding devices - balanced diet for aquarium fishes. Morphology of aquarium plants - vallisneria, Hydrilla.

Unit- V Fish diseases and Management

Common diseases of aquarium fishes. bacterial diseases, viral diseases, fungal diseases - parasitic diseases - Argulus, lernea and ligula.

Books for Reference

1. Yadav, B.N. 2002. *Fish and Fisheries,* Daya Publishing House – New Delhi
2. Bal, D.V. and K.V. Rao. 1984. *Marine Fisheries of India*. Tata Mc Graw – Hill Publishing Company Limited - New Delhi.
3. Biswas K.P. 2009. *Fishes Around Indian Ocean.* Daya Publishing House – New Delhi.
4. Jayashree, K. V., Thara Devi, C.S. and N. Arumugam. 2015. *Home Aquarium and Ornamental Fish Culture*. Saras Publication. Nagercoil.
5. Jamson, D. and R. Santhanam. 1996. *Manual of ornamental fishes and farming technologies.* Department of Fisheries Environment - Fisheries college and Research department - Tuticorin.

SEMESTER V			
Core VII Biotechnology (Common Core)			
Code: 18UBCC51	**Hrs/Week:4**	**Hrs/Sem: 60**	**Credit: 3**

Vision

To gain knowledge about the importance of Biotechnology in different fields
To create graduates who endeavor for the welfare of mankind.
Create opportunities for multi-disciplinary education, training and research in Biotechnology

Mission

Impart quality education for lifelong professional growth and opportunity in a wide range of careers. To create awareness towards socio-ethical implications of potentials of biotechnology. Provide a platform for Biotechnology education, training and research at the interface of multiple disciplines

Course Outcome

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	describe different cloning vehicles and learn the different type of vectors	1	Kn, Un
CO-2	gain knowledge about techniques of biotechnology.	2	Un
CO-3	summarise the different techniques in animal biotechnology	2	Un, An
CO-4	compare the various techniques in plant and animal biotechnology	4	Cr
CO-5	enumerate cell culture, organ culture and stem cell culture and point out implications in health care	6	Kn, An
CO-6	distinguishes methods of alleviating environmental pollution and understand the synthesis of industrial products	5	An
CO-7	relate biotechnology and its benefits to mankind	6	Ap, Ev
CO-8	design, conduct experiments, analyse and interpret data for investigating problems in Biotechnology and allied fields	7,8	Ap

SEMESTER V			
Core VII Biotechnology (Common Core)			
Code: 18UBCC51	Hrs/Week:4	Hrs/Sem: 60	Credits: 3

Unit I Cloning Vectors

Introduction – Scope and importance of biotechnology – cloning vehicles – bacterial plasmid vectors – pBR322 and Ti plasmid – bacteriophage vectors – lambda – M13 – Plant viral vector – CaMV- Gemini virus and tobamovirus – animal viral vector – SV40- Role of restriction and modification enzymes

Unit II Gene Cloning and Screening

Gene cloning – methods of introduction of cloned genes into host cells – transformation – liposome mediated transfer – electroporation – particle bombardment gun – viral vector method – DNA library – PCR – hybridization technique – blotting techniques – Southern, Northern and Western.

Unit –III Cell, Tissue and Organ culture

Culture media – cell culture techniques – monolayer culture and immobilized culture of cell lines –callus culture – suspension culture and anther culture – techniques and applications of human embryonic stem cell culture – plant embryo culture- invitro pollination – organ culture – techniques – tissue engineering of artificial skin and cartilage.

Unit – IV Environmental and Bioprocess technology

Biotechnological methods for sewage and waste water treatment – bioremediation – degradation of xenobiotic (hydrocarbons and pesticides) – role of genetically engineered microbes – biomining – bioleaching – industrial production of penicillin and ethanol – Biodiesel – Biofertilizer – mass cultivation and application of Azolla

Unit –V Health Care Biotechnology

DNA probes and diagnosis of genetic disorders – DNA fingerprinting technique – gene therapy and treatment of genetic diseases – vaccines – recombinant DNA vaccines and viral vaccines – edible vaccines- Bt cotton – Golden rice- Human Genome Project – types – methods of sequencing – potential benefits of mankind

Text Books

1. Dubey R.C.S. 2004. *Atext book of Biotechnology*. Chand and Comp.Ltd, New Delhi,
2. Kumaresan, V. 2010 *Biotechnology*. - Saras Publication, Nagercoil - 2010.

Books for Reference

1. Singh, B.D. 2005. *Biotechnology*. Revised edition, Kalyani Publishers, Chennai.
2. Dubey, R.C. 2006. *Text Book of Biotechnlogy*. 4th edition, S. Chand and Co Ltd, New Delhi.

3. Rema, L.P. 2009. *Applied Biotechnology*, MJP Publishers, Chennai.
4. Shailendra Singh. 2007. *Applied Biotechnology*. 1st edition, Campus Books International New Delhi.
5. Clark, and J. Pazdernik. 2009. *Biotechnology*. Elsevier Academic Press, California, USA.
6. Ramadass, P. 2009. *Animal Biotechnology* – Recent Concepts and Development. MJP Publishers, Chennai.

