ST. MARY'S COLLEGE (Autonomous)

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

Thoothukudi-628001, Tamil Nadu

(Affiliated to Manonmaniam Sundaranar University)

Syllabus

M.Sc. Zoology

School of Biological Sciences

Outcome Based Curriculum

(W.e.f.2019)

Preamble

Master of Science in Zoology is a post graduation course of St. Mary's College. The students pursuing this course would have to develop in-depth understanding of various aspects. The working principles, design, guidelines and experimental skills associated with different fields of Zoology. In pace with the recent trends and developments in Zoology the course content is being modified. There is also scope for self- employment. The practicals will improve all skills of students in microscopy and different laboratory techniques. This curriculum of the zoologists , for the zoologists and by the zoologists developed with the united efforts will take our ever progressive subject to greater heights in the years to come

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.	At the end of the M.Sc. Program, the students will be able to
PO-1	obtain in-depth and detailed functional knowledge of the fundamental theoretical concepts and experimental methods in Science
PO-2	understand their subject areas more clearly and develop skills to critically reflect upon the theory they learn.
PO-3	adopt the scientific methods and hypothesis testing in designing and execution of experiments.
PO-4	think critically, work independently and focus in research oriented activities.
PO- 5	inculcate an ability to engage in life-long learning to improve professional competency.
PO-6	extend and understand the impact of science on society.
PO-7	apply their professional ability for entrepreneurship and self employment.
PO-8	understand and commit to professional ethics and social responsibility.

Course Structure

Semester – I

Subject	Subject Code	Title of the Paper	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Core I	19PZOC11	Cell and Molecular Biology	6	4	40	60	100
Core II	19PZOC12	Genetics and Evolution	6	4	40	60	100
Core-III	19PZOC13	Biochemistry	5	4	40	60	100
Core IV	19PZOC14	Applied Entomology	5	4	40	60	100
Core Practical I	19PZOCR1	19PZOC11, 19PZOC12	4	2	40	60	100
Core Practical II	19PZOCR2	19PZOC13, 19PZOC14	4	2	40	60	100
			30	**20**			

Semester – II

Subject	Subject Code	Title of the Paper	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Core V	19PZOC21	Animal Physiology	5	4	40	60	100
Core VI	19PZOC22	Immunology	5	4	40	60	100
Core VII	19PZOC23	Biotechnology	5	4	40	60	100
Core VIII	19PZOC24	Microbiology	4	4	40	60	100
Field Work	19PZFW21		3	3	40	60	100
Core Practical III	19PZOCR3	19PZOC21, 19PZOC22,	4	2	40	60	100
Core Practical IV	19PZOCR4	19PZOC23, 19PZOC24	4	2			
			30	**23+2**			

It is mandatory for students to complete one MOOC Course during the first year of study. (19PZOM21) 2 credits

Semester – III

Subject	Subject Code	Title of the Paper	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Core IX	19PZOC31	Computational Biology	6	4	40	60	100
Core X	19PZOC32	Aquaculture Practices and Farm Management	6	4	40	60	100
Core XI	19PZOC33	Developmental Biology	5	4	40	60	100
Core XII	19PZOC34	Research Methodology	5	4	40	60	100
Core Practical V	19PZOCR5	19PZOC31, 19PZOC32	4	2	40	60	100
Core Practical VI	19PZOCR6	19PZOC33, 19PZOC34	4	2	40	60	100
Self Study Course / MOOC	19PZOSS1 / 19PZOM31	Zoology for Competitive Examinations		+2		100	100
			30	**20+2**			

Semester – IV

Subject	Subject Code	Title of the Paper	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Core XIII	19PZOC41	Marine Biology	4	4	40	60	100
Core XIV	19PZOC42	Conservation Biology	5	4	40	60	100
Core XV	19PZOC43	Commercial Zoology	5	4	40	60	100
Core Practical VII	19PZOCR7	19PZOC41	2	2	40	60	100
Core Practical VIII	19PZOCR8	19PZOC42, 19PZOC43	4	3	40	60	100
Elective - I	19PZOE41	A. Poultry B. Ornamental Fish Culture C. Clinical Biology	4	4	40	60	100
Project	19PZOP41		6	6		100	100
			30	**27**			

Components	No. of Courses	Hours / Week	Credits	Extra Credits
Core	15	77	60	
Core Practicals	8	30	17	
Field Work	1	3	3	
Elective	1	4	4	
Project	1	6	6	
MOOC	1	-		+2
MOOC/Self Study	1	-		+2
Total	**28**	**120**	**90**	**+4**

Program Specific Outcome

PSO No	Students of M.Sc., Zoology will be able to
PSO-1	comprehend and synthesis advance knowledge in specific areas of zoology
PSO-2	demonstrate an in-depth understanding and the ability to apply information from different areas of biology.
PSO-3	examine and evaluate knowledge across a broad range of courses, acquire a set of transferable skills for employment.
PSO-4	appreciate and use science as a way of problem solving, formulate hypotheses, design experiments and draw logical conclusions.
PSO-5	expound the relevance of the biological science to the real-world issues of bioethical, biological and social basis for human welfare and environment.
PSO-6	achieve practical proficiency in experimental techniques and methods of analysis.
PSO-7	design and develop projects with scientific report, oral / poster presentation and extend the findings to the society
PSO-8	select and apply experimental procedures to the spectrum of fields in biology

SEMESTER - I			
Core I Cell and Molecular Biology			
Code 19PZOC11	**Hrs/week : 6**	**Hrs/Sem: 90**	**Credits: 4**

Vision: Develop basic knowledge and skills in cell and molecular biology and become aware of the complexity and harmony of the cell

Mission : Students will gain the comprehensive knowledge on the molecular structure of cells, organelles including membrane structure and its dynamics

Course Outcome:

CO.No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	acquire knowledge on the structure and function of biological membrane including the roles of gradients in energy transduction	1	Un
CO-2	compare the different types of transporters and its functions	2	An
CO-3	relate the mechanisms of cell to cell signaling, including intracellular second messenger pathways	1, 4	An
CO-4	understand the structure and function of proteins including the roles of amino acids in protein folding and protein-protein interactions.	1	Un
CO-5	identify the regulation of gene at the transcriptional and post transcriptional level	3	Cr
CO-6	illustrate the structural organization of gene and the control of gene expression	5	Cr
CO-7	explain the cell cycle and its regulation, including the mechanism of mitosis and meiosis	6, 7	Ap
CO-8	demonstrate the molecular pathways that are altered in cancers, including oncogenes, tumor suppressors, apoptosis and DNA repair	6, 8	Ap

SEMESTER - I			
Core I Cell and Molecular Biology			
Code 19PZOC11	**Hrs/week : 6**	**Hrs/Sem: 90**	**Credits: 4**

Unit I Cell and Transport Across Cell Membranes

Molecular organization of cell membrane – molecular models (Unit membrane, Trilaminar and Fluid Mosaic). – Intercellular Junctions - Types of transport -diffusion –membrane transport proteins – uniporter catalysed transport – membrane electrical potential. Active transport by ATP powered pumps. Co -transport by symporters and antiporters

Unit II Cell Receptors and Cell Signaling

Cell- cell signaling –principle of cell signaling- signaling mechanisms- intracellular signaling. cell surface receptors –types- G protein coupled receptors- ion channel receptors second messengers (cAMP, IP_3 & DAG, cGMP, IP_3 & Ca^{2+} Calmodulin complex)- signaling from plasma membrane to nucleus.

Unit III Protein Synthesis and Processing

Ultrastructure of ribosome – endoplasmic reticulum – golgi complex. Protein synthesis- translational proof reading. Post translational modification (disulfide bond formation, correct folding, assembly into multimeric proteins and protein glycosylation in endoplasmic reticulum).

Unit IV Chromosome and Genes

Chromosome- types - organization of genes in chromosomes – introns and exons – simple, complex, split and overlapping genes – molecular basis of mutation – transition- transversion – frame shift – induction of mutation – repair systems to counteract DNA damage and mutation.

Unit V Cell Division

Mitosis - meiosis – molecular mechanisms for regulating mitotic events – cyclins and their kinases (cdks) –cell death and its regulations - characteristics of cancer cells – causes and onset of cancer. Molecular designing of cancer treatment.

Books for Reference

1. De Robertis, E.D.P. and E.M.F. Robertis. 1988. *Cell and Molecular Biology*. 9th International Edition, K.M. Varghese Company, Mumbai.
2. David M.Prescott. 1988. *Cells – Principles of Molecular Structure and Function*. Jones and Bartlett Publishers.
3. Lodish, H., Baltimore, D. and J. Darnell. 1999. *Molecular Cell Biology*. Scientific American Book, Inc, USA.
4. Ajoy Paul. 2011. *Text Book of Cell and Molecular Biology,* (Third Edition). Books and Allied (P) Ltd. Kolkata.
5. Bhamrah, H.S. 1995. *Molecular Cell biology*. Anmoi Publications Pvt Ltd, New Delhi.
6. David Freifelder.1995. *Essentials of Molecular Biology*. Narosa Publishing House, New Delhi.

7. Sivarama Sastry, K., Padmanaban, G. and C. Subramanyam. 1994. *Text Book of Molecular Biology*. Mac Millan India Limited, New Delhi.
8. Gerald Karp. 1984. *Cell Biology*. Second Edition McGraw Hill.
9. Prakash S. Lohar. 2007. *Cell and Molecular Biology*. MJP Publishers, Chennai.

PRACTICALS

Hrs / week : 2 **Credit: 1**

1. Preparation of squamous epithelial cells.
2. Preparation of human blood smear.
3. Preparation of cockroach haemolymph smear.
4. Mitotic cell division in onion root tip.
5. Meiotic cell division in grasshopper testis.
6. Giant chromosome in chironomous larva.
7. Observation of blood smear of frog.
8. Observation of sarcomere, columnar epithelial cells and ciliated epithelial cells.
9. Observation of different types of tissues : bone, hyaline cartilage, liver, kidney and nervous tissue.

Books for Reference

1. Nagesh Rao K.M.S. 2007. *Histology.* CBS Publishers and Distributors, New Delhi.
2. Shah and N.J. Chinoy. 1988. *Essential Techniques in Cell Biology*. Anada Book Depot. Educational Publishers, Ahmedabad.
3. Goswaml, H.K., 1986. *Practical cytology*, Applied Genetics and Biostatistics. Himalaya Publishing House, Bombay.

SEMESTER I			
Core II : Genetics and Evolution			
Code: 19PZOC12	**Hrs/Week: 6**	**Hrs/Sem: 90**	**Credits: 4**

Vision

To highlight the importance of genetics and evolutionary significance to the society

Mission

Students will learn about the genetic recombination of chromosomes, microbial genetics, evolutionary concepts and future evolution of man.

Course outcome

CO. No	Upon completion of this course, students will be able to	PSO addressed	CL
CO- 1	examine the chromosomes and genetic recombination and interpret linkage and mapping data	1	Kn ,Un
CO-2	discuss the theories of crossing over and construction of chromosome map	1	Kn,Un
CO-3	infer genetic recombination mechanisms in bacteria and assess the genetic and clinical significance of transposons	2	Un,Ev
CO-4	analyse changes in gene and genotypic changes and evaluate its consequences in populations	6	An, Ev
CO-5	discriminate various human genetic disorders and genetic variations in drug metabolism	4	An
CO-6	provide detailed explanations of neo – Lamarkism, neo – Darwinism, stabilizing and experimental evolution	1 , 6	Un,Cr
CO-7	examine, summarize and integrate central ideas underpinning evolutionary patterns and processes from the molecular to the macro scale	2	Un,Ap,Cr
CO-8	critically analyse, issues such as speciation mechanisms relating to the formation of species.	2	Un, An

SEMESTER I			
Core II : Genetics and Evolution			
Code: 19PZOC12	**Hrs/Week: 6**	**Hrs/Sem: 90**	**Credits: 4**

Unit I Chromosomes and Genetic Recombination.

