JAYARAJ ANNAPACKIAM COLLEGE FOR WOMEN (AUTONOMOUS)

A Unit of the Sisters of St. Anne of Tiruchirappalli

Accredited with 'A' Grade (3rd Cycle) by NAAC

DST - FIST Supported College Since 2015

(Affiliated to Mother Teresa Women's University, Kodaikanal)

PERIYAKULAM – 625 601, THENI DT.
TAMIL NADU.

M.SC. ZOOLOGY
2017 - 2020

DEPARTMENT OF ZOOLOGY

PROGRAMME OUTCOMES - P.G.

PO. NO.	UPON COMPLETION OF THIS PROGRAMME THE STUDENTS WILL BE ABLE TO
1	Endow with in-depth knowledge, analyze and apply the understanding of their discipline for the betterment of self and society.
2	Synthesize ideas from various disciplines, enhance the interdisciplinary knowledge and extend it for research.
3	Gain confidence and skills to communicate orally/ verbally in research platforms and state a clear research finding.
4	Develop problem solving and computational skills and gain confidence to appear the competitive examination.
5	Enhance knowledge regarding research by accumulating practical knowledge in specific areas of research.
6	Achieve idealistic goals and enrich the values to tackle the societal challenges.

PROGRAMME SPECIFIC OUTCOMES - P.G.

PSO. NO.	UPON COMPLETION OF THIS PROGRAMME THE STUDENTS WILL BE ABLE TO	PO MAPPED
PSO - 1	Acquire an in depth knowledge in various fields of Zoology, specialize in anyone of the branch and achieve practical proficiency in experimental techniques and focus on the avenues of research.	PO - 1, PO - 2, PO - 3, PO - 5
PSO - 2	Develop deeper understanding in Biological Chemistry, Cell and Molecular Biology, Genetics, Developmental Biology, Environmental Biology, Immunology, Microbiology, Physiology and Biotechnology	PO - 1, PO - 2, PO - 5, PO - 6
PSO - 3	Develop skill to operate instruments applying the knowledge of Physics & Chemistry and handle biological data efficiently such as to collect, record, analyse and interpret the hypothesis,.	PO - 2
PSO - 4	Acquire knowledge and skill in the applied fields of Zoology in Medical Laboratory Technology, Sericulture, Apiculture, Diary farming, Aquaculture and poultry farming and build their own enterprise.	PO - 5
PSO - 5	Equip to appear for competitive exams at National level and exhibit their potential in teaching and lecture.	PO - 3, PO - 4

P.G. ZOOLOGY COURSE PATTERN (2017 - 2020)

Sem.	Code	Title of Paper	Hours	Credits
I	17PZO1C01	Biological Chemistry	6	5
	17PZO1C02	Cell Biology	6	5
	17PZO1C03	Genetics and Molecular biology	6	5
	17PZO1P01	Biological Chemistry, Cell Biology and Genetics - Lab	6	5
	17PZO1E1A/ 17PZO1E1B	Applied Zoology/ Vermitechnology	6	4
	Total		**30**	**24**
II	17PZO2C04	Developmental Biology	6	5
	17PZO2C05	Environmental Biology	6	5
	17PZO2E2A/ 17PZO2E2B	Biosystematics / Sericulture	6	4
	17PZO2P02	Developmental Biology and Environmental Biology - Lab	6	4
	17PZO2I01	IDC - Microbial Techniques	4	3
	17PGS2S01	Soft skills	2	1
	Total		**30**	**22**
III	17PZO3C06	Immunology	6	5
	17PZO3C07	Basic and Applied Microbiology	6	5
	17PZO3C08	Biophysics and Biostatistics	6	5
	17PZO3P03	Immunology, Microbiology and Medical laboratory Technology - Lab	6	4
	17PZO3E3A/ 17PZO3E3B	Medical laboratory Technology / Entomology	6	4
	Total		**30**	**23**
IV	17PZO4C09	Physiology	6	5
	17PZO4C10	Biotechnology	6	5
	17PZO4P04	Physiology and Biotechnology - Lab.	6	5
	17PZO4R01	Project	12	6
	17PZO4A01	Comprehensive Examination	-	2*
	Total		**30**	**21**
	Total for all Semesters		**120**	**90+2***

* Extra credit

QUESTION PATTERN - EXTERNAL

Time: 3 hrs **Marks: 60**

PART - A

Five either or questions one from each unit 5x3 = 15

PART - B

Five either or questions one from each unit 5x9 = 45

TESTING AND EVALUATION (PG)

Evaluation of students is based on both Continuous Internal Assessment (CIA) and the Semester Examination (SE) held at the end of each Semester. The distribution of marks is indicated below

Course	Continuous Internal Assessment	Semester Examination
Theory	40%	60%
Practical	50%	50%
Project	50%	50%

CONTINUOUS INTERNAL ASSESSMENT (THEORY)

Continuous Assessment will be carried out by the course teachers. The components of CIA are as follows:

Components	Marks
Test - I	30
Test - II	30
Seminar	10
Term Paper	05
Attendance	05
Total	**80**

The total internal marks obtained for 80 will be converted into marks obtained for 40.

PRACTICAL PAPERS

- The ratio of marks in CIA and in Semester Examination is 50:50 for all Practical Papers.
- The components of Internal Practical (50 marks) will be decided by the Department concerned.

PROJECT WORK

Group project 2 students per group (if odd number of students 3 in one group)

The ratio of marks for Internal and External Examination is 50:50. The Internal Components of Project Work is

Components	Marks
First Review	10
Second Review	10
Final Review (Internal Viva Voce)	30
Total	**50**

EXTERNAL VALUATION OF PROJECT WORK

Components	Marks
External Viva Voce	
Internal Examiner	25
External Examiner	25
Total	**50**

The Internal and External Question Paper pattern is left to the discretion of the Department concerned for all other papers.

BIOLOGICAL CHEMISTRY

Semester: I **Hours: 6**

Code : 17PZO1C01 **Credit: 5**

COURSE OUTCOMES:

- Explicate the biochemical aspects of human life.
- Acquire knowledge on the structure and functions of carbohydrate, amino acids, protein and lipids.
- Operate ultra centrifuge and spectrophotometer and perform experiment with chromatography and electrophoresis.
- Elucidate the structure and properties of enzymes, co-enzymes and their mechanism of action.
- Illustrate the metabolic pathways of biomolecules.

UNIT I

Ionization of water, Acid and base, Weak acids and weak bases, molarity and normality, pH scale, pH of various human body fluids and tissues, buffers, biological buffer system (Phosphate, bicarbonate, protein, aminoacid and haemoglobin), maintenance of blood pH, Respiratory acidosis and alkalosis, Metabolic acidosis and alkalosis, Henderson - Hasselbalch equation.**(18 Hours)**

UNIT II

Carbohydrates- Structure and classification. Metabolism of Carbohydrates - Glycolysis, Kreb's cycle, Hexose Mono Phosphate shunt (HMP shunt), Gluconeogenesis, Cori's cycle, Galactose metabolism, Fructose metabolism. **(18 Hours)**

UNIT III

Aminoacid - structure and classification. Configuration of proteins (Ramachandran plot, secondary structure, domains, motif and folds). Transamination and deamination. Catabolism of phenylalanine, Metabolism of heme and bilirubin, inborn errors of metabolism. Biosynthesis of nucleic acids. **(18 Hours)**

UNIT IV

Classification of lipid, β- oxidation of Palmitic acid (Saturated fatty acid) and Oleic acid (Unsaturated fatty acid), and its bio energetic. Bio synthesis of long chain fatty acid (Palmitic acid). Formation of ketone bodies, role of liver in fat metabolism, Prostaglandins, Chylomicrons, VLDL, LDL, HDL, Triglycerides and Cholesterol. **(18 Hours)**