Practicals Sub. Code: 18UBCCR1

Hours:2 **Credit : 1**

1. Isolation of Blue Green Algae
2. Preparation of synthetic seed
3. Estimation of dissolved oxygen and BOD
4. DNA estimation by Spectrophotometric method
5. Preparation of plant and animal tissue culture media
6. Preparation of SDS – PAGE (Gel mould only)
7. Isolation of protoplast
8. Estimation of protein by column chromatography
9. Demonstration :
   Electrophoresis – full technique
   Blotting
   PCR – DNA Amplification
   Mushroom cultivation / Vermiculture
10. Models and Charts pertaining to theory

Books for Reference:

1. Harisha, S. 2007. *Biotechnology Procedures and Experiments Hand Book*. Infenity Science Press, LIC, Hinghum, Massachusett, New Delhi, India.
2. Asish Verma, Surajit Das, Anchal Singh. 2008. *Laboratory Manual for Biotechnology*. S.Chand and Company, New Delhi.

SEMESTER V			
Core VIII: Animal Physiology			
Code: 18UZOC52	**Hrs/Week: 5**	**Hrs/Sem: 75**	**Credits: 4**

Vision

Understand the physiological processes that regulate body functions and the regulation of organ systems and develop independent thinking skills and written and oral communication abilities

Mission

Apply knowledge of a physiological mechanism to explain how the physiological processes occur in an animal.

Course outcome

CO.No	**Upon completion of this course, students will be able to**	**PSO addressed**	**CL**
CO – 1	compare the structure and functions and co-ordination of organs and organ systems	1	Un
CO – 2	assess the causes, diagnosis, prevention and treatment of illnesses	2	Ev
CO – 3	develop personal healthy life style	6	Cr
CO – 4	demonstrate the different lab experiments	5	Un
CO – 5	experiential learning, analysis and drawing conclusion	4	Cr
CO-6	find way for scientific investigation	6	Ev
CO-7	develop various skills which will be helpful in expressing ideas and views clearly and effectively	7	Ap
CO-8	imbibe ethical, moral and social values in personal and social life leading to highly cultured and civilized personality	8	Cr

SEMESTER V			
Core VIII: Animal Physiology			
Code: 18UZOC52	**Hrs/Week: 5**	**Hrs/Sem: 75**	**Credits: 4**

Unit I **Digestion and Nutrition**

Intracellular and extracellular digestion – role of enzymes in digestion of carbohydrates, proteins and lipids – absorption of digested food materials – malnutrition.

Unit II **Respiration and Circulation**

Respiration: Types of respiratory pigments – transport of respiratory gases – anaerobiosis - Respiratory Quotient.

Circulation: Composition of blood – blood coagulation – structure of human heart – heart beat – origin and conduction – cardiac cycle – blood pressure.

Unit III **Excretion and Homeostasis**

Excretion: Structure and function of nephron – mechanism of urine formation in man – nitrogenous waste products – ammonotelism, ureotelism, uricotelism – ornithine cycle – dialysis. Osmoregulation: in crustaceans and fishes – thermoregulation – mechanisms – ectotherms – endotherms – heterotherms

Unit IV **Muscular, Nervous and Chemical Coordination**

Structure of skeletal muscle and myofibril – molecular organization, mechanism and chemistry of muscle contraction.

Structure of neuron – conduction of nerve impulse - synaptic transmission – neuromuscular junction – reflex action - receptors – photo and phonoreceptors.

Endocrine glands: structure and functions of pituitary and pancreas.

Unit V **Reproduction and Behavioural Physiology**

Anatomy of reproductive organs in human – ovary – testis – reproductive cycles – hormonal control of reproduction. Animal behaviour – types – learning and learned behaviour – Biological clock – circadian rhythm – circannual and lunar periodicity.

Text Book

1. Maria Kuttikan, A. and N. Arumugam. 2004. *Animal Physiology.* Saras Publication Kottar, Nagercoil.

Books for Reference

1. Sembulingam, K., Prema Sembulingam. 2008. *Essentials of Medical Physiology*. Jaypee Brothers. New Delhi
2. Rastogi, S.C. 1979. *Essentials of Animal Physiology* – Wiley Eastern Ltd. New Delhi.
3. William S. Hoar. 1987. *General and Comparative Physiology* 3rd Edition. Prentice Hall of India (P) Ltd.
4. Verma, P, Tyagi, S. and V.K. Agarwal. 2002. *Animal Physiology*. S.Chand & Company Ltd. New Delhi.
5. Prosser, C.L. and F.A Brown. 1984. *Comparative Animal Physiology*. Saunders Philadelphia.
6. Sambasivah Kamalakara Rao and Agustin Chellappa. 1983. *Animal Physiology* S. Chand and Company.
7. Nagabhrushanam, R., Kodarkar, M.S. and R. Sarojini. 2002. *Text book of Animal – Physiology*, Second Edition, Oxford and IBH Publishing Co, Pvt. Ltd.

PRACTICALS

Hrs/Week: 2 **Credit -1**

1. Human salivary amylase activity in relation to temperature.
2. Effect of temperature on the opercular movement in fish and calculation of Q_{10}.
3. Examination of excretory products (ammonia, urea and uric acid crystals)
4. Rate of oxygen consumption in fish
5. Estimation of haemoglobin by Haemoglobinometer
6. Haemocytometer – Demonstration
7. Kymograph / simple muscle twitch – model
8. Human blood smear (Preparation and observation of different blood cells)
9. Demonstration of blood pressure with sphygmomanometer
10. Slides – sections of skeletal, cardiac, smooth muscle and endocrine glands.

Books for Reference

1.Nigam S.C. 1982. *Experimental Physiology*, Wiley Eastern Limited New Delhi.

2.Nigam S .C. and Omkar. 2006. *Experimental Animal Physiology* and *Biochemistry*.New Age International (P) Limited New Delhi.