Introduction – human karyotype analysis – linkage – comparison of complete and incomplete linkage – Morgan's experiments - theories and molecular mechanism of crossing over – construction of chromosome map – three point test cross (Drosophila), tetrad analysis (Neurospora) - chromosome banding and chromosome painting techniques.

Unit II Microbial Genetics

Recombination in bacteria – conjugation – transformation – transduction – sexduction – transposons – transposable elements in bacteria and medical significance – Yeast Ty elements – Drosophila transposons – modes of transposition – genetic and evolutionary significance.

Unit III Population Genetics and Human Genetics

Gene pool concept – gene and genotype frequencies – Hardy – Weinberg equilibrium – algebraic proof- estimation of equilibrium gene frequencies for complete dominance, co-dominance and multiple alleles and sex linked inheritance. Neurodegenerative diseases – Alzheimer's – Huntington's disease – genes in pedigree - dermatoglyphics – diagnostic features – pharmacogenetics – drug metabolism – genetic variation in the effect of drugs.

Unit IV Evolutionary Concepts

Neo – Lamarkism, Neo- Darwinism - stabilizing, directional and diversifying selection, experimental evidences - Modern concepts of recapitulation theory; genetic and non-genetic variations origin and evolutionary significance.

Unit V Speciation

Species - modes of speciation. Genetic drift- evolutionary significance - isolating mechanisms and their significance – Simpson's adaptive grid concept – micro, macro, and mega evolution – evolution of man – cultural evolution – future evolution.

Books for Reference

1. Strickberger, M.W. 1985. *Genetics*. 3rd edition, Maxwell Macmillan International Edition, New York.
2. Gardner, Simmons and Snustad. 1991. *Principles of Genetics*, 6th edition Prentice Hall. Inc.New York.
3. Klug, W.S. and M.R. Cummings. 2000. *Concepts of Genetics*. 6th edition Prentice Hall. Inc. New York
4. Emmanuel, C., Ignacimuthu, S. and S. Vincent. 2009. *Applied Genetics – Recent Trends and Techniques.* MJP Publishers, Chennai.
5. Amita Sarkar. 2011. *A Text Book of Human Genetics.* Wisdom Press, New Delhi.
6. Kreb, J.E., Goldstein, S. and T. Kilpatrick. 2011. *Genes* 10th edition. Jones Bartlett Publishers, USA.

7. Ujjwala Deshmukh. 2005. *Cytogenetics and Evolution*. Dominant Publishers and Distributors. New Delhi.
8. Gurbacham S. and Miglani. 2015. *Essentials of Molecular Genetics*. Narosa Publishing House, New Delhi.
9. Ledyard Stebbins. 1970. *Processes of Organic Evolution*. Prentice Hall of India.
10. Ernst Mayr. 1970. *Populations, Species and Evolution. An Abridgment of Animal Species and Evolution*. The Belknap Press of Harvard University
11. Dobzshansky, Francis J. Ayala, G. and W. Ledyard Stebbins James. 1973. *Valentine Evolution*. Surjeet Publications, Delhi.

PRACTICALS

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

1. Construction of genetic map for a given three point test cross.
2. Preparation of culture medium of Drosophila
3. Tracing the stages in the life cycle of Drosophila.
4. Observation of common mutants of Drosophila
5. Survey of simple Mendelian traits and ABO blood group in the class population and estimation of gene and genotype frequencies based on Hardy – Weinberg law.
6. Demonstration of role of random genetic drift in small populations using simulation (beads)
7. Analysis of dermatoglyphic data (finger print) of the class population.
8. Construction of pedigree
9. Bacterial conjugation (chart).
10. Industrial melanism- Peppered moth

Books for Reference

1. Michael Breitenback. 1997. *Experimental Genetics I .– biophysics*. *shg. ac /at/ home.htm*
2. William. D. Stansfield. Schaum's Outline Series. 1977. *Theory and problems of genetics. Second Edition.* Mc Graw Hill Book Company, USA.

SEMESTER I			
Core III : Biochemistry			
Code: 19PZOC13	**Hrs/Week: 5**	**Hrs/Sem: 75**	**Credits: 4**

Vision

To acquire skills in identifying the link between biological and human resources and transform it to enhance the quality of life.

Develop and enhance conservation of optimum academic environment to prepare professional graduates in the field of biochemistry**.**

Mission

To give a broad based knowledge in concepts and principles of Biochemistry.
To foster a culture of scientific inquiry and critical thinking.
To provide opportunities to get
hands on experience in – research oriented education in Biochemistry,
apprenticeship in industries and service agencies
entrepreneurship in Biochemistry-related areas.

Course Outcome:

CO.No	Upon completion of this course,students will be able to	PSO addressed	CL
CO- 1	classify and explain structure and functions of biomolecules	1	Un
CO-2	relate between biology and chemistry	2, 4	Un
CO-3	compare the specificity of enzymes (biochemical catalysts), and the chemistry involved in enzyme action.	3	An
CO-4	recognise the metabolic pathways of protein, amino acids,carbohydrates, fats and nuceic acids	1	Ev
CO-5	relate to real life situations and applications in research and industry	4	Un
CO-6	have firm foundations in fundamental applications of biomolecules	7	Un
CO-7	be skilled in solving the problems of biochemistry	5, 8	Ap
CO-8	design,carryout, record and analyse the results of chemical experiments	6	Cr

SEMESTER I			
Core III : Biochemistry			
Code: 19PZOC13	**Hrs/Week: 5**	**Hrs/Sem: 75**	**Credits: 4**

Unit I Atoms and Molecules

Structure of an atom, chemical bonds (ionic, covalent and hydrogen). Structure and properties of water. Vanderwaals interaction, role of water in life. pH and buffers- Weak acids and alkalies, Henderson and Hasselbalch's equation- Biological buffer system

Unit II Carbohydrates

Classification – structure – properties and functions of carbohydrates, Metabolism: glycolysis – TCA cycle – glycogenolysis – glycogenesis – gluconeogenesis – HMP shunt pathway .

Unit III Protein

Classification – structure – properties and functions of amino acids – classification – properties and functions of proteins – metabolism of proteins – metabolism of tryptophan – phenylalanine – tyrosine.

Unit IV Lipid

Classification – Biological importance of simple lipids (Triglycerides and Wax), compound lipids (phospholipids and glycolipids) and derived lipids (saturated, unsaturated and cholesterol) – β oxidation, ketogenesis – biosynthesis of fatty acids – disorders of fat metabolism (Hypercholestrolemia, Hyperlipoproteinemia and Atherosclerosis). Role of liver in fat metabolism.

Unit V Enzymes and Nucleic acids

Nomenclature – classification – properties – functions and mechanism of enzyme action and its regulation – coenzyme, isoenzyme. Nucleic acids, chemistry of nucleic acids, structure, biosynthesis and degradation, purine and pyrimidine nucleotides and disorders of their metabolism.

Books for Reference

1. Ambika Shanmugam. 2012. *Fundamentals of Biochemistry for Medical Student*s. Navabharat Printers and Traders, Madras.
2. Denise. R. Ferrier, Lippincott. 2014. *Illustrated Reviews: Biochemistry.* 6th edition. Wolters Kluwer Lippincott Williams & Wilkins
3. Pankaj Naik. 2016. *Biochemistry for medical students.* 4thedition. Health Science Publishers, New Delhi
4. Jain, J.L., Sunjay Jain, Nitin Jain. 2007. *Fundamentals of Biochemistry*. S. Chand & Company, New Delhi.

5. Styer.L.W.H. 1995. *Biochemistry*. Freeman & Company, San Francisco.
6. Murray, R.K., Gaaner, D.K., Mayer, P.A. and V.W. Rodwell. 1996. *Harper's Biochemistry*. 24th edition. Prentice Hall of Japan, Inc, Tokyo.
7. Rastogi, S.C. 2003. *Biochemistry*. Second edition. Tata McGraw Hill Publishing Company Ltd, New Delhi.
8. Satyanarayana,U. and U.Chakrapani. 2014. *Biochemistry.* Fourth edition. Elsevier & Allied. Haryana and Kolkata.
9. Edward Staunton West, Wilbert, R. Todd. Howard S.Mason, John .T.Van. Bruggen. 1966. *Biochemistry*. Fourth edition. Oxford and IBH Publishing Co. New Delhi.
10. Bernard L. Oser. 1965. *Hawk's Physiological Chemistry*. 14thedition. Tata McGraw Hill Publishing Company Ltd., New Delhi.
11. Chatterjee, M.N. 2010. *A Textbook of Biochemistry*. Jaypee Brothers, Medical Publishers Pvt Ltd. New Delhi.
12. Lehninger, A.1993. *Principles of Biochemistry*. CBS Publishers & Distributers. New Delhi.

PRACTICALS

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

1. Effect of pH on salivary amylase activity.
2. Effect of salivary amylase activity on substrate concentration
3. Salivary amylase activity in relation to enzyme concentration.
4. Preparation of standard graph for carbohydrate
5. Preparation of standard graph for protein
6. Quantitative estimation of muscle protein
7. Determination of iodine number of an edible oil
8. Separation of lipids by TLC -Demonstration only
9. Separation of amino acids by paper chromatography / Ninhydrin method
10. Preparation of buffers : acetic acid and acetate buffers

Books for Reference

1. J.Jayaraman. 2000. *Laboratory Manual in Biochemistry*. New age International (P) Ltd. Publishers, New Delhi.
2. Kannai L. Mukherjee and Swarajit Ghosh. 2012. *Medical Laboratory Technology*. 2nd Edition. Tata Mc Graw Hill Education (P) Ltd- New Delhi.
3. Deepti Saini and Deepak K. Sain. 2008. *Hand Book of Practical Biochemistry.* PEE PEE Publishers & Distributers (P) Ltd., New Delhi.

SEMESTER –I			
Core IV: Applied Entomology			
Code :19PZOC14	**Hrs/Week : 5**	**Hrs/Sem : 75**	**Credits : 4**

Vision

To explore the richness and significance of insects

Mission

To impart knowledge on the beneficial services, harmful effects rendered by insects and to familiarize them with effective control measures

Course outcome

CO.No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	know about the diversity of insects, classify and state their major different orders	1	Un
CO-2	develop skills for collecting, mounting and preserving insects	1, 6	Cr
CO-3	acquire knowledge on beneficial insects, helpful insects and insects of medicinal and aesthetic value	1	Un
CO-4	analyse the main pest species of crops based on the symptoms of the attack and morphological traits	2	An
CO-5	explain the life cycle of main pest species on crops and insect vectors	2, 1	Un
CO-6	identify, collect and manage different insects of household, man and animals.	4, 6	Ap
CO-7	apply appropriate indirect and direct measures to prevent or reduce pest attack	5, 7	Ap
CO-8	plan and implement crop protection according to the IPM principles	4, 8	Ev, Cr

SEMESTER –I			
Core IV: Applied Entomology			
Code :19PZOC14	**Hrs/Week : 5**	**Hrs/Sem : 75**	**Credits : 4**

Unit I Insect Taxonomy

Introduction – principles of classification – Imm's classification down to orders with their diagnostic characters, familiar and important examples – methods of collection, killing and preservation of insects.

Unit II Beneficial Insects

Productive insects – economic value of products of honey bee, silk worm and lac insect-helpful insects – insect pollinators, scavengers - insects as protein sources of human and animal feeds, medicinal uses of insects , Forensic entomology .