UNIT V

Classification of enzymes, Factors affecting enzyme activity, coenzymes and cofactors. Mechanism of enzyme action and enzyme kinetics. Bio chemical techniques- Principle and applications of Ultra Centrifuge, Chromatography (Paper and Thin Layer Chromatography), Electrophoresis, Spectrophotometry. **(18 Hours)**

BOOKS FOR REFERENCE:

1. Dr. J.L. Jain, Sunjaj Jain, Nitin Jain. (2010). - Fundamentals of biochemistry for university and College Students in India and Abroad S. Chand & Company Ltd., Ram Nagar, New Delhi- 110 055.
2. Prem Prakash Gupta. (2009). Text book of biochemistry CBS Publishers & Distributors, New Delhi.
3. Ambika Shanmugam., (2001). Fundamentals of Biochemistry for Medical students. Kartik Offset Printers, Chennai.
4. T. Van Bruggen., (2004). Edward Staunton West, Wilbert R. Todd, Howard S. Mason, and John Text Book of Biochemistry. 4th edition, Oxford and IBH Publicity Co, PVT, LTD, New Delhi.
5. Geoffrey L. Zubay., (1996). Biochemistry. 4th edition, New Delhi.
6. Thomas M. Devlin., (2002). Text book of Biochemistry with Clinical Correlations. 4th edition, New Delhi.
7. David.L.Nelson and Michael.M.Cox (2008). Lehninger's Principles of Biochemistry. 4th edition, W.H. Freeman and CO., New York.
8. Christopher K.Mathews and K.E. Van Holde (1996). Biochemistry. 2nd edition. The Benjamin Cummings Publishing Company Inc,Menlo Park.
9. Sawhney S.K., (1996). Introductory Practical Biochemistry. Narosa Publishing House, Mumbai.

CELL BIOLOGY

Semester: I **Hours: 6**

Code : 17PZO1C02 **Credits: 5**

COURSE OUTCOMES:

- Handle efficiently different microscopes.
- Explain the structure, functions and significance of plasma membrane.
- Discuss the importance of nucleus and chromosome.
- Describe structure and functions of cell organelles.
- Identify the types of cancer, diagnosis and treatment.

UNIT I

History of cell biology- Cell theory, Protoplasm theory and Organismal theory. General organisation of prokaryotic and eukaryotic cells. Techniques in cell biology Light microscopy - Compound, Florescent, Phase contrast, Polarization, Interference, Dark field and Electron microscopy - Transmission and Scanning electron microscope, Preparation of material for light microscope. Auto Radiography and Cell fractionation. (**18 Hours)**

UNIT II

Cell Membrane - Chemical composition, Functions. Lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport. Inter cellular communications, Cell coat, Cell recognition, Cell surface receptors. Cytoskeleton - filaments and microtubules. **(18 Hours)**

UNIT III

Nucleus - Structure and functions of nucleus, nuclear envelope and nucleolus, Nucleoplasm, Chromosome - Structure, Types, Structure of chromatin, Heterochromatin, Euchromatin, Nucleosomes. Unusual chromosomes - Polytene and Lampbrush chromosome. **(18 Hours)**

UNIT IV

Ultra structure of mitochondria, Mitochondrial particles, Respiratory chain, Electron transport, Ultra structure and functions of Endoplasmic reticulum, Ribosomes, Lysosomes, Golgi complex. Protein synthesis and Protein targetting.

(18 Hours)

UNIT V

Cell Division - Phases of cell cycle, Mitosis and Meiosis. Difference between normal and cancer cells, Types of cancer - Lung, Cervical, Uterine, Vagina, Ovarian, Fallopian, Breast, Prostrate and Testicular cancer. Diagnosis and Therapy - Surgery, Radio, Gene and Chemo therapy. Bone marrow transplantation and immunotherapy. **(18 Hours)**

BOOKS FOR REFERENCE:

1. Powar C.B., (1993). Cell Biology. 3rd edition, Himalaya Publishing House, Bombay.
2. De Robertis E.D.P., (1988). Cell and Molecular Biology. International Edition, 8th edition, M. Varghese Company, Bombay.
3. Verma P.S Agarwal., Norman V.K. Cohn. S., (1978). Cytology. 1st edition, S. Chand and Company Ltd, New Delhi.
4. Gupta M. L., Jangir M.L., (2004). Cell Biology (Fundamentals and Applications). Updesh Purohit for Agrobios (India), Jodhpur.
5. Verma P.S Agarwal (2006). Cytology, S. Chand and Company Ltd, New Delhi.
6. Loewy G and Philip Siekevitz., (1978). Cell structure and function, 2nd edition, Amerind Publishing Co.Pvt.Ltd, New Delhi.
7. Gerald Karp., (1999). Cell and Molecular Biology (Concepts and experiments). 2nd edition, John wiley and sons, Inc.
8. Norman Cohen., (1997). Cell structure, function and metabolism. CBS Publishers, New Delhi.
9. Ranajit Sen., (2004). Principles and management of cancer. B.I. Publications, Pvt. Ltd, New Delhi.

GENETICS AND MOLECULAR BIOLOGY

Semester: I **Hours: 6**

Code : 17PZO1C03 **Credits: 5**

COURSE OUTCOMES:

- Understand the process of inheritance.
- Appraise human genome and gene mapping.
- Gain knowledge on types of DNA, RNA and genetic code.
- Compare the mechanism of gene regulation in prokaryotes and eukaryotes.
- Apply knowledge of genetics and molecular biology in day today life.

UNIT I

Mendelian genetics - Mendelian laws. Gene interaction - Allelic and non allelic gene interaction, polygenic inheritance, Multiple genes, Sex determination, Sex linkage, Syndromes, Sex limited traits, Extra nuclear inheritance. Concepts of gene. **(18 Hours)**

UNIT II

Linkage, Crossing over, Three point test cross and Chromosome mapping, Genetic trait in man, Gene and chromosomal mutation. Principle, application and factors affecting Hardy Weinberg Equilibrium. In breeding and out breeding, Pedigree analysis, Eugenics and Euthenics. **(18 Hours)**

UNIT III

DNA as the genetic material, DNA structure - double helix and alternate forms. Perpetuation of DNA - Replicons, Semi conservative replication of DNA, Repetitive DNA and sequence organization. DNA repair mechanisms - Photo reactivation, Excision and repair, Genetic code, One gene one polypeptide concept. **(18 Hours)**

UNIT IV

Types of RNA - mRNA, tRNA and rRNA. RNA synthesis, RNA polymerases, Transcription - Promoters, Initiation, Elongation and Termination of transcription, Transcription factors. Post transcriptional processing - RNA splicing and RNA editing, Ribozymes. Translation - Role of RNA adapter, Stages in translation - Initiation, Elongation and Termination, Translational factors. Post translational modifications - Protein folding and signal peptides. **(18 Hours)**

UNIT V

Regulation of gene expression in prokaryotes - Transcription regulation - Positive and negative control, Operon systems, Lac and tryptophan Antisense DNA and RNA. Post translational regulation. Gene regulation in eukaryotes at transcriptional, Translational and post translational levels. Role of introns, DNA looping and homeobox in gene regulation. Transposable genetic elements in bacteria and eukaryotes. **(18 Hours)**

BOOKS FOR REFERENCE:

1. Gardner, E.J., Michael J. Simmons, Peter Sunstad, D., (1991). Principles of Genetics. 8th edition John Wiley and Sons, INC.
2. Benjamin Lewin., (2004). Genes VIII. Pearson Prentice Hall, Pearson Education, Inc. Strickberger M.W., (1985). Genetics. 3rd Edition, Macmillan Publishing Co., New Delhi.
3. William D. Stansfield., (1991). Schaum's outline of theory and problems of genetics. 3rd edition, Schaum's Outline Series. Mcgraw-Hill.
4. Daniel L. Haartl., Elizabeth W. Jones., (2001). Genetics. 5th edition, Jones and Bartlett Publishers., Sudbury.
5. Charlotte J. Avers., (1980). Genetics. D.Van Nostrand and Company, New York.
6. Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz, J.A., Weiner, A.M., (1988). Molecular biology of the gene. 4th edition. The Benjamin Cummings Publishing Company Inc, California.
7. Dhawkins, J.D., (1996). Gene structure and expression. 3rd edition Cambridge University press, New York.