SEMESTER -V			
Core IX Cell Biology and Genetics			
Code: 18UZOC53	**Hrs/week : 5**	**Hrs/Sem: 75**	**Credits: 4**

Vision :

To give an insight on basic organization and functions of the cellular components and the principles of inheritance at the cellular level in organisms.

Mission :

To provide unique integrated approach of Cell Biology and Genetics, covering cellular organization, inheritance and hereditary disorders, to gain an enhanced knowledge and understanding of biology and inheritance.

Course Outcome

CO.No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	understand the organization of the cell and to differentiate between prokaryotic and eukaryotic cell.	2	Un
CO-2	describe the structure and functioning of cell organelles as a system to carry out cellular processes	2	Un
CO-3	analyse the complexity and harmony of the cell from the acquired knowledge	2	An
CO-4	explain the types of chromosome; composition, structure, and replication of DNA	4	Ev
CO-5	demonstrate the genetic basis of Mendelian and non-Mendelian inheritance	5	Un
CO-6	develop the ability to think critically, analyse and use the information gained to solve problems related to genetics	6	Cr
CO-7	evaluate hereditary patterns for genetic disorders by applying genetic information to innovate solutions for health related issues	6	Ev
CO-8	apply the practical and conceptual knowledge of Cell biology and Genetics to understand other fields of biology	8	Ap

SEMESTER -V			
Core IX Cell Biology and Genetics			
Code: 18UZOC53	**Hrs/week : 5**	**Hrs/sem: 75**	**Credit: 4**

Unit I Cell and Plasma membrane

Protoplasm theory - Cell theory. Prokaryotic and Eukaryotic cells. Plasma membrane-structure, chemical composition, specialized structures and functions.

Unit II Cell Organelles

Cytoplasm- ultrastructure and functions of mitochondria, golgi apparatus, endoplasmic reticulum, lysosome, ribosome.

Unit III Nucleus

Ultrastructure and functions - nucleus, nuclear membrane, nucleolus. chromosome – structure – types, giant chromosomes - polytene chromosome, lampbrush chromosome. DNA- chemistry, structure and replication.

Unit IV Mendelian Genetics

Mendelian laws – monohybrid and dihybrid cross – back cross – test cross – incomplete dominance – inheritance of combs in fowls – multiple alleles – multiple genes – skin colour in man.

Unit V Sex linked Inheritance and Genetic Disorders

Sex determination in man – sex linked inheritance in man – haemophilia – colour blindness. Inborn errors of metabolism – phenylketonuria – albinism. Mutant haemoglobins – sickle cell anaemia. Syndromes – autosomal – Down's syndrome – sex chromosomal – Turner's and Klinefelter's syndrome.

Text books

1. Arumugam, N. 2017. *Cell Biology*. Saras Publications, 114/ 35G ARP. Camp Road, Periavilai, Kottar P.O, Nagercoil.
2. Meyyan, R.P. 2007. *Genetics*. Saras Publications, 114/ 35G ARP. Camp Road, Periavilai, Kottar P.O, Nagercoil.

Books for Reference

1. Power, C.B. 2004. *Cell Biology*. Himalaya Publishing House, Ramdoot Dr. Bhalenaomang Gingaon Mumbai.
2. Verma, P.S. and V.K. Agarwal. 2008. *Cytology* (8^{th} edition). S.Chand and Co Ltd 7361 Ram Nagar, New Delhi .

3. De Robertis, E.D.P. and E.M.F De. Robertis, 1988. *Cell and Molecular Biology* 9th International Edition, K.M. Varghese Company, Mumbai.
4. Verma, P.S. and V.K. Agarwal. 2008. *Genetics*. 9th Edition, S. Chand and Co Ltd., New Delhi.
5. Gardner, Simmons and Snustad. 1991. *Principles of Genetics*, 8th Edition. John Wiley and Sons. Inc. New York.

PRACTICALS

Hrs / Week : 2 **Credit - 1**

1. Preparation of squamous epithelium.
2. Onion root tip squash: Observation of different stages of mitosis.
3. Chironomous larva: Mounting of polytene chromosomes.
4. Observation of cells through ultramicroscope.
5. Micrometry.
6. DNA – Watson & Crick model, Golgi complex, endoplasmic reticulum, mitochondria, ribosome (models/ charts)
7. Verification of Mendel's monohybrid cross using beads.
8. Verification of Mendel's dihybrid cross using beads.
9. Sex linked inheritance of colour blindness and haemophilia (chart).
10. Genetic basis and clinical manifestations of Down's, Klinefelters and Turner's syndrome (chart).

Books for Reference:

1. Verma P.S. 1992. *A Manual of Practical Zoology - Chordates*. S. Chand & Company Ltd. Ram Nagar, New Delhi -.
2. Jayasurya, Dulsy Fatima, Meyyan, R.P., Arumugam, N. and V. Kumaresan 2013. *Practical Zoology*. *(Cell Biology-Embryolgy- Animal Physiology- Immunology Ecol Genetics- Evolution - Microbiology - Biochemistry - Biophysics*) Saras Publication, Kottar P.O., Nagercoil.
3. Emmanuel C., Rev. Fr. S. Ignacimuthu, S.J. and S. Vincent. 2006. *Applied Genetics - Recent Trends and Techniques*. MJP Publishers, 47, Nallathambi Street, Triplicane, Chennai
4. Eldon John Gardner, Michael J. Simmons and D. Peter Snustad. 1991. *Principles of Genetics.* Eighth Edition. John Wiley & Sons, INC. New York.