Unit III Harmful Insects

Insect pests of crops – general characters, bionomics and control measures of any three important pests of paddy, sugarcane and coconut – pests of stored products – internal and external feeders.

Unit IV Medical Entomology

Insects in relation to public health –Biology, mode of transmission of diseases and control: housefly, human head louse and mosquito (special reference to dengue, chikungunya and filariasis).

Unit V Pest Management

Methods of pest control - natural, cultural, mechanical, legal, biological and chemical (organic and inorganic compounds – synthetic pyrethroids). Recent trends in pest control: chemosterlants, hormones, pheromones, anti-feedants, Integrated Pest Management (IPM).

Books for Reference

1. Fenemore, P.G. and B. Prakash. 1997. *Applied Entomology*. Wiley Eastern Ltd., New Delhi.
2. Tembhare. D.B. 1997. *Modern Entomology*, Himalaya Publishing House, New Delhi,
3. Nayar, K.K., Vasantharaj David, B. and T.N.Anantha Krishnan. 2004. *General and Applied Entomology.* Tata Mc Graw Hill Publishing Company Ltd., New Delhi.
4. Nalina Sundari, M.S. and R. Shanthi. 2006. *Entomology.* MJP Publishers, Chennai.
5. Abishek Shukla. 2009. *Economic Entomology*. Daya Publishing House, New Delhi.
6. Sandhya Agrawal. 2009. *Applied Entomology.* Oxford Book Company, Jaipur, India.
7. Ravindran K.R. 2013. *A Text Book of Economic Zoology*. Wisdom Press, New Delhi.
8. Sathe, T.V., Satha, A.T. and Jagtap Mahendra. 2011. *Mosquito Borne Diseases*. Mangalam Publishers and Distributers, New Delhi.
9. Saxena, R. C. and R.C. Srivastava. 2007. *Entomology.* Agrotech Publishing Academy, Udaipur.

PRACTICALS

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

1. Identification and classification of common insects – Butterfly, Grasshopper, Stick insect, Leaf insect, Beetle.
2. Mounting of mouth parts of insects – Honey bee, Mosquito
3. Study of beneficial insect - Honey bee colony and their product(honey)
4. Study of beneficial insect - Silk moth – life stages, silk
5. Study of any three insect pests and their damages – one pest on each crop paddy, coconut, sugarcane.
6. Study of life history of the insect vector – House fly
7. Study of life history of the insect vector – Mosquito
8. Study of any two household insects – Bed bug, Silver fish
9. Study of any two ectoparasites – Human head louse, Flea
10. Submission of insect box with minimum 10 insects.

Books for Reference

1. Vasantharaj David, B. 2001. *Elements of Economic Entomology*. Popular Book Depot, Chennai.
2. Nayar, K.K., Vasantharaj David, B. and T.N.Anantha Krishnan. 2004. *General and Applied Entomology.* Tata Mc Graw Hill Publishing Company Ltd., New Delhi.
3. Fenemore, P.G. and Alka.Prakash 2006. *Applied Entomology*. New Age International Publishers, New Delhi.

SEMESTER II			
Core V : Animal Physiology			
Code :19PZOC21	**Hrs/ Week: 5**	**Hrs/Sem: 75**	**Credits: 4**

Vision

Provide students with an outstanding educational experience that prepares them for different careers, research, and academia.
Conduct innovative and cutting edge research that addresses vital issues related to human health and physiology.

Mision

To equip the students in the discipline of Physiology, by imparting knowledge and understanding of structure and function of human and biological systems.

To foster the development of professional skills through well designed curriculum; based on experiments, training and research.

Course Outcome :

CO. No	Upon completion of this course, students will be able to	PSO addressed	CL
CO- 1	compare digestive and circulatory system and infer regulation of blood pressure and heart beat	1, 2	Un,An
CO-2	understanding mechanisms of respiration and point out physiological adaptations to special conditions	1, 2	Un,An
CO-3	indicate the relationship between different environments and excretory organs and osmo ionic regulation	5	Ap, An
CO-4	appraise neuromuscular and sensory mechanisms and relate the physical and chemical phenomena	2 , 6	Un,Ap
CO-5	associate the endocrine glands with physiological actions and develop healthy life style	2, 4	Un,Cr
CO-6	perceive the steps involved in transmission of nerve impulses	5	Ev
CO-7	relate the structure and physiology of muscular system	7	Un
CO-8	elaborate the integration and interactions of hormones	8	Cr

SEMESTER II			
Core V : Animal Physiology			
Code :19PZOC21	**Hrs/ Week: 5**	**Hrs/Sem: 75**	**Credits: 4**

Unit I **Digestive and Circulatory Systems**

General organization of gastrointestinal tract - gastrointestinal secretary functions and the glands-physiology of absorption - role of GI hormones. Structure of mammalian heart-cardiac cycle - cardiac output- control of heart beat - blood pressure and its regulation – related diseases (hypertension , hypotension, stroke)

Unit II **Respiratory System**

Human respiration**: A**natomy and Physiology of the respiratory tract- transport of oxygen and carbondioxide-regulation of respiration-artificial respiration-physiological response to oxygen deficient stress (diving, high altitude) and exercise.

Unit III **Excretory System**

Human: kidney –nephron – mechanism of urine formation- regulation of ionic and osmoregulation in invertebrates with reference to Protozoa, crustaceans and insects, fishes, birds and mammals -endocrine regulation of water and mineral balance

Unit IV **Neuromuscular System**

Nervous system: neurons –structure and types- nerve impulse propagation – concept of synapse- transmission of electrical and chemical synapse- reflex arc-– reflex action.

Muscular system**:** Structural basis of contraction - sliding filament theory – mechanism and energetics of muscle contraction.

Unit V **Endocrinology**

Basic mechanisms of hormone action -endocrine glands in mammal - hormones and functions-hormonal disorders- role of hormones in reproductive cycles-menstrual and estrous cycle – pregnancy – parturition – lactation - hormones and neoplastic growth.

Books for Reference

1. Hoar. 1975. *General and Comparative Physiology*. Prentice. Hall of India Pvt Ltd .New Delhi.
2. Sembulingmam, K. and Prema Sembulingam. 2006. *Essentials of Medical Physiology.* Jay Pee Brothers New Delhi.
3. KuntSchmidt-Nielsen.K. 1985. *Animal Physiology. Adaptation and Environment* Cambridge University Press, Cambridge.
4. Ladd Prosser, C. 1984.*Comparative Animal Physiology*. Third edition. Satish Book Enterprise Book Sellers and Publishers, Agra.

5. Malcolm, S. Gordon. 1984. *Animal Physiology Principles and Adaptations*. Third edition. Collier MacMillan International edition, New Delhi
6. Nagabhushanam, R and M.S. Kodarkar.1978. *Textbook of Animal Physiology* Oxford and IBH Publishing Co. New Delhi.
7. Bentley.P.J.1980 *Comparative Vertebrate Endocrinology*, First edition. Chand & Company Ltd, Delhi.
8. Constance R. Martin. 1985. *Endocrine Physiology*. First edition. Oxford University Press, New York
9. Prakash S Lohar. 2005. *Endocrinology – Hormones and Human Health*, MJP Publishers, Chennai.
10. Sawant, S.C. 2015. *A Textbook of Human Physiology* Wisdom Press, New Delhi.

PRACTICALS

Hrs/Week 2 **Credit : 1**

1. Estimation of haemoglobin
2. Determination of erythrocyte sedimentation rate (ESR)
3. Detection of haemin crystals of blood
4. Salt loss/ salt gain in a fish
5. Effect of temperature on oxygen consumption of fish
6. Urine analysis for sugar, albumin and sediments
7. Urine analysis for urea and creatinine
8. Assay of acid/ alkaline phosphatase enzyme
9. Study of endocrine glands in chick/ rat - chart
10. Chart/ slide/ photograph
    a. ECG
    b. Conditional reflex.
    c. Transverse section of pituitary, thyroid, pancreas, adrenal, ovary and testis
    d. Reproductive cycles (estrous and menstrual cycle)

Books for Reference

1. Rastogi, 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 II			
Core VI : Immunology			
Code: 19PZOC22	**Hrs /Week : 5**	**Hrs / Sem: 75**	**Credits : 4**

Vision : To understand the fundamentals of immunology and key principles of immune system

Mission : To impart knowledge on the structure and functioning of immune system and how it relates to health and disease.

Course Outcome:

CO. No	Upon completion of this course, students will be able to	PSO addressed	C L
CO-1	analyse the genetic basis of antibody diversity, organization and arrangement of immunoglobulin genes	1	An
CO-2	understand the principle of the routine serologic procedures performed in the clinical laboratory.	1, 2	Un
CO-3	describe the structure and function of MHC molecules and the immunologic responses involved in preventing and combating infections	1	Un
CO-4	describe the basic mechanisms, distinctions and functional interplay of innate and adaptive immunity	1, 4	Un
CO- 5	describe immunological response and how it is triggered and regulated	1	Un
CO -6	transfer knowledge of Immunology into clinical decision-making	5	Ev
CO-7	discuss the role and advances being made in transplantation with artificial organs and the aberrations of the immune system such as immunodeficiency and autoimmunity	1, 6	Cr
CO- 8	familiarize the modern laboratory techniques applicable in the diagnosis and monitoring of diseases involving the immune system.	6	Cr

SEMESTER II			
Core VI : Immunology			
Code: 19PZOC22	**Hrs /Week : 5**	**Hrs / Sem: 75**	**Credits : 4**

Unit I Immunoglobulin Genes - Organisation and Expression

Scope- structure of Immunoglobulin (IgG)- Genetic model for Immunoglobulin structure - germ line and somatic variation – Dryer and Bennett two gene model Organization of Immunoglobulin (Ig) genes. Gene rearrangements in variable region - Mechanism of variable region DNA rearrangements - generation of diversity – class switching.

Unit II Antigen- Antibody Responses

Antigen - Antibody reactions: Salient features of antigen antibody reaction. Detection of antigen antibody reaction - precipitation - single radial immunodiffusion -doubleimmunodiffusion - immunoelectrophoresis – rocket immunoelectrophoresis- Immunofluorescence. Agglutination: haemagglutination- bacterial agglutination- passive agglutination- - agglutination inhibition test - ELISA.

Unit III Immunobiology

Hypersensitivity: - Types – Type I Anaphylaxis – Type II Antibody dependent cytotoxicity – Type III Immune complex mediated disease – Type IV Delayed type hypersensitivity and Type V Stimulatory hypersensitivity- Factors causing hypersensitivity- Major Histocompatibility Complex - MHC products – structure, distribution and functions - clinical importance of HLA - HLA typing - HLA paternity testing - HLA and diseases.

Unit IV Tumour Immunology and Autoimmunity

Immune responsiveness to tumours - natural immunity to tumours – T cell mediated immunity to tumours - tumour markers - hormones useful as tumour markers - therapeutic approaches to cancer - immune surveillance - Autoimmunity: cause of autoimmune diseases - classification of autoimmune diseases - diagnosis and treatment of autoimmune diseases.

Unit V Clinical Immunology

Transplantation immunology - types of grafts - mechanism of graft rejection - graft versus host reaction - tissue typing - immunosuppression - prevention of graft rejection – Immunodeficiency diseases - humoral deficiencies, cell mediated deficiencies and combined immunodeficiencies

Books for Reference

1. Catherine Sheehan. 1997. *Clinical Immunology*. Principles and Laboratory Diagnosis. Wolterskluwer Company, Philadelphia, Newyork, London.