BIOLOGICAL CHEMISTRY, CELL BIOLOGY AND GENETICS - LAB

Semester: I **Hours: 6**

Code : 17PZO1P01 **Credits: 5**

COURSE OUTCOMES:

- ❖ Demonstrate the working principles and applications of biochemical instruments.
- ❖ Simulate methodology for qualitative analysis of biomolecules.
- ❖ Observe chromosomes in different stages of cell division.
- ❖ Acquire skill on the preparation of permanent slides.
- ❖ Differentiate the mutant forms of Drosophila.

1. Qualitative analysis of carbohydrate, protein, lipid
2. Preparation of standard graph for carbohydrate
3. Quantitative estimation of carbohydrate in liver / muscle
4. Preparation of standard graph for protein
5. Quantitative estimation of protein in liver / muscle
6. Quantitative estimation of ascorbic acid.
7. Chromatographic separation of amino acids.

INSTRUMENTS

Colorimeter, pH Meter, Centrifuge, Chromatogram, Electrophoretic unit.

CELL BIOLOGY

1. Preparation of squamous epithelium
2. Study of mitotic stages in onion root tips.
3. Study of meiotic stages in grasshopper testis.
4. Polytene chromosomes in chironomous larva.
5. Measurement of cell size.

GENETICS

1. Preparation of permanent slides - histology and whole mount
2. Preparation and maintenance of culture of Drosophila and observation of mutant forms.
3. Study of human syndromes in local areas.
4. Mendelian traits and pedigree analysis in man.
5. Dermatoglyphics

APPLIED ZOOLOGY

Semester: I **Hours: 6**

Code : 17PZO1E1A **Credits: 4**

COURSE OUTCOMES:

- Equip them for self employment.
- Gain knowledge on bee keeping and the importance of honey and its medicinal value.
- Understand the economic importance of earth worm, honey bee, poultry, mushroom, oyster and fishes.
- Design their career.
- Attain knowledge on ornamental fish culture.

UNIT I: VERMICULTURE

Introduction, Ecological Classification of Earth worms, Life cycle of Earth worm- *Eisenia foetida* (manure worm) General importance of Earth worms, Monoculture, Polyculture, Earth worm's feed, Organic wastes suitable for vermiculture. Vermicomposting, types of composting- methods- bin, Windrow method, Harvesting, vermicast, vermiwash. Pests of earthworm-Rat, Birds Centipedes, Ants, mites. Economic importance of Earth worms - Role of worms in organic farming - its quality and advantages over chemical input, small scale industry and its economic importance. **(18 Hours)**

UNIT II: APICULTURE

Classification of bees - rock bee, Indian bee, little bee and dammer bee. Distinction race lines and identification of queen, drone, and worker bees. Beekeeping - Newton's hive, and modern methods of bee keeping and their equipments. Enemies and diseases of honey bees, Natural and artificial foods of the bees, swarming, robbing, absconding. Extraction, preservation and storage of honey. Extraction and uses of bee venom, beewax and royal jelly. Nutritional and medicinal properties of honey. **(18 Hours)**

UNIT III: POULTRY FARMING

Poultry industry in India - Nutritive value of egg meat - Identification of the common breeds of fowl - Poultry housing and equipment - Incubation; Collection and storage of eggs. Fumigation - Hatchery sanitation - Causes of low hatchability. Sexing, De-beaking and De-worming. Rearing and management of broiler & layer. Vaccination and medication programme for broilers and layers - Culling of layers - Biosecurity and disease management. **(18 Hours)**

UNIT IV: MUSHROOM CULTURE CULTIVATION OF OYSTER (*PLEUROTUS Florida)*

Spawn production for oyster mushroom, Soaking of paddy straw, Bed preparation, Maintenance of mushroom production, Economics of mushroom production, Identification of edible and non edible mushroom. **(18 Hours)**

UNIT V: ORNAMENTAL FISH CULTURE

Setting up of fish tank, Planting with plants, Identifications of popular ornamental fishes eg. Siamese, Fighting fishes, Gourami, Gold fish, Angel fish. Preparation of balanced diet for aquarium fishes. Common diseases of ornamental fishes. Economics of ornamental fish culture. **(18 Hours)**

BOOKS FOR REFERENCE:

1. Arumugam N., Murugan S., Johnson Rajeshwar and Ram Prabhu R., (2005). Applied zoology. Saras Publications, Kanyakumari.
2. Harbans Singh Earl N. Moore., (1982). Live stock and poultry production and prentice. Hall of India Pvt. Ltd, New Delhi.
3. Jameson J.D and Santhanam R., (1996). Manual of Ornamental Fishes and Farming Technologies. Fisheries College and Research Institute, Tuticorin.
4. John William, S. (2003). Poultry for Sustainable Food Production and Livelihood. Loyola Publication, Chennai.
5. Banerjee, G. C., (1992). Poultry, Oxford and IBH, New Delhi.
6. Subrata, Mushrooms: A manual for cultivation.

VERMITECHNOLOGY

Semester: I **Hours: 6**

Code : 17PZO1E1B **Credits: 4**

COURSE OUTCOMES:

- Identify the indigenous earth worm species.
- Analyse critically the biology and the ecology of earth worm.
- Practice and apply the techniques in vermiculture.
- Formulate a new vermi by - product.
- Create a new technique in the process of vermi compost.

UNIT I

Earthworms: Historical aspects - Taxonomy, diversity and features of earthworm. Distribution and population studies - Mapping methods. Ecological classification - Epigeic, Anacic and Endogeic forms. Humus feeders and humus formers, leaf mould, top soil and sub soil types. **(18 Hours)**

UNIT II

Biology of earthworms - Morphology and anatomy, Life cycle, food habits of earthworms. Impact of earthworms on soil - Physical, chemical, biological. Earthworm casts. **(18 Hours)**

UNIT III

Vermiculture techniques - insitu and exsitu culture, advantages. Vermicomposting - insitu and exsitu, advantages. Optimal conditions for Vermiculture - Temperature, moisture, pH, soil type and organic matter, sunlight, rain. predators, food preference. **(18 Hours)**

UNIT IV

Vermitech products - Vermiwash, worm tea (Vermicomposting Leachate), vermicasts. Worms and seeds - Production, management and quality care. Model vermiunit and Budget. **(18 Hours)**

UNIT V

Application of vermisystem - Soil replenisher, in bait - market, waste management, sludge management, food and drug. Organic farming, current trend in vermitechnology, earthworms as biological controlling agent. **(18 Hours)**

BOOKS FOR REFERENCE:

1. Edwards C.A. and P.J.Bohlen., (1996). Ecology of earthworms, III Edition. Chapman and Hall
2. Ismail S.A., (1970). Vermicology. The biology of earthworms. Orient Longman, London
3. Lee K.E., (1985). Earthworms: Their ecology and relationship with soil and land use. Academic press, Sydney.