SEMESTER V			
Core Integral I : Marine Biology			
Code: 18UZOI51	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 4**

Vision

To provide quality education and training in the field of marine biology and environment

Mission

Provides an excellent education in marine biology, emphasizing the flora and fauna of marine environment

To raise awareness about marine environments for the community and the society

Course Outcome

CO.No	Upon completion of this course, students will be able to	PSO addressed	CL
CO - 1	classify the different ecological zones of marine environment, diversity of marine organisms and their adaptations	1,2	Un
CO - 2	explain the physical and chemical properties of sea water and their significance to marine life	1,4	Un, Ev
CO - 3	appraise the ocean production, characteristics and types of coral reefs, mangroves and estuaries	3	Ev
CO - 4	outline the formation, types and properties of the dynamics of ocean	1,2	Un
CO - 5	analyse various types of marine resources and assess the various environmental concerns related to the use and abuse of marine resources	5,6	An, Cr
CO - 6	gain specialized skills in a range of theoretical and practical applications	8,	Cr
CO - 7	develop awareness of scientific issues in marine biology within the larger social context	6	Ap, Cr
CO - 8	design and implement effective solutions to problems in marine environment	7,8	Cr

SEMESTER V			
Core Integral I : Marine Biology			
Code: 18UZOI51	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 4**

Unit I Marine Habitat

Classification of marine habitat. Characteristics of pelagic and benthic divisions – intertidal, rocky, sandy and muddy shores – the features of flora, fauna and adaptations.

Unit II Physical and Chemical Properties of Sea Water

Physical properties – temperature, temperature distribution, dissolved gases, T/S diagram. Chemical properties - Nutrients (major, minor and trace elements) illumination, salinity - distribution.

Unit III Biological Characteristics of the sea

Plankton – classification, adaptations and methods of collection. Ocean production - Energy flow in the marine environment. Coral reef, mangroves, estuaries - characteristics and types.

Unit IV Dynamics of the Ocean

Tides - generating forces, types, effects of tides in coastal areas; Waves - formation, properties, types - tsunami.

Unit V Resources of the Sea

Chemical resources - manganese nodules, beach placers, Oil resource (Petroleum) Fishery products - fish meal and fish oil. Formation, ornamental and medicinal importance of natural pearls.

Text Book

1. Olivia J. Fernando. 1999. *Sea water - Properties and dynamics.* Dhanesh Publications, Ponnagam, Thanjavur.

Books for Reference

1. Gross, G., 1993. *Oceanography: A view of the Earth*. Sixth edition. Prentice Hall Inc., New Jersey.
2. McCormick, J.M. and J.V. Thiruvathaakal. 1976. *Elements of Oceanography*. W.B. Saunders Company, Philadelphia.
3. Nybakken, J.W. 1997. *Marine Biology – An Ecological Approach*. Addison Weslay Longman, Inc. California, 477pp.
4. Girish Chopra, 2006. *Coastal and Marine Geography*, Common Wealth Publisher, Delhi.
5. Veena. 2012. *Understanding Marine Biology*- Discovery Publishing House PVT.LTD New Delhi
6. Russel. 1970. *Marine Ecology*. Academic Press- London and New York.
7. Nelson and Smith. 1973. *Oil Pollution and Marine Ecology*-Plenum press, New York.

SEMESTER – V			
Core Integral II: Commercial Aquaculture			
Code:18UZOI52	**Hrs/ Week: 4**	**Hrs/ Sem:60**	**Credits: 4**

Vision

To highlight the importance of aquaculture to augment food production

Mission

To impart knowledge on fish culture techniques, health management measures and fish preservation

Course Outcome

CO.No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	understand the biology of a variety of commercially important food fishes.	1	Un
CO-2	analyse the different methods of integrated fish farming	7	An
CO-3	understand the conditioning factors and how they can be manipulated	1, 2	Un
CO-4	interpret the basic culture methodologies of commercially important species	8	Ev
CO-5	acquire knowledge on feed organisms and feed formulation	1	Un
CO-6	identify the common aquaculture diseases and apply appropriate measures for fish health management	8	Ap
CO-7	explain the different techniques of fish processing and preservation	4	Un, Ev
CO-8	apply principles and concepts to solve problems that may be encountered in commercial production	7	Ap

SEMESTER – V			
Core Integral II: Commercial Aquaculture			
Code:18UZOI52	**Hrs/ Week: 4**	**Hrs/ Sem:60**	**Credits: 4**

Unit I **Cultivable Species**

Importance of aquaculture – Current status of aquaculture in India – Cultivable organisms and their qualities. Fin fishes – carps and live fishes. Shell fishes- shrimp, lobster – edible oyster, mussel, pearl oyster. Cultivable sea weeds.

Unit II **Culture Methods and Farm Management**

Polyculture, integrated fish farming – paddy - cum fish culture, animal husbandry - cum fish culture, Management of culture ponds - control of water quality parameters - fertilization - control of predators and weeds.

Unit III **Culture Techniques**

Fin fish - culture of Indian major carp (Catla) - seed collection, breeding and culture techniques

Shell fish - culture of marine prawn, pearl oyster

Unit IV **Fish feed and Disease management**

Fish feed – artificial feed - feed formulation and composition of formulated feed, live feed organisms. Common diseases – white spot disease, dropsy, fin rot, gill rot, saprolegniasis. Parasites - argulus, lernea - prevention and management. Principles of fish health management

Unit V **Fish Processing and Preservation**

Fish preservation – freezing, canning, dry curing, salt curing, smoke curing, Irradiation, special cured products. Preservation and export techniques.