2. David Male, Brian Champian and Annie Cooke. 1987. *Advanced Immunology*. J.B. Lippincott Company, Philadelphia, Gower Medical Publishing, London&N.York.
3. Emil, R. Unanue and Baruj Benacerraf. 1984. *Text Book of Immunology*. II Edition. Williams and Wilkins, Baltimore, London, Los Angels, Sydney.
4. Ivan M. Roitt. 1994. *Essential Immunology*. Blackwell Scientific Publications, Oxford.
5. Joshi, K.R., Osamo, N.O. 1994. *Immunology*. Agro Botanical Publishers, India.
6. Mary S. Leftfell., Albert D. Donnenberg. and Noel R. Rose. 1997. *Hand Book of Human Immunology.* CPC Press, Boca Raton, New York.
7. Rao, C.V. 2005. *An Introduction to Immunology*. Narosa Publishing House, New Delhi.
8. Rastogi, S.C., 2002. *Essentials of Immunology*. CBS Publishers and Distributors, New Delhi.
9. Talwar G.P. and Gupta, S.K. 1993. *A Hand Book of Practical and Clinical Immunology.* CBS Publishers and Distributors, Delhi.
10. Yadav P.R., 2004. *Immunology.* Discovery Publishing House, New Delhi.
11. Surendra Naha. 2012. *Fundamentals of Immunology*. Dominant Publishers Pvt. Ltd. New Delhi.

PRACTICALS

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

1. Lymphoid organs in rat (chart)
2. Radial Immunodiffusion.
3. Double Immunodiffusion.
4. Direct Agglutination - ABO blood grouping.
5. Rh - Typing.
6. Immunoelectrophoresis.
7. ELISA - Demonstration.
8. Isolation of lymphocytes and enumeration.
9. HLA typing.
10. Haemagglutination.

Books for Reference

1 Rabindra Narain 2012 *Practical Immunology*. Wishdom Press, New Delhi

2. Talwar, G. and S. K. Gupta. 1992. *A Handbook of Practical and Clinical Immunology*

Vol 1 Second Edition. CBS Publishers & Distributers, Delhi.

SEMESTER – II			
Core VII : Biotechnology			
Code : 19PZOC23	**Hrs / week : 5**	**Hrs / Sem : 75**	**Credits : 4**

Vision: Maintaining integrity and professionalism through a broad spectrum of bio and nanotechniques on a global scale

Attaining new heights by taking research in biotechnology and creating a promising group of students.

Mission : To motivate the students to develop a scientific attitudes towards emerging technologies

To discover the potential sources of biotechnology and their applications in various fields

To serve as a platform for students to explore their professional skills.

To familiarize with basic concepts and applications of nanotechnology

Course Outcome

CO.No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	outline about the introduction and history of Biotechnology	1	Un
CO-2	get more insight on the basic properties and advanced functions of different vectors.	3	Un
CO-3	attain research skills in the field of manipulations of animal cell and tissue culture.	7	Ap
CO-4	understand the beneficial effects of microorganisms and the impact of microbial production on human health	3	Un
CO-5	apply their knowledge in designing techniques for enzyme production in small and large scale industries	8	Ap
CO-6	evaluate the need and impact of biotechnological methods in enzyme production through industries	3	Ev
CO-7	imbibe the practical and theoretical knowledge of nanomaterials essential for pursuing higher studies.	2	Un
CO-8	achieve skills in handling tools and techniques in Biotechnological manipulation.	6	Ev

SEMESTER – II			
Core VII : Biotechnology			
Code : 19PZOC23	**Hrs / week : 5**	**Hrs / sem : 75**	**Credits : 4**

Unit I Cloning and Screening

Definition – scope – vectors - properties of good vector-cloning and expression vectors - E.coli vector- screening of recombinants - pBR 322 - bateriophage – Lambdaphage – plasmid and yeast. vector - integration of DNA insert with the vector - introduction of vector into suitable host.

Unit II Animal Cell and Organ Culture

Cell culture - culture media - initiation of cell culture - large scale culture of cell lines- stem cell culture – organ culture - hybridoma technology – Artificial insemination - transgenic animals- fish and mice.

Unit III Microbial Biotechnology and Human Welfare

Microbial biotechnology- Isolation and improvement of microbial strains –cloned genes and production of chemicals - human peptide hormones – insulin – vaccine for hepatitis B – foot and mouth disease viruses - disease prevention - gene therapy - DNA finger printing – Bioremediation.

Unit IV Enzyme and Industrial Biotechnology

Methods of enzyme production – immobilization of enzymes -application of enzymes. Single cell protein- mushroom culture – techniques-advantages and nutritive value. Bio gas production – mechanism of methane production

Unit V Nanotechnology

Nanomaterials, synthesis of nanoparticles: RF plasma, chemical methods, thermolysis, nanobiosensor, nanofluids, nanocrystals- synthesis of nanodrugs- nanomedicine.

Books for Reference

1. Dubey.R.C. 2006. *A Text Book of Biotechnology*. 4th edition. S.Chand & Company Ltd,New Delhi.
2. Singh.B.D. 2005. *Biotechnology.* Revised edition. KalyaniPublishers, New Delhi.
3. Kumaresan, V. 2009. *Biotechnology*. Saras Publication, Nagercoil.
4. Rema, L.P. 2007. *Applied Biotechnology*. MJP Publishers,Chennai.
5. Satyanarayana, U. 2006. *Biotechnology,* Books and Allied (P) Ltd. Kolkatta
6. Robert Preidt, Laura Costlow and Peter. 2007. *Introductory Nanotecnology*. Dominant Publishers and Distributors, Delhi
7. Suhas Bhattacharya. 2013. *Introduction to Nanotechnology*. Wisdom Press. Delhi

Practicals

Hrs/week : 2 **Credit: 1**

1. Isolation of plasmid DNA
2. Isolation of Genomic DNA
3. Immobilization of enzymes by sodium alginate method
4. PCR amplification.
5. Western blotting analysis.
6. Biogas production
7. Mushroom culture
8. Charts and models pertaining to theory for spotters
9. Report of visit to biotechnology lab

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 and Anchal Singh. 2008. *Laboratory Manual for Biotechnology*. S.Chand and Company, New Delhi.

SEMESTER II			
Core VIII		Microbiology	
19PZOC24	Hrs/ Week : 4	Hrs / Sem : 60	Credits : 4

Vision : To prepare graduate students with thorough knowledge and understanding of the core concepts in the field of Microbiology

Mission : To equip the students with knowledge about Taxonomy, organization, multiplication and infection of microbes and to develop expertise in microbiological techniques.

Course Outcome :

CO.NO	Upon completion of this course, the students will be able to	PSO addressed	CL
CO- 1	classify micro organisms focusing on the modern trends of Taxonomy	1	Un
CO- 2	prepare media to be utilized in the cultivation of microorganisms	2	Ev
CO-3	understand the structural organization and life cycle of microorganisms	2	Un
CO-4	explain the role of microorganisms in fermentation, medicine and the production of microbial products	2	An
CO-5	gain familiarity with the unique role of pathogens in human infectious diseases	2	Ev
CO-6	identify the methodologies used in disease treatment and prevention	6	An
CO-7	demonstrate practical skills in the use of technologies and methods common to microbiology	8	Ev
CO-8	apply scientific methods in the design and execution of experiments	8	Ap

SEMESTER II			
Core VIII		Microbiology	
19PZOC24	Hrs/ Week : 4	Hrs / Sem : 60	Credits : 4

Unit I Classification

Classification of microorganism – Five Kingdom concept . Modern trends of bacterial Taxonomy- Ribosomal RNA and sequencing - Construction of phylogenetic tree. General characters of main groups of microorganisms.

Unit II Cultivation of microorganisms

Preparation of culture media – Isolation and maintenance of pure culture- Cultural and morphological characteristics of bacteria – Microscopic examination of microorganisms- gram staining- acid fast staining – spore staining - capsular staining – flagellar staining.

Unit III Microbes – Structural organization

Structural organization of bacteria, virus and fungi – Life cycle of Actinomycetes, yeast and mycoplasma.

Unit IV Production of microbial products

Yeast fermentation and its products – Production of alcohol, beer and wine. Mixed fermentation product- Production of vinegar. Production of antibiotics - penicillin and tetracycline.

Unit V Microbial diseases

Protozoan diseases- ameobiais and sleeping sickness. Bacterial diseases- diphtheria, tetanus and gonorrhea. Viral diseases- chikungunya, dengue fever, rabies and ebola. Fungal diseases- actinomycosis and aspergillosis.

Books for Reference

1. Arti Kapil. 2016. *Text Book of Microbiology*. 9th Edition. University Press. Hyderabad.
2. Dubey, R .C and D.K. Maheswari. 2006. *A Text Book of Microbiology.* S chand & Co New Delhi.
3. Roger Stainer, John Lingraham, Mark I Wheelis and Page R. Painter. 1992. *General Microbiology* Mac Millan, Hampshire, London.
4. Pelzer Chan and Krieg. 1998. *Microbiology.* 2nd Edition. Tata MC Grow Hill Publishing Company, New Delhi.
5. Presscott Harley and Klein. 2005. *Microbiology.* WCB MC Graw Hill Co New York.
6. Purohit, S.S. 1991. *Microbiology – Fundamentals and Application*. M/ S Saraswathi Publication, India
7. Power, C.B, and K.F. Daginawala. 1988. *General Microbiology* . Vol I & II. Himalaya Publishing House, Mumbai.
8. Vijaya Ramesh. 2007. *Food Microbiology.* MJP Publishers, Chennai.

PRACTICALS

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

1. Sterilization Techniques
2. Sample handling for microbial studies
3. Preparation of culture media:

   Nutrient broth, Nutrient agar, Potato dextrose agar, Mullen- Hinters agar
4. Counting of viable cells (CFU/ ml) by serial dilution & spread plate or pour plate methods
5. Gram staining
6. Spore staining
7. Simple biochemical tests of bacteria

   a Acid and gas production in glucose broth

   b Starch hydrolysis

   c Catalase

   d Nitrate reduction
8. Dye reduction test in milk
9. Test for antibiotic sensitivity
10. Isolation of symbiotic nitrogen fixing bacteria from root nodules
11. Observation of algae, fungi and blue green algae

Books for Reference:

1. Kannan N. 1996. *Laboratory Manual in General Microbiology.* Palani Paramount Publications, Palani.
2. James Cappuccino and Natalie Sherman. 1990. *Microbiology A Laboratory Manual*. Addison - Wesly- Hyman Inc,Tokyo.
3. Dubey R.C. and D.K. Maheswari. 2008. *Practical Microbiology*. S Chand & Company Ltd., New Delhi.

SEMESTER - III			
Core IX Computational Biology			
Code : 19PZOC31	**Hrs/Week : 6**	**Hrs/Sem : 90**	**Credits : 4**

Vision

To understand the central concepts of biostatistics and bioinformatics

Mission

To impart interdisciplinary expertise from the biological science, computer science and mathematics

Course Outcome:

CO. No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	analyse and interpret results of descriptive statistical methods effectively	1, 3	An, Ev
CO-2	apply the methods of hypothesis testing, statistical inference and design	4	Ap
CO-3	appreciate biological data in statistical perspective correctly and contextually	4	Un
CO-4	infuse critical appraisal skills to assess the research data and produce original research	7	Cr
CO- 5	carry out correlation and regression analysis and recognise theoretical distributions	6	Un, An
CO -6	formulate and test using appropriate statistical software	4	Cr
CO-7	implement statistical methods and statistical software programmes to a variety of practical problems	5	Ap
CO- 8	demonstrate the mastery of concepts of bioinformatics	1, 2	Un,

SEMESTER - III			
Core IX Computational Biology			
Code : 19PZOC31	Hrs/Week : 6	Hrs/Sem : 90	Credits : 4

Unit I Biostatistics –Descriptive Statistics

Introduction – measures of central tendency - arithmetic mean, geometric mean, harmonic mean, median and mode – measures of dispersion – range, quartiles, mean deviation, standard deviation, standard error and coefficient of variation – measures of skewness and kurtosis – stem and leaf diagram - box plot.