DEVELOPMENTAL BIOLOGY

Semester: II **Hours: 6**

Code : 17PZO2C04 **Credits: 5**

COURSE OUTCOMES:

- Explain gametogenesis and the process of fertilization.
- Understand the events and the importance of organogenesis.
- Acquire knowledge on growth and development of an organism.
- Understand the reproductive cycle and role of hormones in reproduction.
- Acquire Knowledge on advanced medical techniques.

UNIT I

Basic stages and principles of Developmental Biology - Origin of primordial germ cells in Invertebrates and Chordates. Structure of male and female gametes. Gametogenesis - Spermatogenesis, oogenesis, ovulation, morphology and types of eggs, Fertilization - sperm attraction, acrosome reaction, fusion of egg and sperm, theories of egg activation, types of fertilization, **(18 Hours)**

UNIT II

Cleavage - patterns, types, physiology and factors affecting cleavage. Morphogenetic movements, fate map, study of frog development up to gastrulation. Role of genes and chemical changes during gastrulation. Organogenesis - development of heart, eye and brain in chick. **(18 Hours)**

UNIT III

Nucleo - cytoplasmic interaction, nuclear transplantation, gradients, embryonic induction, regeneration. Metamorphosis in insects and amphibians. Molecular basis of differentiation, immunological studies of embryonic differentiation. **(18 Hours)**

UNIT IV

Human development - male and female reproductive organs, hormonal control of ovulation and pregnancy, menstrual cycle, gestation period, physiological changes during pregnancy, parturition, lactation, missed abortion, ectopic pregnancy, abortion and still birth. **(18 Hours)**

UNIT V

Medical implications of Developmental Biology - Genetic errors of human development, Infertility, ART (Assisted Reproductive Technology), teratogenesis. Stem cells and therapeutic cloning. Biological diagnosis of pregnancy. prenatal diagnosis **(18 Hours)**

BOOKS FOR REFERENCE:

1. Mohan P. Arora., (2002). Embryology. Himalaya Publication House, Mumbai.
2. Scoh F. Gilbert., (2006). Developmental Biology. Sinauer Associates Inc, 8th edition
3. Verma. P.S. and Agarwal V.K.,(2003). Chordate Embryology, S. Chand and Company Ltd, New Delhi.
4. Werner A. Muller., (2005). Developmental biology. Springer (India) Private Ltd, New Delhi.
5. Leon W. Browder., Carol A. Erickson.,William R. Jeffery.S., (1991). Developmental Biology. 3rd edition, Saunders College Publishing, Florida.
6. Subramanian, T.(2005). Developmental biology, Narosa publishing house, New Delhi.
7. Balinsky, B.I., (1970). Introduction Embryology Philadelphia & London.
8. Carlson, Bruce, M., (2009), Human Embryology and Developmental Biology, Elsevier,Philadelphia.

ENVIRONMENTAL BIOLOGY

Semester: II **Hours: 6**

Code : 17PZO2C05 **Credits: 5**

COURSE OUTCOMES:

- Discuss the concepts of ecosystem, community ecology and population ecology.
- Compare different habitats of ecology and understand how flora and fauna are adapted to the habitat.
- Analyse the causes and consequences of pollution and address the pollution problems.
- Identify and compare renewable and non-renewable energy resources, their conservation and better management.
- Assess the current research practice and methodologies in the field of biodiversity, its management and conservation.

UNIT I

Ecosystems: Ecosystem structure, ecosystem function, energy flow and mineral cycling (C,N, P), Types and measurement of primary and secondary productivity

Habitat and Niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche. Characteristics and adaptations of fresh water habitat, marine habitat, terrestrial habitat and estuarine habitat. **(15 Hours)**

UNIT II

Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones

Population Ecology: Characteristics of a population, population growth curves, population regulation, life history strategies (r and K selection); concept of metapopulation - demes and dispersal, interdemic extinctions, age structured populations .

Ecological Succession: Types, mechanisms, changes involved in succession, concept of climax **(15 Hours)**

UNIT III

Pollution: Causes, consequences, control and remedial measures of air pollution, water pollution, soil pollution, noise pollution, radioactive pollution and thermal pollution. **(15 Hours)**

UNIT IV

Biodiversity: Definition, characterization, levels, types and values, Mega diversity countries, Diversity hotspots, IUCN categories of threatened species, biodiversity and sustainable development, gene banks, cryopreservation and DNA bar coding. **(15 Hours)**

UNIT V

Resources: Renewable resources - Forest, water, air and Solar energy. Non Renewable resources - Nuclear fuels, Minerals, Biomass, Biogas, Energy and Fossil fuels.

Conservation : Concept of conservation, Insitu and Exitu Conservation - Wild life conservation, Endangered species, Fisheries Management. **(15 Hours)**

BOOKS FOR REFERENCE:

1. Sharma P.D., (1999). Ecology and Environment. Prakasan media, Shivaraj Road, Meerut. U.P.
2. Odum E.P., (1996). Fundamentals of Ecology. 3rd edition, Natraj Publication, Gayathri Offest, New Delhi.
3. Verma K.S. and Agarwal P.S., (1986). Principles of Ecology. S. Chand and Co, New Delhi.
4. Kumar H.D., (1999). Biodiversity and Sustainable Conservation. Oxford and IBH Publication Co. Pvt. Ltd, NewDelhi.
5. Sharma B.K., (2001). An Introduction to Environmental Pollution. Krishnan Prakashan Media Pvt. Ltd, Meerut.
6. Krishnan N.T and Santhana kumar G., (1992). Environmental Biology. J.J. Publications, Nagercoil

BIOSYSTEMATICS

Semester: II **Hours: 6**

Code : 17PZO2E2A **Credits: 4**

COURSE OUTCOMES:

- Identify and categorize levels of structural organization of invertebrates.
- Organize a flow chart to classify the invertebrates.
- Identify the systemic position of Plants and microorganisms.
- Classify Prochordates and Chordates.
- Compare the functional anatomy of various systems of vertebrates.

UNIT I

Levels of structural organization : Unicellular, colonial and multicellular forms. Levels of organization of tissues, organs and systems. types of coelom and their formation. Grouping of invertebrates into phyla distinctive characters of phyla with one example each. Nomenclature, unit of classification. **(18 Hours)**

UNIT II

Outline classification of plants and microorganisms. Important criteria used for classification in each taxon. Classification of plants and microorganism.**(18 Hours)**

UNIT III

Classification of the Animal kingdom : Basis of classification, Evolution, phylogeny, morphology, larval forms. Distinction of invertebrates from vertebrates. **(18 Hours)**

UNTI IV

Classification and salient features of prochordates and chordates up to classes with one example each. **(18 Hours)**

UNIT V

Comparative and functional anatomy of various systems of vertebrates, digestive system, respiratory system, circulatory system, reproductive system and sense organs. **(18 Hours)**

BOOKS FOR REFERENCE BOOKS:

1. Durgadaas Mukerji (11977).Text Book of Zoology. The New Book Stall, Calcutta, India.
2. Jordan, E. L and verma P.s., (2015). Invertebrate Zoology, S. Chand and company Pvt. Ltd. NewDelhi
3. Jordan, E. L and verma P.s., (2015). Chordarte Zoology, S. chand and company Pvt. Ltd. NewDelhi
4. Kapoor, V.C., (2001). Practice of Animal Taxonomy(Fifth edition) . Oxford and IBH publishing Co. Pvt. Ltd.
5. Simpson, G.G., (1969)Principles of Animal Taxonomy.Oxford and IBH publishing Co. Pvt. Ltd.
6. Supriyo Chakraborty, (2004).Biodiversity, Pointer Publishers, Jaipur.
7. Trivedi, P.C. and Sharma, K. C. ,(2003). Biodiversity Conservation, Avishekar publishers, Jaipur.
8. Kotpal.R.L., (2005). Modern Textbook of Zoology, Invertebrates, Rastogi Publications.
9. Ekambaranatha Iyer, M. and Anantha Krishnan (1986). Manual of Zoology, part I and II. Viswanathan printers and publishers Pvt. Ltd., Chennai.
10. Ekambaranatha Iyer, M. (1971). A Manual of Zoology, II (chordata). Viswanathan printers and publishers Pvt. Ltd., Chennai.
11. Kato, M. (2000). The biology of biodiversity.Springer - Verlag, Tokyo.