Text Book

1. Santhana Kumar and A.M. Selvaraj. 2006. *Concepts of Aquaculture*. Mac ram Publications, Nagercoil.

Books for Reference

1. Santhanam, R., Sukumaran, M. and P. Natarajan. 1990. *A Manual of Freshwater Aquaculture.* Oxford & IBH publishing Co Pvt. Ltd, Janpath, New Delhi.
2. Dinabandhu Sahoo, S.Z. Qasim. 2009. *Sustainable Aquaculture*. A.P.H Publishing Co, NewDelhi.
3. Agarwal, S.C. 1994. *A Hand book of Fish Farming*. Naranda Publishing House, Delhi.
4. Chaudhuri, A.B. 2009. *Aquaculture Resurgence Birth of Blue Revolution*. Daya Publishing House, Delhi.
5. Sailendra Ghosh. 2009. *Fisheries and Aquaculture Management*. Adhyayan Publisher & Distributors, New Delhi.
6. Santhanam,R., N. Ramanathan and G. Jegathesan 1990. *Coastal Aquaculture in India.* First Edition, CBS Publishers, New Delhi.

SEMESTER V	
Self Study : Vermitechnology	
Code : 18UZOSS3	**Credit : 2**

Vision : To impart knowledge on organic compost and equip the students for self employment

Mission : Acquire knowledge on different techniques in vermitechnology and become the entrepreneurs

Course Outcome

CO.No	**Upon completion of this course, students will be able to**	**PSO addressed**	**CL**
CO-1	classify and choose the suitable species of earthworm for making compost	1	Un
CO-2	examine the suitable physico-chemical parameters required for vermicomposting	2	An
CO-3	explain the different methods of vermicomposting	4	Un
CO-4	understand the preparation, composition and applications of vermiwash	5	Un
CO-5	examine the applications of vermitechnology in various fields	3	Ev
CO-6	describe the use of products of vermiculture	8	Ap
CO-7	demonstrate the vermiculture technique	7	Un
CO-8	develop skills for self employment	6	Cr

SEMESTER V	
Self Study : Vermitechnology	
Code : 18UZOSS3	**Credit : 2**

Unit I **Vermiculture Technique**

Definition- need for vermiculture-species selection -vermiculture process

Unit II **Vermicomposting Technology**

Selection of suitable species of earthworm, preparation of worm bed – maintainance of vermicomposting bed- harvesting the worms

Unit III **Vermicomposting Methods**

Pit method - bin method, windrow method, vermiwash- preparation- composition- applications

Unit IV **Vermicompost**

Vermicompost- chemical composition, physical and biological features- applications.

Unit V **Economic Importance of Earthworm**

Earthworm - as bait- as food - in agriculture - in medicines- in laboratory research purpose- benefits to society.

Books for Reference

1. Talashilkar S.C. and Dosani. 2005. *Earthworm in Agriculture.* First edition Agrobios Publications, Jodhpur
2. Renganathan L. S. 2006. *Vermibiotechnology from Soil Health to Human Health*. First edition, Agrobios, India.
3. Prakash Malhotra. 2008. *Economic Zoology*. First edition. Adhyayan Publishers and Distributers, New Delhi.
4. Gupta P. K. 2012. *Vermicomposting for Sustainable Agriculture.* 2nd Revised Edition, Agrobios, India.

SEMESTER –VI			
Core X: Immunology and Microbiology			
Code: 18UZOC61	**Hrs/week : 5**	**Hrs/sem: 75**	**Credits: 4**

Vision

To highlight the importance of various immune systems, lymphoid organs and the culture techniques of microbes.

Mission

Acquire knowledge about the immune response, antigens, antibodies, immunoglobulins and the culture techniques of microbes.

Course outcome

CO. No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	understand the importance of immune system, immune organs and immunoglobulins.	2	Cr
CO -2	identify structure and characteristics of different types of Lymphoid organs	3	Un
CO-3	analyse the structure and functions of immune systems	4	Un
CO-4	narrate and explain antigen and antibody	5	Un
CO-5	analyse the types of immunoglobulins	2	Cr
CO-6	understand the structure, classification and culture techniques of microbes	7	Un
CO-7	analyse and distinguish food poisoning, food spoilage and preservation methods	8	An
CO-8	determine the nature of the microbes and to realize their beneficial and harmful effects	3	Un

SEMESTER –VI			
Core X: Immunology and Microbiology			
Code: 18UZOC61	**Hrs/week : 5**	**Hrs/Sem: 75**	**Credits: 4**

Unit I **Immunity Types and Lymphoid Organs**

History and scope of Immunology. Immunity – types – innate immunity – factors controlling innate immunity – acquired immunity – types – active and passive immunity. Lymphoid organs – thymus - bone marrow – Bursa of fabricius – spleen and lymphnodes.

Unit II **Immune Response**

Cells of the immune system – development and fate of stem cells - Lymphocytes, B Lymphocytes, T Lymphocytes - types of T cells and macrophages – Immune response - humoral - primary and secondary – B cell activation- factors controlling antibody formation - cell mediated immune response – T cell activation – biological functions of cell mediated immunity.

Unit III **Antigens and Antibodies**

Antigens - definition – epitopes – general properties - cross reactive antigen - heterophile antigen – Frossman antigen – haptens. Antibodies (Immunoglobulins) - definition – basic structure of immunoglobulin – Ig classes - IgG, IgA, IgM, IgD and IgE - biological properties – general functions.

Unit IV **Structure, Shape and Culture of Microbes**

Importance and scope of Microbiology – classification of bacteria- general structure of bacteria, fungus and virus - culture media, continuous and batch culture techniques - bacterial growth curve.