Unit II Inferential Statistics

Theoretical probability distributions - binomial - Poisson – normal distribution – steps in hypothesis testing procedure – student's t- test – chi – square test – goodness of fit and contingency tables – ANOVA – assumptions - types - one way and two way.

Unit III Correlation and Regression

Computation and interpretation of correlation coefficient – Karl Pearson's correlation coefficient – coefficient of determination - Spearman's rank correlation coefficient – regression – types – regression lines and their properties – fitting linear regression equations and forecasting – relationship between correlation and regression coefficients.

Unit IV Computer Applications

MS Excel – spread sheet – statistical functions calculation of arithmetic mean – t test – ANOVA one way classification– statistical packages –SIGMAPLOT – statistical calculation –SPSS package – Principal Component Analysis(PCA).

Unit V Bioinformatics

Basic concepts and scope - nucleic acid database - GENBANK and EMBL – protein sequence database - NBRF – PIR and SWISSPROT - database similarity searches – BLAST and PSI – BLAST algorithms – Smith – Waterman algorithm – Needleman – Wunsch algorithm – scoring matrices - PAM and BLOSUM – multiple sequence alignment – sum of pairs method and progressive method.

Books for Reference.

1. Jerrold H. Zar. 1984. *Biostatistical Analysis*. 2nd edition, Prentice -Hall International Edition. USA.
2. Snedecor, G.W. and W.G. Cochran. 1991. *Statistical Methods.* (8th edition). Affiliated East West Press, New Delhi,.
3. Gurumani, N. 2005. *An Introduction to Biostatistics*. MJP Publishers, 2nd edition, Triplicane, Chennai-5
4. Agarwal, S.K. 2008. *Bioinformatics.* APH Publishing Corporation. New Delhi.
5. Gautham, N. 2009. *Bioinformatics - Databases and Algorithms*. Narosa Publishing House Pvt Ltd. New Delhi.

6. Thiagarajan, B. and Pa.Rajalakshmi 2009. *Computational Biology,* MJP publishers, Chennai .
7. Rajathi, A and Chandran, P. 2010. *SPSS for you*. MJP Publishers, Chennai.

PRACTICALS

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

1. Computation of mean, median, mode, variance, standard deviation, standard error and coefficient of variation for biological variables.
2. Display of data through stem and leaf diagram.
3. Test of significance using student's t – test.
4. Test of goodness of fit of data with the aid of chi- square test.
5. Analysis of variance of molluscan shells
6. Correlation coefficient between height and weight of students and length and width of leaves.
7. Fitting regression equations for two variables and prediction of values.
8. Seqence alignment and similarity searching - BLAST
9. Statistical calculation using SPSS software package.
10. Retrieving data from EMBL database - Print out.

Books for Reference

1. Gurumani, N. 2005. *An Introduction to Biostatistics*. MJP Publishers, 2nd edition, Triplicane, Chennai-5.
2. Rajadurai, M. 2010. *Bioinformatics – A Practical Manual*, PSB Book Enterprises, Chennai.

SEMESTER – III			
Core X : Aquaculture Practices and Farm Management			
Code : 19PZOC32	**Hrs / week : 6**	**Hrs / Sem : 90**	**Credits : 4**

Vision

To develop a comprehensive knowledge and transferable professional skills for career in aquaculture industry

Mission

To acquaint with technical and general knowledge for competent fisheries management

Course Outcome

CO. No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	design aquaculture systems	1	Cr
CO-2	develop practical skills for management of culture ponds	3	Ap
CO-3	apply techniques involved in breeding and culture of various organisms	1,2	Cr,Ap
CO-4	demonstrate competency in live feed culture and feed formulation	2,3	Un,Ev
CO-5	evaluate and manage aquaculture diseases, health and safety issues in aquaculture ventures	1,6	Un Ev
CO-6	discuss important factors for performing a sustainable aquaculture	1,3	Un, Ap
CO-7	compare the principles of genetic improvement of fish stock	1	Un
CO-8	analyse aquaculture economics and marketing strategies	1,3	An,Ap

SEMESTER – III			
Core X : Aquaculture Practices and Farm Management			
Code : 19PZOC32	**Hrs / week : 6**	**Hrs / Sem : 90**	**Credits : 4**

Unit I **Aquaculture Basics and Management**

Scope of aquaculture, aquaculture in India, Fishery resources of India in general and Tamil Nadu in particular. Selection of site,construction of fish farm, soil chemistry. Designing layout and construction of different types of fish ponds. Management of culture ponds - fertilization, water quality management, predators and weed management

Unit II **Seed Production and Culture Techniques**

Carp culture : Carp: Brooders care and management seed collection from natural sources, bundh breeding, hypophysation, in-vitro fertilization. Fish seed transport, hatching and rearing techniques. Culture of edible oyster, pearl oyster and seaweed.

Unit III **Nutrition and Health management**

Culture of fish feed organisms: diatoms,cladocerans,rotifers, artemia, artificial feed formulation and management, probiotics in formulated feeds. Bacterial (gill rot & Furunculosis),viral (EUS & Erythrocytic necrosis) fungal diseases (Saprolegniasis & Erythroderma) nutritional deficiency diseases, ectoparasites, endoparasites, principles of fish health management, fish vaccines.

Unit IV **Aquaculture for Stable Environment**

Water pollution, its effect on fisheries and methods of its abatement. Sewage - fed fish culture, sewage treatment , sewage- cum fish culture in India. Integrated fish farming: animal husbandry cum fish culture, paddy cum fish culture, fish culture in cages and pens. Culture of air breathing fishes.

Unit V **Aquaculture Biotechnology and Economics**

Genetic improvement of stock: selective breeding, hybridization, polyploidy, production of monosex, sterile fish, transgenic fish, sex manipulation, gynogenesis, androgenesis, role of biotechnology in conservation of fish. Aquaculture economics, fish marketing, involvement of government organizations in marketing. Role of CMFRI, NIOT,CIBA & NABARD.

Books for Reference

1. Dubey, S. K. and Bandand Ghosh. 2012. *Fish Biotechnology*. Wisdom Press, New Delhi.
2. Amita Saxena, 2011. *Fisheries Economics*. Daya Publishing House, New Delhi.
3. Schonder, S. L. 1980. *Hypophysation in Indian Major Carps*. Sathish Book Enterprises Agra.
4. Pandian, I.D. Abhinandan Kumar and Rajbhushan Prasad. 2009. *Aquaculture and Biotechnology.* A. K. Publ. New Delhi.
5. Agnihotri. S. B. 2013. *Aquaculture Management and Technology*. Swastik Publication, Delhi.

6. Felix, S. 2010. *Marine and Aquaculture Biotechnology*. Agrobios, Jodhpur, India

7. Santhanam, R., Ramanathan, N. and G. Jegathesan. 1990. *Coastal Aquaculture in India.* 1st edn. CBS Publishers, Delhi.

8. Shagufta. 2012. *Fish Health and Diseases*. APH Publishing.,Corpoartion, NewDelhi

9. Yougesh Kumar and Rajeev Tyagi. 2013. *Aquaculture Fisheries Biotechnology and Genetics*. Mangalam Publishers & Distributors, Delhi

10. ChandraSekar. Y.S . 2012. *Fish Nutrition in Aquaculture*. Swasthik Publishers &Distributers, Delhi.

11. Rajendra Kumar Rath. 2011. *Freshwater Aquaculture*. Scientific Publishers, Jodhpur.

12. Singh, V.B. 2010. *Fish Farming*. ALP Books, New Delhi.

13. *Economics of Fish Culture Operations*. FAO- www.fao.org.docrep

PRACTICALS

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

1. Estimation of dissolved ammonia in water samples
2. Estimation of alkalinity in water samples.
3. Analysis of freshwater plankton
4. Decapsulation technique and hatching of artemia cysts
5. Feed formulation exercise – preparation of compound feed Demonstration
6. Identification of cultivable food fishes
7. Identification of aquatic weeds, predatory fishes and insects.
8. Study of fish parasites and diseases.
9. Visit to aquaculture farm – drawing the layout of ponds, dikes and sluices

Books for Reference

1. Methods in Hydrobiology Manual, *Centre for Advanced Studies in Marine Biology*, Published by Annamalai University, Parangipettai, Chidambaram.
2. Felix, N., Ahilan, B. and S. Athithan. 2004. *Fish Nutrition and Feed Technology Manual.* Fisheries College and Research Institute, Tamilnadu Verteinary & Animal Science University, Thoothukudi.
3. FAO Fisheries Technical Paper. No.361; *Manual on the Production and Use of Live food for Aquaculture.* Laboratory of Aquaculture and Artemia Reference Centre, University of Ghent, Belgium.

SEMESTER - III			
Core XI - Developmental Biology			
Code : 19PZOC33	**Hrs / Week : 5**	**Hrs/ Sem : 75**	**Credits : 4**

Vision

To understand the sequential changes in the development and organization of an embryo

Mission

To acquire knowledge about embryonic development, congenital abnormalities and the role of genes in development

Course Outcome:

CO.No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	define the process of gametogenesis and describe the structure of gametes	1, 2	Un
CO-2	outline the events that lead up to and comprise the process of fertilization	2	Un
CO-3	compare and contrast the patterns of cleavage in the various model organisms	1, 2	An
CO-4	discuss the morphogenetic movements, cellular mechanisms and the functions of gastrulation	1	Un, Cr
CO-5	elaborate tissue interactions and the development of organ systems in vertebrates	1	Un, Cr
CO-6	analyse the role of genes, stem cells and the impact of teratogens in development	5	An
CO-7	illustrate the role of hormones in amphibian and insect metamorphosis	6, 1	Un
CO-8	demonstrate the ability of regeneration in different groups of organisms	6, 1	Cr

SEMESTER - III			
Core XI - Developmental Biology			
Code : 19PZOC33	**Hrs / Week : 5**	**Hrs/ Sem : 75**	**Credits : 4**

Unit I Gametogenesis and Fertilization

Gametogenesis – spermatogenesis – oogenesis. Structure of gametes - sperm and egg of sea urchin and mammal. Fertilization (biochemical, molecular aspects) in sea urchin and mammal- prevention of polyspermy . Parthenogenesis.

Unit II Cleavage and Gastrulation

Planes and patterns of cleavage – cleavage in sea urchin, drosophila, frog, bird and mammal. Mechanism of cleavage. Fate map of frog. Gastrulation – morphogenetic movements - gastrulation in sea urchin and frog

Unit III Organogenesis

Organogenesis in vertebrates - CNS, eye, skin and its derivatives, heart, kidney, digestive tube and its derivatives. Development of extraembryonic membranes in chick. Placentation in mammals - types and physiology.

Unit IV Role of Genes in Development

Genomic equivalence – differential gene expression – amplified genes – selective gene transcription – control of gene expression. Congenital abnormalities – teratogenic agents - programmed cell death in development.

Unit V Metamorphosis and Regeneration

Insect metamorphosis - moulting and metamorphic changes - hormonal control of insect metamorphosis. Amphibian metamorphosis – morphological, physiological, biochemical change and causation of metamorphosis. Regeneration – patterns – morphollaxis - epimorphosis and heteromorphosis – regeneration ability in different group of organisms - mechanism of limb regeneration in amphibian.