SERICULTURE

Semester: II **Hours: 6**

Code : 17PZO2E2B **Credits: 4**

COURSE OUTCOMES:

- Restate the importance of mulberry in sericulture.
- Describe the anatomy and life cycle of silk worm.
- Categorize the types of eggs in silk worm.
- Develop skill in rearing silk worm and aspire to be an entrepreneur.
- Design methods to enhance the production of cocoon and improve the yield.

UNIT I

Introduction to Sericulture - historical note, origin and evolution, present status. Moriculture - classification of mulberry, methods of cultivation, harvesting and storage, pests and diseases. **(18 Hours)**

UNIT II

Silkworm biology - Taxonomy, life cycle, anatomy, physiology - digestive system, respiratory system, circulatory system, excretory system and reproductive system. **(18 Hours)**

UNIT III

Seeds/silkworm eggs - types, structure - commercial and reproductive, Non - hibernating: voltinism, seed preparation and handling moth emergence, moth examination, acid treatment, incubation, hibernation schedule - loose egg and card egg preparation **(18 Hours)**

UNIT IV

Rearing facilities - Rearing house, Rearing appliances, Appliances used for keeping the worms being reared, Appliances used for feeding, Appliances used for bed cleaning, Appliances used to support the spinning larvae, Appliances needed for disinfection, Appliances needed for optimum conditions, Rearing methods, mounting, spinning and harvesting of cocoons, Disease of *Bombyx mori* - protozoan, bacterial, viral, fungal diseases. Pests of silkworm. **(18 Hours)**

UNIT V

Cocoon marketing - transport of cocoons, physical characters of cocoons considered for commercial purposes, defective cocoons, cocoon markets. Silk reeling - stifling, sun-drying, steam stifling, hot stifling, storage of cocoons, sorting of cocoons, deflossing, cocoon cooking, boiling, brushing, reeling operations, reeling appliances, by products of sericulture. **(18 Hours)**

BOOKS FOR REFERENCES:

1. Ganga G. and J. Sulochana Chetty,(2012) An introduction to sericulture (2nd edition) Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Ganga G., (2003) Comprehensive Sericulture, Volume - 2 Silkworm rearing and silk reeling. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Dandin, S B., Jayant Jayaswal and K. Giridhar, (2001), Hand Book of Sericultural Technologies, Central Silk Board, Madivala, Bangalore - 68.
4. Kamile Afifa, S. and M. Amin Masoodi (2000), Principles of temperate Sericulture, Kalyani Publishers, B-1/1292, Rajinder Nagar, Ludhians.
5. Kesary M. and M. Johnson, Sericulture, Department of Zoology, N. M. Christian College, Marthandam, Saras Publication, Nagercoil
6. Khan M. A, and M. Anil Dhar, S. B. Zeya and A. R. Trag, (2004), Pests and diseases of Mulberry and their Management. Bishen Singh Mahendra Pal Singh, 23-A, New Connaught Palace, Dehra Dun.
7. Madan Mohan Rao, M. (1999), Comprehensive Sericulture Manual, B. S. Publications, Sultan Bazar,Hyderabad.
8. Narasaiah, M. l., (2003), Problems and prospects of Sericulture, Discovery Publishing House, New Delhi.
9. Sathi, T. V. and A.D.Judhav, (2012) Sericulture and pest management. Days Publishing House, Delhi.

DEVELOPMENTAL BIOLOGY AND ENVIRONMENTAL BIOLOGY-LAB

Semester: II **Hours: 6**

Code : 17PZO2P02 **Credits: 4**

COURSE OUTCOMES:

- Acquire skill in mounting chick blastoderm and observe the stages of chick embryo.
- Gain knowledge on the life cycle of mosquito.
- Become experts in identifying the developmental stages of frog and analyze the impact of hormones on their metamorphosis.
- Analyse the quality of water and air.
- Estimate primary and secondary productivity.
- Determine LC_{50} value.

DEVELOPMENTAL BIOLOGY

1. Observation of meiotic stages in grasshopper testis.
2. Study of mosquito life cycle
3. Mounting of chick blastoderm
4. Observation of cleavage, blastula, gastrula of frog - slides
5. Study of life cycle of frog up to froglet stage.
6. Effect of hormones in amphibian metamorphosis.
7. Spotters
    a. Observation of 24, 48 72 and 96 hour's chick embryo.
    b. T.S of testis and ovary of frog and mammal
    c. Observation of any two congenital abnormalities - chart
    d. Observation of sperm and egg of mammal

ENVIRONMENTAL BIOLOGY

1. Estimation of BOD, P^H, COD of given water Samples
2. Assessment of air pollution and CO_2 level at various sites.
3. Estimation of primary productivity of aquatic macrophytes - light and dark bottle method
4. Estimation of primary productivity of terrestrial plants - harvest method
5. Estimation of secondary productivity - Biomass production in grasshopper
6. Collection and mounting of Phyto and zoo planktons.
7. Phytoremediation with plants for dye industry effluents.
8. Estimation of LC50 value using fish/mosquito larva model

MICROBIAL TECHNIQUES

Semester: II **Hours: 4**

Code : 17PZO2I01 **Credits: 3**

COURSE OUTCOMES:

- Explain and demonstrate the basic equipments used in microbiology.
- Demonstrate isolation, identification and measurement of microbial growth.
- Discuss the medical significance of microbes.
- Define drug resistance and their effectiveness on chemotherapeutic agents.
- Describe the antimicrobial susceptibility tests and the important disease causing microorganisms.

UNIT I

Glasswares, autoclave, hot air oven, laminar air flow, colony counter, compound microscope, Electron Microscope - SEM, TEM Sterilization Techniques, Inoculation Techniques, Isolation of pure culture (Purification) of microorganisms - common methods, special methods. Maintenance of pure culture. **(12 Hours)**

UNIT II

Stain and staining techniques - staining procedure- Gram staining. Microbial growth - Introduction, Generation Time (doubling time) of bacteria. Monoauxic growth (Normal growth) : Batch culture, Growth curve, Measurement of microbial growth, measurement of cell mass. **(12 Hours)**

UNIT III

Bionanotechnology and nanomedicine, nanoparticles in waste water treatment, nanoparticles in sensors, possible adverse health, environmental and safety impacts. **(12 Hours)**

UNIT IV

Drug resistance- mechanism, origin, spread and drug resistance encounter, factors that influence the effectiveness of chemotherapeutic agents, antibiotics - classification and mode of action. **(12 Hours)**

UNIT V

Antimicrobial drug susceptibility tests - techniques and importance. Important viral, bacterial, protozoan and fungal diseases (any one) - Causative agent, symptoms and treatment. **(12 Hours)**