Unit V **Food and Medical Microbiology**

Food Microbiology - food poisoning, food spoilage and preservation methods. Medical Microbiology - causative agent, symptoms, treatment and prevention of diseases. Bacterial diseases - diphtheria, tuberculosis, typhoid, leprosy, gonorrhea. Fungal diseases – candidiasis and dermatophytosis. Viral diseases - AIDS, poliomyelitis, chickenpox, hepatitis, dengue and swine flu.

Text book

1. Arumugam, N., Mani, A., Narayanan, L.M., Dulsy Fatima and A.M. Selvaraj. 2015. *Immunology and Microbiology*. Saras Publication, Nagercoil.

Books for Reference

1. Ivan M.Roitt. 1994. *Essential Immunology*. 6th Edition. ELBS English Language Book Society/ Blackwell Scientific Publications.
2. Rao, C.V. 2005. *An Introduction to Immunology*. Narosa Publishing House, New Delhi.
3. Joshi K.R and Osamo N.O. 1994 *Immunology.* 4th Edition Agro Botanical Publishers, India.
4. Kannan I. 2007. *Immunology*. MJP Publishers, Chennai.
5. Surendra Naha, 2012. *Fundamentals of Immunology*. Dominant Publishers & Distributors Pvt. Ltd., New Delhi.
6. Pelczar, M.J, Chan, E.C.S. and N.R. Krieg. 1986. *Microbiology* Mc Graw – Hill Book Company, New Delhi.
7. Chakraborty, P.A. 1995. *Text Book of Microbiology*. New Central Book Agency (P) Limited, Kolkata
8. Powar and Daginawala. 1988. *General Microbiology*. Himalaya Publishing House, Mumbai.
9. Arti Kapil. 2013. *Text Book of Microbiology.* 9th Edition. Universities Press (India) Pvt. Ltd.

PRACTICALS

Hours / Week : 2 **Credit - 1**

Immunology

1. ABO blood grouping
2. Rh factor typing.
3. Lymphoid organs of rat (chart)
4. Single Radial Immunodiffusion (Demonstration)
5. Double Immunodiffusion (Demonstration)
6. Cells of the immune system – stem cells, lymphocytes, macrophages.

Microbiology

1. Sterilization techniques
2. Preparation of culture media
3. Serial dilution technique
4. Simple staining of bacteria
5. Gram staining of bacteria
6. Hanging drop technique.
7. Study of distribution of microorganisms in nature – soil, water and air.
8. Spotters – autoclave, hot air oven, laminar hood, inoculation needle, agar plate.
9. Detection of coliforms for determination of the purity of potable water.
10. Culture and counting of bacterial colonies using colony counter.

Books for Reference

1. Jayasurya, Dulsy Fatima, Meyyan, R.P., Arumugam, N. and V. Kumaresan. 2013. *Practical Zoology. (Cell biology-embryolgy- Animal Physiology- Immunology- Ecology-Genetics-Evolution - Microbiology - Biochemistry - Biophysics*) Saras Publication, Kottar P.O., Nagercoil.
2. Arumugam, N. Mani, A., Narayanan, L.M., Dulsy Fatima and A.M. Selvaraj. 2015. I*mmunology and Microbiology*. Saras Publication, Nagercoil.

SEMESTER - VI			
Core XI : Biostatistics and Bioinformatics			
Code : 18UZOC62	**Hrs/Week : 5**	**Hrs/Sem : 75**	**Credits : 4**

Vision

- To explore the integration and application of statistics and bioinformatics in biology

Mission

- To acquire the skills and perspectives on statistics and bioinformatic tools in analysis and interpretation of data

Course Outcome

CO No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO 1	attain an insight on statistical methods for analysis of biological data	1	Kn
CO 2	acquire knowledge on the bio informatics concepts for analyzing molecular data	1	Kn
CO 3	identify the problems in data analysis and match the appropriate statistical method and corresponding software	4	Un
CO 4	analyse and use the bioinformatics tools for advanced sequence alignment, database searches, genome analysis and protein structure studies	8	Ap
CO 5	undertake statistical operations in biology	7	Ap
CO 6	operate commonly used bioinformatic tools and statistical methods and understand their limitations	8	Ap
CO 7	apply bioinformatics in life science research	8	Ap
CO 8	understand and critically evaluate the data analysis procedures in publications of molecular biology research	2,3	Un

SEMESTER - VI			
Core XI : Biostatistics and Bioinformatics			
Code : 18UZOC62	**Hrs/Week : 5**	**Hrs/Sem : 75**	**Credits : 4**

Unit I **Biostatistics – Collection and Display of Data**

Introduction – populations and samples – types of variables – collection of primary data – survey – census - sampling methods – sources of secondary data – classification of data – frequency distribution – presentation of data – tables - parts -types – diagrams – line diagram – bar diagram – pie diagram – graphs – histogram.

Unit II **Measures of Location and Dispersion**

Concept – computation for grouped and ungrouped data – relative merits and limitations of measures of central tendency mean, median and mode – measures of dispersion – range, variance, standard deviation, standard error and coefficient of variation.

Unit III **Statistical Inference and Correlation Analysis**

Probability theory – terminology – types - theorems of probability - chi- square test and goodness of fit – correlation – definition – types – scatter diagram – Karl Pearson's correlation coefficient – calculation of r value and interpretation – testing the significance of relationship using student's t-test.