Books for Reference

1. Philip Grant. 1985. *Biology of Developing Systems.* Hall – Saunders International edition, Japan.
2. Scott F. Gilbert. 1994. *Developmental Biology.* Sinamer Associates Inc Publishers, Sunderland, Massachusetts.

3. Wendell Smith, C.P., Williams,P.L. and Sylvia Tread Gold. 1996. *Basic Human Embryology*. ELBS Edition. Pitman Publishing Ltd., Great Britain.

4. Banerjee, S. 2005. *A Text Book of Developmental Biology.* Dominant Publishers and Distributors, New Delhi.

5. Lewis Wolpert and Cheryll Tickle. 2010. *Principles of Development.* Fourth edition. Oxford University Press, New Delhi.

6. Verma, P.S, Agarwal, V.K. and B.S. Tyagi. 1980. *Chordate Embryology.* S. Chand & Company Ltd, New Delhi.

7. Sanjib Chattopadhyay. 2017. *An Introduction to Developmental Biology*. Books and Allied (P) Ltd., Kolkata.

PRACTICALS

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

1. Observation of sperm, egg, T. S. of testis and T.S. of ovary of frog - slides.
2. Observation of sperm, egg, T.S. of testis and T.S. of ovary of mammal - slide.
3. Observation of developmental stages of frog - cleavage, blastula, gastrula external gill stage and tadpole stages – slides
4. Mounting of chick blastoderm.
5. Observation of chick embryos – 24 hrs, 48 hrs, 72 hrs, 96 hrs.
6. Types of placenta in mammals (one eg. in each type)
7. Study of any two congenital abnormalities – Phocomelia, Cyclopic lamb.
8. Study of effect of thyroxin in amphibian metamorphosis
9. Study of regeneration in the tail of tadpoles

Books for Reference.

1. Verma P.S, Agarwal, V.K. and B.S. Tyagi. 1980. *Chordate Embryology.* S. Chand & Company Ltd, New Delhi.
2. Verma P. S.1992. *A Manual of Practical Zoology Chordates.* S. Chand and Company Ltd, New Delhi.
3. Balinsky B.I. 1976. *An Introduction To Embryology.* Fourth edition, B.W.Saunders Company, U.S.A and Toppan Company Ltd, Japan.

SEMESTER – III			
Core XII : Research Methodology			
Code : 19PZOC34	**Hrs / Week : 5**	**Hrs / Sem : 75**	**Credits : 4**

Vision

To inculcate research aptitude in students

To be leaders in making use of various scientific techniques and research methods available to and usable by scholars

.

Mission

To introduce the principles and applications of various instruments used in Biology and to prepare them to use these techniques in their own research

Provide an environment to students to participate in consulting and improve their skills

To build scientific teams that can combine various techniques and to create novel approaches to understanding

Strengthen research by assisting students using scientific techniques in the most optimal way.

Course Outcome

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	demonstrate critical thinking and scientific approach in the design and implementation of an experiment.	1,3	Un, Cr
CO-2	effectively communicate scientific ideas in both written and oral formats	1,2	Un, Ev
CO-3	acquire a broad range of basic laboratory skills to perform experiments and for employment prospects	5	Un, Ap
CO-4	demonstrate and apply a working comprehension of the technical and procedural aspects of laboratory testing, safety and ethical standards of practices	4	Ap
CO-5	write a research report and thesis and Appreciate the components of scholarly writing and evaluate its quality.	6	Cr,Ev
CO-6	verify and test important facts and find solutions to scientific problems	7	An
CO-7	develop new scientific tools, concepts and theories to solve and understand scientific problems	7	Cr
CO-8	design and conduct independent laboratory or field research that is consistent with the highest standards and practices of research	8	Ap

SEMESTER – III			
Core XII : Research Methodology			
Code : 19PZOC34	**Hrs / Week : 5**	**Hrs / Sem : 75**	**Credits : 4**

Unit I Research Designing

Introduction – literature collection-sources – literature citation – manuscript preparation of research report, Internet and e-journals- thesis formating and typing – safety measures in a laboratory – Plagiarism (URKUND)

Unit II Microscopy Types

Principle, construction and applications of Phase contrast- Polarization – Electron microscope– types (SEM,TEM)- fixation and staining techniques for EM (freeze - etching and Freeze fracture), fluorescence - flow cytometry - atomic force and magnetic force microscope – micrometry.

Unit III Spectroscopic Techniques

Absorption and emission principles – construction and applications of UV-visible spectrophotometer, FTIR, spectrofluorometer- flame photometer-atomic absorption and emission spectrophotometer -NMR and Mass spectrometer in Biology

Unit IV Centrifugation and Chromatographic Techniques

Principles of centrifugation— ultra centrifuge, differential centrifugation- density gradient– isopycnic- Principle, instrumentation and application of chromatography – column - gas - liquid - HPLC – ion exchange - affinity- gel filteration.

Unit V Electrophoresis & Radioactive Techniques

Principle and applications of electrophoresis – agrose - PAGE- SDS-PAGE- isoelectric focusing- radioisotopes used in Biology GMcounter, solid and liquid scintillation counters – sample preparation for radioactive counting. Autoradiography - calorimetry – bomb calorimeter, calorific value- applications.

Books for Reference

1. Palanichamy S. and M. Shanmugavelu. 1997. *Research Methods in Biological Sciences*. Palani Paramount Publication, Palani.
2. Gurumani. 2011. *Research Methodology for Biological Sciences*. M.J.P. Publishers, Chennai.
3. Veerakumari. L. 2007. *Bioinstrumentatio*n. M.J.P Publishers, Chennai.
4. Aparna Mathur. 2013. *Laboratory Instrumentation*. Black Prints. New Delhi.
5. Chinmoy Goswami, Abhijit Paintal and Rabindra Narain. 2011. *Hand Book of Bioinstrumentation.* South Anarkali Delhi.

6. Debbie Holmes Peter Moody and Diana Dine, 2006. *Research Methods for the Biosciences.* Oxford University Press, UK.
7. Rabindra Narain . 2012. *Practical Immunology*. Wisdom Press, New Delhi.

PRACTICALS
Hrs / Week - 2 **Credits - 1**

1. Fractionation of rat liver by density gradient
2. Measurement of cell size by micrometry
3. Phase contrast microscopic observation of living cells
4. Estimation of lipids (Bragdon method)
5. Absorption spectra of proteins/ pigments
6. Column chromatographic separation of plant pigments.
7. Calculation of citation index in SCI/ Scopus/ Google scholar/ICI
8. Use of different instruments in research methodology.(Spotters)
    i. Electron microscope
    ii. Spectrophotometer
    iii. Chromatography
    iv. HPLC
    v. SDS - PAGE

Books for Reference

1. Gurumani. 2011. *Research Methodology for Biological Sciences*. M.J.P. Publishers, Chennai.
2. Veerakumari. L. 2007. *Bioinstrumentation.* M.J.P. Publishers, Chennai.

SEMESTER III	
Self Study Course: Zoology for Competitive Examinations	
Code: 19PZOSS1	**Credit:2**

Vision To make students competent to face competitive examinations effectively

Mission To provide in-depth knowledge on different fields in zoology which are vital for any competitive examination.

Course Outcome:

CO. No	Upon completion of this course, students will be able to	PSO addressed	CL
CO- 1	gain knowledge about the systematic position of the organisms.	1	Un
CO-2	able to identify the different species	2	An
CO-3	relate the various physiological mechanisms prevailing in the organism	3	An
CO-4	understand the physiological concepts and mechanism of the action of endocrine glands	1	Un
CO-5	analyse genetic concepts and laws	4	Un
CO-6	understand different theories and patterns of evolution	1	Un
CO-7	acquire in-depth knowledge about cellular components and protein synthetic machineries	1	Cr
CO-8	evaluate the techniques help in bioremediation and demonstrate gene therapy technique	7,8	E

SEMESTER III	
Self Study Course: Zoology for Competitive Examinations	
Code: 19PZOSS1	**Credit:2**

Unit I Classification

Concepts of species and hierarchial taxa, classical and quantitative methods of taxonomy of animals. Classification of invertebrates up to classes and chordates up to order – diagnostic features and examples.

Unit II Physiology

Physiology of digestion and absorption, respiration, transport of oxygen, carbon – di-oxide, structure of kidney and nephron, urine formation in man.-structure, composition and functions of blood of man, types of muscle, structure of neuron, nerve impulse conduction – physiology of vision and hearing in man.Structure and functions of pituitary, islets of Langerhans, human reproductive systems – menstrual cycle.

Unit III Genetics and Evolution

Modern concept of gene, split gene, genetic regulation, genetic code. Sex chromosomes and their evolution, Sex determination in Drosophila and man. Mendel's law of inheritance, recombination, linkage, multiple alleles, genetics of blood groups, pedigree analysis, hereditary diseases in man – Inborn errors of metabolism-mutations and mutagenesis-theories of evolution- natural selection, role of mutation in evolution, evolutionary patterns, molecular drive, mimicry, variation, isolation and speciation.

Unit IV Cell and Molecular Biology

Structure and function of cell and its organelles (nucleus, plasma membrane, mitochondria, golgi bodies, endoplasmic reticulum, ribosomes and lysosomes), cell division (mitosis and meiosis), mitotic spindle and mitotic apparatus, chromosome movement, chromosome type – polytene and lamp brush, organization of chromatin, heterochromatin, cell cycle regulation. Protein synthesis, structure of DNA, RNA, replication of DNA.Nucleic acid topology, DNA motif, transcription, RNA processing, translation, protein folding and transport.

Unit V Biotechnology and Microbiology

Transgenic animals. Bioremediation and Phytoremediation. Tissue culture, Genomics and its applications to health – Gene therapy – Recombinant

vaccines. Major infectious and communicable diseases (malaria, filaria, tuberculosis, cholera and AIDS) their vectors, pathogens and prevention.

Books for Reference

1. Jordan, K.C. and P.S.Verma. 2009. *Invertebrate Zoology*. S. Chand & Company Ltd, Ram Nagar, New Delhi.
2. Jordan, E.L. and P.S.Verma. 1965. *Chordate Zoology*. S.Chand & Company Ltd, Ram Nagar, New Delhi.
3. Shembulingam. K. and PremaShembulingam. 2005. *Essentials of Medical physiology*. Jaypee Brothers, Medical Publishers Ltd. New Delhi.
4. Verma. P.S and V.K. Agarwal. 2013. Cell Biology, Genetics, Molecular Biology, Evolution & Ecology. S. Chand & Company Ltd, Ram Nagar, New Delhi.
5. Kumaresan, V. 2009. *Biotechnology.* Saras Publication, Kottar, Nagercoil.

SEMESTER IV			
Core XIII : Marine Biology			
Code: 19PZOC41	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 4**

Vision

Provide quality output in terms of education and training in the field of marine biology and environment, and raise awareness about marine environments for the community and the society.

Mission

Provide quality education and training in marine biological sciences
Conduct qualitative researches in the marine biological sciences
Establish a national and international cooperation in the field of educational research.
Develop public awareness materials, and train personnel in the field of marine biology

Course Outcome

CO.No	Upon completion of this course, students will be able to	PSO addressed	CL
CO – 1	explain the various ecological zones of marine environment and their fauna and flora, their adaptations and distribution	2,3	Un
CO – 2	appraise the biological, chemical, biological and physical aspects of the marine environment and their significance to marine life	3,	Ev
CO-3	compare the marine ecosystems, types and threats to coral reefs, mangroves and salt marshes	1	An
CO- 4	relate ecological relationships that exist among marine organisms within a variety of habitats	4	An
CO-5	know the types and causes of marine pollution and their abatement	6	Un
CO-6	assess different sampling methods used in the marine biology and then using standard techniques for analysing samples in the laboratory	4,5	Ev
CO-7	analyse various types of marine resources and assess the various environmental concerns related to the use and abuse of marine resources.	2	An, Cr
CO-8	design and implement effective solutions to problems in marine environment	7,8	Ap

SEMESTER IV			
Core XIII : Marine Biology			
Code: 19PZOC41	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 4**

Unit I Marine Environment – Zonation and Biota

Sea as a biological environment. Classification of marine environment.– Plankton – classification (size, life, habitat) and adaptations. Inter-tidal, rocky, sandy and muddy shores –features of the flora, fauna and adaptations. Carbon pump and hydrological cycle.