BOOKS FOR REFERENCE BOOKS:

1. Singh, R. P. (2004). Microbiology, Kalyani Publishers, New Delhi.
2. Kanika Sharma (2011). Text Book of Microbiology, Ane's Student Edition, New Delhi.
3. Cappuccino J.G and Sherman N. (2005). Microbiology A Laboratory Manual. VII edition. Pearson Education and Dorling Kinderley Pvt. Ltd. NewDelhi.
4. Dubey and Maheswari D.K. (2013). A Text Book of Microbiology. Revised edition. S. Chand and Company Ltd. New Delhi.
5. George J Banwan. (2002). Basic Food Microbiology II edition. CBS Publishers and distributers. New Delhi.
6. Green Wood D., Slack R.C.B and Peutherery J.F. (2002). Medical Microbiology. Sixteenth edition. Churchill Livingstone An Imprint if Elseviers Science Ltd.
7. Jeffery C. Pommerville. (2014). Alcamo's Fundamentals of Microbiology X edition. Jones and Bartlett India Pvt. Ltd. New Delhi.
8. Patel A.H.(2012). Industrial Microbiology. II edition. Macmillan Publishers India Ltd. New Delhi.
9. Pelcezar M. J., (1993). Microbiology and Reid. Rc Graw Hill Book Company, New York.
10. Schelgel H. G., (1993). General microbiology. Cambridge University Press U.K.
11. Somnath Ditta. (2009). Medical Microbiology, Adhyayan Publishers and Distributors. New Delhi.Sugandhar Babu R. P. (2008). Food Microbiology. Adhyayan Publishers and Distributors. New Delhi.

SOFT SKILLS

Semester: II **Hours: 2**

Code : 17PGS2S01 **Credit: 1**

COURSE OUTCOMES:

- Develop their social, interpersonal, cognitive, ethical, professional, reading and communication skills.
- Increase their self-esteem and confidence.
- Achieve their short and long term goals.
- Prepare and formulate their resumes wisely.
- Face the mock group discussions and interviews with a challenge and choose their right career.

UNIT I: SOFT SKILLS

Introduction - Soft skills - Importance of soft skills - Selling your soft skills - Attributes regarded as soft skills - Soft skills - Social - Soft skills - Thinking - Soft skills - Negotiating - Exhibiting your soft skills - Identifying your soft skills - Improving your soft skills - will formal training enhance your soft skills - Soft Skills training - Train yourself - Top 60 soft skills - Practicing soft skills - Measuring attitude. **(6 Hours)**

UNIT II: CAREER PLANNING

Benefits of career planning - Guidelines for choosing a career - Myths about choosing a career - Tips for successful career planning - Developing career goals - Final thoughts on career planning - Things one should know while starting career and during his/her career. **(6 Hours)**

UNIT III: ART OF LISTENING AND SPEAKING

Two ears, one mouth - Active listening - Kinds of Listening, Common - poor listening habits - Advantages of listening - Listening Tips. Special features of Communication - Process - Channels of Communication - Net Work - Barriers - Tips for effective communication and Powerful presentation - Art of public speaking - Public Speaking tips - Over coming fear of public speaking. **(6 Hours)**

UNIT IV: ART OF READING AND WRITING

Good readers - Benefits - Types - Tips - The SQ3R Technique - Different stages of reading - Rates of Reading - Determining a student's reading rate - Increasing reading rate - Problems with reading - Effective reader - Importance of writing - Creative writing - Writing tips - Drawbacks of written communication. **(6 Hours)**

UNIT V: PREPARING CV / RESUME

Meaning - Difference among Bio-data, CV and Resume - The terms - The purpose of CV writing - Types of resumes - Interesting facts about resume - CV writing tips - CV/Resume preparation - the dos - CV/Resume preparation - the don'ts - Resume check up - Design of a CV - Entry level resume - The content of the resume - Electronic resume tips - References - Power words - Common resume blunders - Key skills that can be mentioned in the resume - Cover letters - Cover letter tips. **(6 Hours)**

COURSE BOOK:

Dr. K. Alex, Soft Skills, Chand & Company Pvt. Ltd., New Delhi.

REFERENCE BOOK:

1. Dr. T. Jeya Sudha & Mr. M.R. Wajida Begum : Soft Skills/Communication Skills, New Century Book House (P) Ltd., Chennai.
2. S. Hariharen, N. Sundararajan & S.P. Shanmuga Priya : Soft Skills, MJP Publishers, Chennai.

SOFT SKILLS

Semester: II **Hours: 2**

Code : 17PGS2S01 **Credit: 1**

QUESTION PATTERN

Part - A	3 Questions to be answered out of 5	Each Carries 4 marks	12 Marks
Part - B	2 Questions to be answered out of 4	Each Carries 9 marks	18 Marks

The Components of Internal Assessment for Soft Skill are as follows

Components	Marks
Test - I	30
Test - II	30
Mock Interview	30
Communication Skill	10
Total	**100**

IMMUNOLOGY

Semester: III **Hours: 6**

Code : 17PZO3C06 **Credits: 5**

COURSE OUTCOMES:

- Revise the Non-specific and Specific immunity, lymphoid organs and the cells of the immune system.
- Describe the types of antigens and their properties, diversity of immunoglobulins and method of detection of Antigen-antibody interaction.
- Assimilate deep ideas on MHC antigens and their clinical application, Hypersensitivity implications, cytokines and complement system.
- Summarize the ideas on tumor and transplantation immunology and their clinical applications.
- Communicate the immunology of common infectious diseases and study deficiency diseases of immune system.

UNIT I

Overview of Immunity - Non specific, Specific, Active, Passive, Cellular and Humoral, Primary and secondary lymphoid organs, Cells of the Immune system, Haematopoiesis, Activation and differentiation of T Cell and B cell and T Cell and B cell receptors, Antigen Presenting Cells. **(18 Hours)**

UNIT II

Antigens - Immunogenicity, haptens, epitopes, allergens, adjuvants, antigenic determinants, thymus dependent and independent antigens. Antibodies - structure, classes, functions. Monoclonal antibodies - Hybridoma technology. Antigen-antibody reaction and their assays - properties of Ag - Ab reaction, Precipitation ring test, Lattice model of precipitation, Immunodiffusion - diffussion in gel, single radial immunodiffusion, Immunoelectrophoresis and their types, Agglutination - direct, indirect, active, passive and haemagglutination, Immunofluorescence technique, Radio immunoassay, ELISA and Western Blotting. **(18 Hours)**

UNIT III

Major Histocompatibility Complex - MHC antigens, HLA system, clinical significance and MHC restriction phenomenon. Hypersensitivity reactions - Type I, II, III & IV. Cytokines - Properties, classes, cytokine receptors and cytokine related diseases. Complement system - components, complement activation pathways, function and biological consequences of activation. **(18 Hours)**

UNIT IV

Tumor Immunology - Theory of surveillance, Tumors of the immune system, Tumor antigens, Immune response to tumors, Tumor evasion of the immune system, Cancer immunotherapy. Transplantation immunology - Immunological basis of graft rejection, clinical manifestation of graft rejection, tissue typing, immunosuppression, clinical transplantations. Vaccines - methods of vaccine preparation, types of vaccines used in human, Immunological memory, Immunotolerance. **(18 Hours)**

UNIT V

Immunity to infection - Epidemiology, immune response and immune evasion to - Viral (HIV), Bacterial (Tuberculosis) Protozoan (Malaria), Helminth (Filarial) and Fungal (Candidiais) infection. Immuno deficiency diseases - Primary immune deficiencies - Defects in lymphoid lineage and myeloid lineage, Secondary immune deficiencies - AIDS and SCID. Auto immunity - factors behind auto immune diseases, Organ specific and Systemic Auto immune disorders and their treatments. **(18 Hours)**