Unit IV **Bioinformatics – An Overview**

Definition – scope – applications of bioinformatics – properties of biological databases –databases retrieval tools – PubMed – Medline – Locuslink – Entrez - SRS

Unit V **Protein and Nucleotide Sequence Databases.**

Protein sequence databases – NCBI – SWISS PROT - nucleotide sequence databases – EMBL – GENBANK - sequence alignment softwares – BLAST – FASTA – applications of bioinformatics tools in research on bioinformatics.

Text Book

1. Arumugam, N. 2010. *Biostatistics, Computer Applications, Bioinformatics and Instrumentation,* Saras Publication, Nagercoil

Books for Reference

1. Palanisamy. S. and M. Manoharan. 1990. *Statistical Methods for Biologists.* Palani Paramount Publications, Palani

2. Gurumani, N. 2005. *An Introduction to Biostatistics.* 2nd edition, MJP Publishers, Chennai
3. Agarwal, S.K. 2008. *Biostatistics,* APH Publishing Corporation. New Delhi
4. Arunima Mukherjee, 2008. *Bioinformatics,* Oxford Book Company, Jaipur, India
5. Thiagarajan, B. and Pa.Rajalakshmi. 2009. *Computational Biology.* MJP Publishers, Chennai

PRACTICALS

Hours / Week : 2 **Credit - 1**

1. Preparation of a questionnaire and collection of data by survey method.
2. Demonstration of simple random sampling by simulation using students (lottery and table of random number method)
3. Construction of continuous frequency table for the weight / height of students.
4. Diagrammatic presentation of data - simple bar diagram and pie diagram
5. Graphical presentation of data – histogram, frequency polygon and frequency curve
6. Calculation of mean, median, mode, standard deviation, standard error and coefficient of variation using neem leaves
7. Study of probability and chi - square test with two coins tossing experiment
8. Calculation of correlation coefficient and testing its significance
9. BLAST
10. FASTA

Books for Reference

1. Rajadurai, M. 2010. *Bioinformatics – A Practical Manual*, PSB Book Enterprises, Chennai.
2. Gurumani, N. 2005. *An Introduction to Biostatistics.* 2nd edition, MJP Publishers, Chennai.

SEMESTER VI			
Core XII Ecology and Biodiversity			
Code: 18UZOC63	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits:4**

Vision

To support advanced knowledge building in ecological principles and conservation ecology

Mission

To develop knowledge and critical understanding of ecology, conservation and biodiversity science and practice and sustainable use and management of its ecosystem services.

Course Outcome

CO.No	Upon completion of this course, students will be able to	PSO addressed	CL
CO – 1	understand and relate the interactions and the interdependence among environmental factors and living organisms.	1,2	Un
CO – 2	compare the adaptations of the organisms in different habitats	2	Un
CO – 3	analyse the mechanisms regulating the dynamics composition and organization of communities	2	Un,An
CO – 4	explore the interactions between organisms, the dynamics of populations and environment	1,3	Un,An
CO –5	explain different levels of biodiversity	1	Un,
CO – 6	discuss the direct and indirect values of biodiversity	1,3	Cr
CO-7	identify key threats to biodiversity evaluate management options for conserving biodiversity	1,3	Ap,Ev
CO-8	develop skills and competencies for career in eco-conservation and Eco- tourism	7	Ap

SEMESTER VI			
Core XII Ecology and Biodiversity			
Code: 18UZOC63	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits:4**

Unit I **Ecological Factors**

Abiotic factors : Basic concepts and biological effects of temperature and light
Biotic factors : Intra and interspecific relationships -mutualism, commensalism and antagonism (antibiosis, parasitism, predation and competition) – Biogeochemical cycles: carbon - nitrogen and phosphorous cycles

Unit II **Population& Community Ecology**

Population - Definition – density and estimation, natality – mortality – age distribution – age pyramids – population growth patterns –population fluctuations- population equilibrium — biotic potential – regulation of population density – dispersal – dispersion – population interaction
Community : concepts and characteristics – diversity – structure – community dominance – community stratification – periodicity – community interdependence
Ecotone– Edge effect – ecological niche – Ecological succession

Unit III **Habitat Ecology**

Aquatic - Freshwater – pond
Marine – classification of pelagic and benthic zones ,
Deep sea characteristics , fauna and adaptations .
Terrestrial habitat – desert and cave , characteristics , fauna and adaptations .

Unit IV **Biodiversity**

Definition and levels of Biodiversity (Genetical, Ecological, and Species diversity), values of biodiversity , Threats and loss of biodiversity – causes (natural, and manmade). Hot spots of biodiversity (with special reference to India) IUCN threat categories . Common threatened animal Taxa of India – Red Data Book

Unit V **Biodiversity Conservation and Management**

Conservation of Biodiversity : *In- situ* conservation (Sanctuaries,National parks , Biosphere Reserves, World Heritage sites) Project Tiger – *Ex- situ* conservation (Botanical gardens, gene banks , cryopreservation)
Role of Organizations in conservation: International Union for Conservation of Nature and Natural Resources (IUCN) , Zoological Survey of India (ZSI) , World Wildlife Fund (WWF), National Bureau of Plant Genetic Resources (NBPGR) and Convention on Rio Summit Agenda 21, Biodiversity Act, 2002 .

Text Books

1. Arumugam, N. 2010. *Concepts of Ecology*. Saras Publication, Kottar, Nagercoil.
2. Saha,T.K. 2008. *Ecology and Environmental Biology*. Books and Allied (P) Ltd,Kolkata.