Unit II Characteristics of Sea Water

Physical properties: waves, tides, currents- types, causes , and their impact on marine organisms. Light, temperature, pressure,. Chemical properties: nutrients, (major, minor, and trace elements), salinity, pH, density, dissolved gases (oxygen, carbon-di-oxide).

Unit III Marine Ecosystems

Estuaries, mangroves. Coral reef -– ecology and types, species interaction, adaptations and importance. Threats and conservation of coastal ecosystems (coral reef and mangroves)

Unit IV Marine Pollution

Sources, effects and control measures of heavy metal, radioactive, oil, and thermal pollutions. Algal blooms-sources and effects. Microbial indicators of pollution. Role of microbes in pollution abatement, biofouling.

Unit V Wealth of the sea

Living resources: Fishery products- fish meal and fish oil. Non-living resource: oil. Bioactive compounds from marine organisms (bacteria, fungi and macro algae and sponges). Phycocolloids, agar-agar and algin.

Books for Reference

1. Girish Chopra. 2006. *Coastal and Marine Geography*. Common Wealth Publisher, Delhi, 281pp.
2. Gross, G. 1993. *Oceanography: A view of the Earth.* Sixth edition. Prentice Hall Inc., New Jersey.
3. Mc Cormick, J.M. and J.V.Thiruvathaakal.1976. *Elements of Oceanography*. W.B. Saunders Company, Philadelphia.
4. Nybakken, J.W. 1997. *Marine Biology – An Ecological Approach*. Addison Weslay Longman, Inc. California.
5. Olivia J. Fernando. 1999. *Sea water-Properties and Dynamics*. Dhanesh Publications, Ponnagam, Thanjavur.

6. Frank E.Firth. 1969. *The Encyclopedia of Marine Resources.* Van Nostrand Reinhold Company, New York.
7. Veena. 2012. *Understanding Marine Biology*. Discovery Publishing House PVT.LTD, New Delhi
8. Russel. 1970. *Marine Ecology*. Academic Press- London and New York.
9. Neera Sen and Kumudranjan Naskar. *Algal Flora of Sunderban Mangal,* Durga Publishing House, Delhi.
10. Atlas, R.M., and Bartha. M. 2003. *Microbial Ecology- Fundamentals and Applications.* Benjamin- Cummings, Menlo Park, California.
11. Vijaya Ramesh, K. 2004. *Environmental Microbiology*. MJP Publishers, Chennai.
12. Moshrafuddin Ahamed and Basumatary, S.K. 2006. *Applied Microbiology.* MJP Publishers, Chennai.
13. Tait, R.V. and F.A. Dipper. 1998. *Elements of Marine Ecology*. 4th ed. British Library Cataloguing in Publication Data.

Practicals

Hours/week :2 **Credits :2**

1. Determination of acidity
2. Determination of salinity
3. Determination of alkalinity
4. Determination of total dissolved solids
5. Determination of nitrite
6. Determination of phosphate
7. Collection and identification of marine plankton (any three phyto and zooplanktons)
8. Identification and remarks of the following
   i. Plankton net
   ii. Inter-tidal organisms
      a.Rocky shore :Sea anemone, Chiton
      b.Muddy shore:Uca, Cerithidia
      c.Sandy shore: Arenicola, Murex
   iii. Food fishes*:* Cybium, Sardinella
   iv. Sea weeds: Gracilaria, Sargassum,
9. Submission: Record Note Book/ Field visit

Books for Reference

1. Strickland and Parsons. J.D.H. 1972. *A Practical Handbook of Seawater Analysis*. Bulletin 167 (Second Edition), Fisheries Research Board of Canada.
2. *Manual of Hydrobiology* Published by CAS Annamalai University 1992.
3. Kiewood Maff, D. Fisheries Lab ICES 2007. *Techniques in Marine Environmental Sciences.* No.17 , Nutrients: Practical Notes on their determination in sea water, Pakefield Road, Lowtoft, Suffolk, NR33 OHT, United Kingdom.

SEMESTER IV			
Core XIV : Conservation Biology			
Code: 19PZOC42	**Hrs / Week: 5**	**Hrs/Sem : 75**	**Credits : 4**

Vision

To create environmental awareness among students.

Mission

To inculcate knowledge about the natural resources, biodiversity their conservation and efforts towards their sustainability.

To generate concepts of prediction, prospecting, preservation and restoration of dwindling natural resources.

Course Outcome

CO.No	Upon completion of this course, students will be able to	PSO addressed	CL
CO - 1	infer the problems of unsustainable development	1	Un
CO - 2	justify that human survival depends on developing practices that will achieve sustainable systems	3	Ev
CO - 3	explore the biological, sociological and legislative perspectives for the management of flora and fauna to conserve wildlife.	5	An
CO - 4	evaluate the importance of natural resources on conservation of biodiversity	3	Ev
CO - 5	analyse the conservation management of various resources	3	An
CO - 6	gain knowledge on values and threats of biodiversity	2	Ap
CO - 7	learn the role of various organization in conservation of biodiversity	6	Un
CO - 8	apply scientific principles and modern technologies to resolve problems in disaster management	8	Ap

SEMESTER IV			
Core XIV : Conservation Biology			
Code: 19PZOC42	**Hrs / Week: 5**	**Hrs/Sem : 75**	**Credits : 4**

Unit I Environment – Sustainable Development

From unsustainable to sustainable development - environmental ethics; Environmental Protection Act (1986) - Forest Conservation Act (1980), Wildlife (Protection) Act of Government of India (1972).

Unit II Conservation of Forest and Water Resources

Forest resources: Use and over exploitation- deforestation- timber extraction- mining- dams and forests – tribes.

Water resources: Use and over exploitation of ground water – surface water – conflicts over water- dams - benefits and problems - conservation of water.

Unit III Conservation of Land and Energy Resources

Land resources: Land as a resource- land degradation- soil erosion and desertification - conservation of soil.

Energy resources: Growing energy needs – renewable and non-renewable energy sources – use of alternate energy source.

Role of individual in conservation of natural resources.

Unit IV Biodiversity and Conservation

Biodiversity - values of biodiversity - threats to biodiversity - hotspots. *In - situ* conservation - *ex- situ* conservation - role of organizations in conservation - NB PGR, BSI, ZSI, WWF, IUCN - Ramsar Convention.

Unit V Disaster Management

Climate change - Global warming

Cyclone - wild fires - land slide - drought - A guideline for disaster management.

Books for Reference

1. Dhulasi Brindha, V. 2004. *Environmental Studies*. Allied Publishers Pvt. Ltd., New Delhi.
2. Veer Bala Rastogi and M.S. Jayaraj. 2009. *Animal Ecology and Distribution of Animals* Kedarnath Ramnath, Meerut – Delhi.
3. Agarwal, A.C. 1999. *Environmental Biology*, Agro Botanical, Bikaner.

4. Anjaneyalu, Y.B. 2004. *Introduction to Environmental Science*, SPBS. Publications. Hyderabad.

5. Kormondy Edward J. 1994. *Concepts of Ecology.* Prentice Hall of India, Pvt. Ltd.

6. Odum, E.P. 1983. *Basic Ecology.* CBS College Publishing, Saunder.

7. Anubhakaushik and C.P. Kaushik. 2007. *Environmental Science and Engineering*. Newage International (p) Publishers. New Delhi.

8. Ravikrishnan, A. 2010. *Environmental Science and Engineering*. Sri Krishna Publications, Chennai.

9. Saha, T.K. 2008. *Ecology and Environmental Biology*. Books and Allied (P) Ltd.

PRACTICALS

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

1. Estimation of population density using Quadret method
2. Population density study – Mark and Recapture method
3. Chart – Threatened, Endangered and Extinct species.
4. Mapping of National Parks and Wild Life Sanctuaries in India with a note on important fauna
5. Visit to an ecologicaly important place.

Books for reference

1. Gareth Williams. 1987. *Techniques and Fieldwork in Ecology*. Bell & Hyman Ltd. London.
2. Jaya Surya, Arumugam.N, Dulsy Fatima, Meyyan, R.P., Prasannakumar, S., Mani, A., Mariakuttikan, A., Narayanan, L.M., Nallasingam, K., Kumaresan, V. and A.M. Selvaraj. 2013. *Practical Zoology Vol-3*. Saras Publication, Nagercoil.

SEMESTER - IV			
Core XV - Commercial Zoology			
Code :19PZOC43	**Hrs /Week: 5**	**Hrs/ Sem : 75**	**Credits : 4**

Vision :

To facilitate self- employment and entrepreneurship in Apiculture and Sericulture.

Mission :

To motivate the students to take up carriers related to agro- based, rural oriented cottage industry through imparting knowledge in apiary management, mulberry cultivation and silkworm rearing.

Course Outcome:

CO. No	upon completion of this course, students will be able to	PSO addressed	CL
CO-1	identify, choose suitable bees and maintain bee hive successfully	2	Ev
CO-2	understand the behavior of bees, prevent swarming and manage bee colonies	3	Un
CO-3	inspect bee colony, identify diseases of bees, recognize their enemies and take necessary control measures	4	An, Ap
CO-4	apply their knowledge to implement the procedure to extract honey and other bee products and to preserve honey	5	Ap
CO-5	demonstrate an understanding of mulberry cultivation, silkworm rearing and silk reeling	1	Un
CO-6	identify diseases, pests of mulberry and silkworm and adapt control measures	4	Ap, Cr
CO-7	utilize their knowledge in harvesting, marketing cocoons and reeling operations	5	Ap
CO-8	develop practical proficiency in apiculture and sericulture from the lab work and visit to the apiary and the department of sericulture	6	Ap

SEMESTER - IV			
Core XV - Commercial Zoology			
Code :19PZOC43	Hrs /Week: 5	Hrs/ Sem : 75	Credits : 4

Unit I Bee keeping technology

Apiculture as a cottage industry - choice of species in apiculture- Indian bee, European bee. Bee keeping equipments - Langstroth hive and Newton's hive- Appliances used in apiaries. Swarming – prevention and control. Queen rearing and introduction. Artificial feeding.

Unit II Management of bees & Honey bee products

Diseases of bees- brood diseases, diseases of adult bees - nosema and septicemia, enemies - greater wax moth, lesser wax moth, ants, wasps - control measures. Extraction and uses of honey- bee wax- bee venom and pollen. Preservation and storage of honey.

Unit III Moriculture

Mulberry cultivation – cultivation practices – biofertilizers – foliar spray – triacontanol and seriboost. Diseases of mulberry – white root rot, stem canker, leaf spot, powdery mildew, leaf blight and leaf mosaic - deficiency diseases — symptoms and control measures.

Unit IV Silk worm rearing

Mulberry silk worm development – silk worm rearing – rearing house – rearing appliances rearing operations – chawki rearing – application of sampoorna. Silk worm diseases - flacherie, muscardine, grasserie, and pest- Indian uzifly- symptoms and control measures.