BOOKS FOR BOOKS FOR REFERENCE:

1. Kuby, Richard A. Goldsby and Kind T.J., (2000). Immunology. 4th edition W. H Freeman and company, New York.
2. Jonathan, Abramoff, David male, Ivan M Roitt, Karger and Barel, (1994). Immunology, Blackwell Scientific Oxford.
3. Rao C.V., (2008). Immunology - A Text Book. Narosa Publishing House, New Delhi.
4. Slites D.P., Stoho J.D., Fundeaberq H.M and Wells J.V., (1994). Basic and Clinical Immunology. Medical Publication, USA.
5. Seemi Farhat Basir, (2012). Text book of Immunology. PHI Learning Private Limited, New Delhi.
6. Fathimunisha Begum, (2014). Immunology. PHI Learning Private Limited, Delhi.
7. Helen Chapel, Mansel Haeney, (1984). Essentials of Clinical Immunology. English Language Book Society/Blackwell scientific Publications, London.
8. Kannan I., (2007). Immunology. MIP Publishers, Chennai.
9. Chakravarty A.K., (2000). Immunology. Tata McGraw-Hill.
10. Hildemann W.H., (1984). Essentials of Immunology. Elsevier science Publishing Co., Inc, New York.
11. Rajasekara Pandian M. and Senthil Kumar B., (2007). Immunology and Immunotechnology. Panima Publishing Corporation, Bangalore, New Delhi.
12. Hannigan B.M., (2008). Immunology. Viva Books Private Limited, New Delhi.
13. Arun Ingale, (2010). Basic Immunology. New Central Book Agency (P) Ltd., London.

BASIC AND APPLIED MICROBIOLOGY

Semester: III **Hours: 6**

Code : 17PZO3C07 **Credits: 5**

COURSE OUTCOMES:

- Recall the characteristics of microbes, culture media, culture and staining techniques, methods of growth and growth measurements.
- Restate the microbial components of polluted water and get aquainted with food poisoning.
- Appraise the role of microbes in soil fertility and bioremediation of pesticides.
- Review the production of vaccines and various microbial products.
- Enlist the disease causing microbes and acquire knowledge on drug resistance and drug susceptibility test.

UNIT I

History and scope of microbiology, Pioneer contributors - Antoni Van Leeuwenhock, Robert Koch, Sir Alexander Fleming and Joseph Lister. Outline classification of microbes - Bergey's classification, General features of bacteria, virus, actinomycetes and fungi, Types of culture media and culture techniques, Stains and staining techniques, Gram staining, Acid fast staining. Microbial nutrition - Nutritional requirements, Nutritional types of microorganisms, microbial growth - Monoauxic and Diauxic growth, Measurement of growth - cell mass, cell number, factors affecting growth of microorganisms. **(18 Hours)**

UNIT II

Food microbiology - Microbial components of water, substances responsible for water pollution, microbial indicators of water pollution. Food preservation methods - heat, low temperature, drying, osmotic pressure, chemical preservatives, radiation, anaerobiosis, controlled atmospheres, probiotics. Food poisoning - Staphylococcal, Clostridial, Salmenellosis and Bacillus. Microbes associated with food spoilage - milk, poultry, meat, sea food. **(18 Hours**)

UNIT III

Soil and agricultural microbiology - Role of soil microbes in nitrogen fixation and soil fertility. Role of microbes in sewage disposal and Bio remediation. Pesticides and microorganisms - bio deterioration of the pesticides - bio pesticides, virus as pesticides, bacterial and fungal pesticides, nematicides and herbicides, microbial bio fertilizer - types, applications and cultivation of azolla. **(18 Hours)**

UNIT IV

Industrial microbiology - Types of Fermentors, Production of alcohol, Antibiotic - pencillin, aminoacid - lysine, enzyme - amylase, vitamin - B12, single cell protein and insulin, Role of microbes in the production of vaccine. Microbes as biological weapons. **(18 Hours)**

UNIT V

Medical microbiology - Biology, infective process and control measures of Bacterial (Air borne disease - Bacterial conjunctivitis and corneal ulcer, food borne - Botulism, waterborne - Cholera), Viral - influenza, insect borne- dengue, direct contact - rabies. Nosocomial infection, Drug resistance - mechanism, origin, spread and drug resistance encounter, factors that influence the effectiveness of chemotherapeutic agents, antibiotics - classification and mode of action, Antimicrobial drug susceptibility tests - techniques and importance.

(18 Hours)

BOOKS FOR BOOKS FOR REFERENCE:

1. Kanika Sharma, (2011). Text Book of Microbiology, Ane's Student Edition, New Delhi.
2. Cappuccino J.G. and Sherman N., (2005). Microbiology A Laboratory Manual. VII edition. Pearson Education and Dorling Kinderley Pvt. Ltd., New Delhi.
3. Dubey and Maheswari D.K., (2013). A Text Book of Microbiology. Revised edition. S. Chand and Company Ltd., New Delhi.
4. George J Banwan, (2002). Basic Food Microbiology II edition. CBS Publishers and distributers, New Delhi.
5. Green Wood D., Slack R.C.B. and Peutherery J.F., (2002). Medical Microbiology. Sixteenth edition. Churchill Livingstone An Imprint if Elsevier's Science Ltd.
6. Jeffery C. Pommerville, (2014). Alcamo's Fundamentals of Microbiology. X edition. Jones and Bartlett India Pvt. Ltd., New Delhi.
7. Patel A.H., (2012). Industrial Microbiology. II edition. Macmillan Publishers India Ltd., New Delhi.
8. Pelcezar M. J., (1993). Microbiology. Reid. Rc Graw Hill Book Company, New York.
9. Schelgel H. G., (1993). General Microbiology. Cambridge University Press, U.K.
10. Sugandhar Babu R. P., (2008). Food Microbiology. Adhyayan Publishers and Distributors, New Delhi.
11. Sullia S. B. and Santhanam, (2000). General Microbiolgy. Oxford & IBH Publishing Co. Pvt. Ltd.
12. Singh, R. P., (2004). Microbiology, Kalyani Publishers, New Delhi.

BIOPHYSICS AND BIOSTATISTICS

Semester: III **Hours: 6**

Code : 17PZO3C08 **Credits: 5**

COURSE OUTCOMES:

- Summarize biochemical and biophysical basis of life.
- Apply thermodynamics law in everyday life.
- Relate principles of physics in bioinstrumentations.
- Formulate hypothesis and design experiment.
- Use statistical tools and techniques for project work and research.