Books for Reference

1. Kumaraswamy, K, AlagappaMoses, A. and Vasanthy, M. 2004. *Environmental Studies* Publication Division.
2. Prabhakar, V.K. 2004. *Environmental Education*. Anmol publications(P) Ltd, New Delhi.
3. Agarwal, K.C. 1999. *Environmental Biology*. AgroBotanica.
4. Verma, P.S. and V.K.Agarwal. 2013. *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology.* S.Chand& Company.
5. Arumugam, N and V.Kumaresan. 2014. *Environmental Studies*, Saras Publication, Nagercoil.
6. Verma and Agarwal. 1985. *Principles of Ecology*. S.Chand& Company Ltd, New Delhi.
7. Veer BalaRastogi and M.S.Jayaraj. 1988. *Animal Ecology and Distribution of Animals*. Kedar Nath& Ram Nath, Delhi
8. Krisnamoorthy, K.V. 2004. *An Advanced Text Book of Biodiversity.* Oxford and IBH, New Delhi

PRACTICALS

Credit - 1

1. Estimation of dissolved O_2 in water sample (pond / sea water)
2. Estimation of alkalinity in water sample (pond / sea water)
3. Estimation of BOD of water samples collected from various sources
4. Detection of transparency of water by Secchi disc
5. Analysis of plankton – fresh water / marine
6. Museum specimens / slides / models and charts
   - Mutualism (Hermit crab & Sea anemone)
   - Commensalism (Echeneis & Shark)
   - Parasitism (Sacculina on crab)
   - Map showing Biosphere Reserves of India
   - Hotspots of India
   - Endangered animals : Greater one horned Rhinoceros , Asiatic lion
   - Endemic animals :Lion tailed Macaque , NilgrisTahr
7. Report on visit to any place of ecological interest – (compulsary).

Books for Reference

1. Jeyasuriya, Arumugam, N. and Dulcy Fatima. 2013. Narayanan L.M *Practical Zoology Vol.3* Saras Publications, Kottar, Nagercoil.
2. Methods in Hydrobiology Manual, *Centre for Advanced Studies in Marine Biology*, Annamalai University.
3. Krisnamoorthy, K.V. 2004. A*n Advanced Text Book of Biodiversity*, Oxford and IBH, New Delhi.

SEMESTER – VI			
Core Integral III – Sericulture			
Code : 18UZOI61	**Hrs/Week : 4**	**Hrs/Sem : 60**	**Credits : 4**

Vision

Towards exploring the scope of various techniques involved in sericulture and moriculture for self employment.

Mission

To impart knowledge and technical skills in various aspects of sericulture and moriculture.

Course Outcome

CO.No	Upon completion of this course, students will be able to	PSO addressed	CL
CO - 1	acknowledge various organizations involved in the welfare of sericulture.	7	Un
CO - 2	interpret the practices of Moriculture.	3	Un
CO -3	attain information on the various diseases and pests affecting mulberry and its control measures.	1	Ev
CO - 4	develop skills on various silkworm rearing processes and operations.	8	Ap
CO - 5	use the knowledge of cocoon mounting and harvesting.	7	Ap
CO - 6	enumerate silkworm diseases and its control measures.	7	Un
CO - 7	involve in cocoon stifling, deflossing and reeling.	8	Ap
CO - 8	understand the uses of the products and byproducts of sericulture.	7	Un

SEMESTER – VI			
Core Integral III – Sericulture			
Code : 18UZOI61	**Hrs/Week : 4**	**Hrs/Sem : 60**	**Credits : 4**

Unit I **Introduction**

Introduction to sericulture – sericulture in India and world – role of Central Silk Board(CSB), Central Sericultural Research and Training Institute(CSRTI) –

Unit II **Moriculture**

Commercial varieties of mulberry – mulberry cultivation – cultivation practices – biofertilizers – foliar spray for mulberry – bacterial – viral – fungal –nematode and deficiency diseases – pests of mulberry – symptoms and control measures.

Unit III **Silkworm Rearing**

Mulberry silkworm –Popular silkworm breeds and hybrids in India- morphology– silk gland. Silk worm rearing – rearing house – rearing appliances – rearing operations – chawki rearing – rearing of late age worms – application of sampoorna.

Unit IV **Cocoon Mounting and Marketing**

Mountages – mounting methods – harvesting of cocoons – transport of cocoons – defective cocoons – cocoon markets. Silkworm diseases – bacterial, fungal and viral diseases – pest (Uzifly) symptoms and control measures.

Unit V **Silk Reeling.**

Cocoon stifling – methods of stifling – storage of cocoons – deflossing cocoon cooking – reeling operations. reeling appliances – cottage basin – filature units – uses of silk.

Text Book

1. Ganga, G. and J. Sulochana Chetty. 1991. *An Introduction to sericulture*. Oxford & Publishing Co Pvt. Ltd. New Delhi

Books for Reference

1. Krishnaswamy S. 1990. *New Technology of Silkworm Rearing.* Published by Central Silk Board, Bangalore.
2. Hisao Aruga. 1990. *Principles of Sericulture*. Published by Oxford & IBH Publishing Co. Pvt.Ltd., New Delhi.
3. Tammanna N. Sonwalker. 1993. *Hand Book of Silk Technology*. Published by Wiley Eastern Ltd, Madras.
4. Manjeet S. Jolly. 1987. *Appropriate Sericulture Techniques*. Published by Director, International Centre for Training and Research in Tropical Sericulture, Mysore.
5. Kamal Jaiswal, Sunil, P., Trivedi, B., Pandey, V. and P.N. Pandey 2009. *Indian Sericulture*. ALFA Publication, New Delhi.