Unit V Cocoon Mounting and Reeling

Mountages- mounting methods - cocoons – harvesting, transport and marketing. Silk reeling – reeling operations, reeling appliances – cottage basin – filature units. By-products of sericulture.

Books for Reference

1. Mishra. R.C. 1997-98. *Perspectives in Indian Apiculture.* Agro Botanica, 4E 176 J.N.Vyas Nagar, Bikaner, H.S.Offset Printers,Daryagunj, New Delhi.
2. Pierre Jean – Prost. 1994. *Apiculture*. Oxford & IBH Publishing Co.Pvt. LTD. New Delhi.
3. Root, R.I. 1985. *Encyclopedia of Bee Culture*. International Books & Periodicals Supply Service. 24 – B/5, Desh Bandhu Gupta Road, New Delhi

4. Raja Instus, E. 1994. *Economics of Bee Keeping Industry.* Rawat Publications, Jaipur and New Delhi.
5. Everett Franklin Phillips. 2010. *Bee Keeping.* Agrobios (India), Agro House, Chopasani Road, Jodhpur – 342 002.
6. Ganga, G. and J. Sulochana Chetty. 1997. *An Introduction to Sericulture*. Oxford & IBH Publishing Co Pvt. Ltd. New Delhi.
7. Krishnaswami, S. 1990. *Improved Method of Rearing Young Age Silkworms*. Central Silk Board – Bangalore.
8. Acharya, J. 1993. *Sericulture and Development*. Indian Publishers Distributers Kamak Nagar – New Delhi
9. Hisao Aruga. 1990. *Principles of Sericulture*. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

PRACTICALS

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

1. Identification of bee species and casts.
2. Mounting of mouth parts and legs of worker bee.
3. Bee keeping equipments - Newton's hive, hive tool, smoker, uncapping knife, pollen box, honey extractor.
4. Identification of diseases and enemies of honey bees.
5. Mulberry diseases and pests
6. Development of silkworm.
7. Silk gland.
8. Rearing house and appliances.
9. Silkworm diseases and pests.
10. Visit to an apiary and sericulture department.

Books for Reference

1. Alka Prakash. 2001. *Laboratory Manual of Entomology*. New Age International (P) Ltd, 4835/ 24, Ansari Road, Daryaganj, New Delhi – 110002.
2. Tammanna N.Sonwalker.1993. *Hand Book of Silk Technology*. Wiley Eastern Ltd. Chennai.

SEMESTER - IV			
Elective - I	**A**	**Poultry**	
Code :19PZOE41	**Hrs /Week: 4**	**Hrs/ Sem : 60**	**Credits :4**

Vision

To create an avenue for self employment and entrepreneurship

Mission

To impart knowledge on the fundamentals of poultry management and production
To provide information on the advanced technology in poultry industry

Course Outcome

CO.No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO 1	attain an insight on the present status of poultry industry	1	Un
CO 2	acquire knowledge on the technological advancements in poultry farming	2	Un
CO 3	identify the problems in handling poultry	3	Un
CO 4	analyse the management techniques and handle various situations	3	An
CO 5	able to get career choices in bird production, processing, research and business	8	Ap
CO 6	attain the skill to manage the farm in a profitable manner	6	Ap
CO 7	apply the skills to become entrepreneurs	6	Ap
CO 8	manage to get a rewarding carrier in poultry industry or self employment	8	Ap

SEMESTER - IV			
Elective - I	**A**	**Poultry**	
Code :19PZOE41	**Hrs /Week: 4**	**Hrs/ Sem : 60**	**Credits :4**

Unit I Poultry Industry

Transformation in – breeding, hatcheries, egg production, meat production, processing and marketing. Poultry products for good nutrition – eggs and poultry meat, other poultry products in industry. Different breeds and classes of fowl, choosing commercial layers and broilers – sexing in day old chicks, strategies to maintain profit in broiler farming

Unit II Practical Aspects of Rearing Fowl

Poultry housing, deep litter system, cage rearing, management of chick, broiler , grower and layer, restricted feeding, grit feeding.

Unit III Management of Poultry

Summer management - winter management, forced moulting, lighting -debeaking of chick- growers- layers and broilers.

Unit IV Poultry Nutrition

Nutritional requirements- energy- proteins and amino acids- vitamins and essential inorganic elements, feed stuffs of poultry, feed formulation– non- nutritive feed additives.

Unit V Disease Management

Poultry diseases - viral- bacterial - fungal and parasitic diseases- prevention and management, vaccination programme, homeopathy in poultry diseases.

Books for Reference

1. Gnanamani,M.R. 2010. *Modern Aspects of Commercial Poultry Keeping*. Deepam Publication, Madurai, Tamil Nadu.
2. Gnanamani, M.R. 2003. *Profitable Poultry Farming*. Giri Publication, Madurai.
3. Ensminger, M.R. 2015. *Poultry Science* CBS Publishers & Distrubutors Pvt. Ltd. New Delhi.
4. Ravindranathan. 2013. *A Text Book of Economic Zoology*. Wisdom Press, New Delhi.
5. Prakash Malhotra. 2008. *Economic Zoology*. Adhyayan publishers, New Delhi.

SEMESTER - IV			
Elective - I B	**Ornamental Fish Culture**		
Code : 19PZOE41	**Hrs / Week : 4**	**Hrs / Sem : 60**	**Credits : 4**

Vision

Impart basic understanding for operating an ornamental fish farm and improve the quality of fisheries education, research and extension activities. Instill competence and confidence among the students for self employment.

Mission

Generate technically skilled man power to work in ornamental fish farms

Augment ornamental fisheries trade and export earnings

Course Outcome:

CO.No	Upon completion of this course, students will be able to	PSO addressed	CL
CO - 1	explain the construction, fabrication and accessories required for setting up an aquarium tank	2,3	Un
CO - 2	apply the knowledge and skills in aquarium management	1	Ap
CO - 3	evaluate the types and culture of live feed organisms and formulate the artificial feed	3	Ev
CO - 4	describe the factor related with taxonomy and biology of ornamental fish	3	An
CO - 5	choose the commercially important fresh water and marine ornamental fishes and their transport	8	Ev, Cr
CO - 6	analyse the different varieties of ornamental fish	2,3	An
CO - 7	acquire confidence to become an entrepreneur in ornamental fish culture	3	Un
CO - 8	develop entrepreneurial skills and make aware of National and International export earnings	2,7	Cr

SEMESTER - IV			
Elective - I B	Ornamental Fish Culture		
Code : 19PZOE41	Hrs / Week : 4	Hrs / Sem : 60	Credits : 4

Unit I Construction of fish tanks

Design and Construction of fish tanks - setting up of tanks - accessories for aquarium tanks - hood, light source, hand net, suction tube, scrapper tool, aerator, gravels, filters and ornamental objects - aquarium plants and its importance.

Unit II Aquarium maintenance

Maintenance of water quality - temperature, water hardness, ammonia, pH, O_2, CO_2. Control of snail and algal growth. Diseases - protozoan - fungal - bacterial and nutritional diseases - diagnosis and treatment.

Unit III Nutritional requirements of ornamental fishes

Different types of feed - artificial and live feed - culture of live feed organisms - infusorians - zooplankton - rotifers - copepods - cladocerans - spirulina - brine shrimp - chironomous - tubifex. Artificial feed - principles of feed formulation - preparation of artificial feed - balanced diets.

Unit IV Popular ornamental fishes

Taxonomy and biology of egg layers - siamese fighting fish, gourami, gold fish, koi, rosy barb, neon tetra, zebra cichlid and angel fish. Live bearers - molly, guppy, sword tail and platy. Breeding and spawning of egg layers and live bearers .

Unit V Marine ornamental organisms

Commercially important marine ornamental fishes - butterfly fish, parrot fish, clown fish, marine angel fish. Transport of ornamental fishes - use of sedatives.

Books for Reference

1. Jameson. J.D. and R. Santhanam, 1996. Manual of Ornamental Fishes and Farming Technologies – Fisheries College and Research Institute TANUVAS, Tuticorin.
2. Santhanakumar. R. and A.M. Selvaraj. 2007. Manual of Freshwater Ornamental Fish Culture, Department of Fisheries Extension, Fisheries College and Research Institute, TANUVAS, Tuticorin .
3. Venkataramani V.K. and N. Jeyakumar. 2004. Biodiversity and Stock Assessment of Marine Ornamental Fishes. Department of Fisheries Biology and Capture Fisheries, Fisheries College and Research Institute, TANUVAS, Tuticorin
4. Tharadevi, C.S. and K. V. Jayashree. 2009. Home Aquarium. Saras Publications, Nagercoil.
5. Santhanam R., Sukumaran N.and P. Natarajan 1990. A Manual of Fresh Water Aquculture. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.
6. Gupta, S. K. and P. C. Gupta. 2006. General and Applied Ichthyology 1st Edn. Chand and Company Ltd, New Delhi.
7. Dholakia, A.D. 2009. Ornamental Fish Culture and Aquarium Management. Daya publishing House, Tri Nagar, Delhi.
8. Amita Saxena. 2003. Aquarium Management. Daya Publishing House, Tri Nagar, Delhi.

SEMESTER - IV			
Elective I C Clinical Biology			
Code : 19PZOE41	**Hrs / week : 4**	**Hrs/ sem : 60**	**Credits : 4**

Vision

- To learn the practical application in medicine, health care and laboratory diagnostics.

Mission

- To provide quality instruction and experiential learning in the broad field of clinical biological science.

Course Outcome:

CO. No	Upon completion of this course, students will be able to	PSO addressed	CL
CO -1	Understand the overview on clinical biology and its protocols	4	Un
CO – 2	Acquire knowledge on the various sub divisions and the practices and protocols of clinical biology.	6	An
CO – 3	Understand the laboratory practices and know how to maintain the laboratory instruments	4	An
CO - 4	Analyse and distinguish various types of blood cells	3	Un
CO – 5	Understand various diseases based on the laboratory analysis of body fluids.	4	Un
CO – 6	Develop skills in various lab techniques	7	Cr
CO – 7	Acquire knowledge to handle clinical equipments	6	Un
CO – 8	Design, carry out and interpret scientific experiments	7	Ap

SEMESTER - IV			
Elective I C	**Clinical Biology**		
Code : 19PZOE41	**Hrs / week : 4**	**Hrs/ sem : 60**	**Credits : 4**

Unit I Introduction to Clinical Biology

Introduction to Clinical Biology and its importance –First Aid – First Aid kit – First Aid procedure - Physical diagnosis – Body Temperature – Blood Pressure – Pulse reading

Unit II GLP and Instrumentation

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, Medical Imaging – X-Ray Bone Fracture MRI and CT Scan.

Unit III Haematology

Composition of blood- preparation and use of blood components- blood groups (A,B,AB,O& Rh factor) and blood cross matching,-Collection and storage of blood. General laboratory preparation in blood bank. Testing of blood glucose using Glucometer-kit

Unit IV Clinical Pathology

Infectious diseases: Causes, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis. Non - infectious diseases: Causes, symptoms, diagnosis and prevention of diabetes (Type I and Type II), Hypertension (Primary and Secondary) Tumors: Types (Benign/ Malignant) – Detection - Metastasis.

Unit V 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.

Books for Reference

1. Biswajit Mohanty and Sharbari Basu. 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 Learing Fastern press (Bangalore) Pvt. Ltd., Bangalore.
3. Kannai, L. Mukherjee. 1997. *Medical Laboratory Technology*. Vol-I, Vol-II and Vol-III, Tata Mc Graw Hill Publishing Company Limited, Chennai.
4. Ramnik Sood. 2005. *Medical Laboratory Technology Methods and Interpretations*. Jaypee Brothers Medical Publishers (P) Ltd., New Delhi.