UNIT I

Introduction - scope of biophysics - I, II, III laws of Thermodynamics, Concepts of free energy, Entropy, Enthalpy, Bioenergetics - Mitochondrial, ATP Bioenergetics. Oxidation and reduction - Redox reactions - redox potential. Principles of kinetics of molecules - Passive & active transport. Donnan Equilibrium in living systems, Dialysis - Principles of dialysis in artificial kidney, kinds of dialysis. **(18 Hours)**

UNIT II

Photo Biophysics - Visible and Invisible region, Effects of UV in Macromolecules, Bioluminescence - Physical characteristics, Biochemistry and significance of Bioluminescence. Radiation Biology - Types of radiation, Direct and Indirect effects of radiation, Measuremment of radiation - levels and limits. Geiger Muller Scintillation Counter, Autoradiography. Possible implications of radiotherapy, Biological effects of radiation. Principle, Instrumentation and applications of TLC, HPLC and NMR. **(18 Hours)**

UNIT III

Define - Data, variable, sample, population. Types of variables, measurement scales. Measures of Central Tendency - Mean, Median, Mode - their properties and applications. Measures of variation - range, mean deviation, percentiles and quartiles, inter quartile range, standard deviation, variance, coefficient of variations, standard error. **(18 Hours)**

UNIT IV

Data distribution - Binomial, Poisson and Normal Distribution. Skewness and Kurtosis. Correlation Analysis - types, methods - Scatter plot, Karl Pearson's Correlation Coefficient, Spearman's Rank correlation. Simple regression Analysis - predicting X on Y and Y on X. **(18 Hours)**

UNIT V

Hypothesis - H_0 and H_1, Hypothesis testing, significance level, degrees of freedom, statistical errors - Type I and II, rejection regions, paired and unpaired tests, one tailed and two tailed tests, parametric and nonparametric tests. Chi Square test - properties, calculating expected values, goodness of fit, contingency tables. Comparing means of two samples - Student's t test. Comparing more than two samples - Analysis of Variance (ANOVA). **(18 Hours)**

BOOKS FOR BOOKS FOR REFERENCE:

1. Salil Bose., (1986). Elementary Biophysics. Himalaya Publishing House, New Delhi.
2. Daniel M., (2000). Basic Biophysics for Biologists. Maharaja Sayjirao University, Baroda.
3. Vasantha Pattabhi and Gautham N., (2000). Biophysics. Narosa Publishing House, New Delhi.
4. Thiraviya Raj S., (2001). Principles of Biophysics. Saras Publications, Nagercoil.
5. Palanichamy, S and Shanmugavelu, M., (2002). Principles of Biophysics. Palani Paramount, Palani.
6. Subramanian M.A., (2006). Biophysics Principles and Techniques, MJP Publishers, Chennai.
7. Daniel W.W., (2009). Biostatistics. 9th edition, John Wiley and Sons, New York.
8. Gupta S.P., (2011). Statistical Methods. 40th edition, S.S. Chand Publishers, New Delhi.
9. Zar J.H., (2011). Statistical Analysis.4th Edition, Pearson Education, South Asia.
10. Kothari C.R., (2004). Research Methodology. 2nd edition, New Age International Publishers, New Delhi.

IMMUNOLOGY, MICROBIOLOGY AND MEDICAL LABORATORY TECHNOLOGY - LAB

Semester: III **Hours: 6**

Code : 17PZO3P03 **Credits: 4**

COURSE OUTCOMES:

- Demonstrate immunological techniques.
- Simulate experiment in microbial techniques.
- Critically analyse clinical samples in medical lab technology.
- Choose any field of Biological and Biomedical research in future career.

IMMUNOLOGY

1. Display of Lymphoid organs of Chick.
2. Histology of lymphoid organ. -
   i) Primary lymphoid organs - Thymus, Bone Marrow.
   ii) Secondary lymphoid organs - Lymph nodes, Spleen.
3. Isolation of lymphocytes from peripheral blood.
4. Identification and enumeration of human T lymphocytes using E - Rosette technique.
5. Isolation of lymphocytes from solid lymphoid organ.
6. Demonstration of Radial Immuno diffusion.
7. Demonstration of Double Immuno diffusion.
8. Demonstration of Haemagglutination.
9. Demonstration of Immuno Electrophoresis.

MICROBIOLOGY

1. Cleaning and sterilization of glasswares.
2. Preparation of culture media for microbes
   a) Broth media b) Agar media c) Slant
3. Pure culture of bacteria
   a) Serial dilution, b) Pour plate c) Spread plate technique
4. Staining of bacteria - Simple, Negative and Gram stain.
5. Study of microbial population in raw milk and soil.
6. Wet mount preparation and handing drop technique.
7. Indirect method of microbial estimation using spectrophotometer.
8. Physiological character - Hydrolysis of starch.
9. Testing the quality of water using presumptive test (MPN technique).

MEDICAL LAB TECHNOLOGY

1. Bleeding time, Clotting time.
2. Estimation of Haemoglobin concentration.
3. Estimation of Erythrocyte Sedimentation Rate.
4. Estimation of Packed Cell Volume.
5. Differential count, Total count, Blood grouping.
6. Blood sugar, cholesterol, urea and creatinine
7. Urine Analysis: Urine sugar, albumin, bile salt and bile pigment.
8. Microscopic examination of crystals and cast.
9. Pregnancy test.
10. Compulsory visit to various clinics and hospitals.

MEDICAL LABORATORY TECHNOLOGY

Semester: III **Hours: 6**

Code : 17PZO3E3A **Credits: 4**

COURSE OUTCOMES:

- Diagnose and address common human ailments and remedy.
- Analyse and understand the principles of immunohaematology.
- Explicate the clinical chemistry.
- Analyse and report urine, stool and sputum.
- Develop skills to handle clinical samples and become entrepreneur.

UNIT I

Principles of haematology and clinical significance of blood transfusion. Routine Haematological test - Bleeding Time (BT), Clotting Time (CT), Haemoglobin Concentration (Hb), Erythrocyte Sedimentation Rate (ESR), Haematocrit (PCV), Cell Study - Counting of Cells - Differential count and Total Count, Cell indices - Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC). **(21 Hours)**

UNIT II

Clinical Biochemistry - ELIZA and Western Blot, Venereal Disease Research Laboratory Test (VDRL), Widal test for enteric fever, Rheumatoid arthritis, Immunologic test for pregnancy, Blood glucose, blood urea, blood creatinine and blood cholesterol. **(18 Hours)**

UNIT III

Analysis of Urine - Physical properties of Urine - Colour, volume, specific gravity, odour and p^H. Chemical composition of Urine - urine sugar, albumin, bile salts and bile pigments, Microscopic examination of organized and unorganized sediments. **(12 Hours)**

UNIT IV

Laboratory diagnosis - Causative organisms, mode of transmission, clinical symptoms and laboratory diagnosis of bacterial diseases - Leprosy, Typhoid and Tetanus. Viral diseases - Jaundice, Mumps, Measles, Rubella, and AIDS. Fungal diseases - Ringworm infections, Mycoses. Protozoan diseases - Amoebiasis, Malaria, Giardiasis. Helminth infections - Filariasis, Tape worm infections, Ascariasis. **(21 Hours)**

UNIT V

Analysis of stool and sputum, Macroscopic examination - Colour and consistency of sputum, microscopic and biochemical examination of sputum. Gram stain and Acid Fast Bacilli (AFB). Analysis of stools - Macroscopic examination - colour, form consistency and odour. Microscopic examination of ova and cyst. **(18 Hours)**

BOOKS FOR BOOKS FOR REFERENCE:

1. Gabriel Virella, (1987). Microbiology and Infectious Diseases. B. I. Waverly Pvt. Ltd.
2. Isidro Aquilar and Herminia Galbes, (1999). Encyclopedia of Health and Education for the family. Education and Health Library, Published under the title of Encyclopedia familiarrida, Amor Y sexo.
3. Kanai L., Mukherjee, Volume 1. (2005). A Procedure Manual for Medical Laboratory Technology. Routine diagnostic test. Tata McGraw-Hill Publishing Company Ltd., New Delhi.
4. Kanai L., Mukherjee, Volume 2. (2005). A Procedure Manual for Medical Laboratory Technology. Routine diagnostic test. Tata McGraw-Hill Publishing Company Ltd., New Delhi.
5. Kanai L., Mukherjee, Volume 3. (2008). A Procedure Manual for Medical Laboratory Technology. Routine diagnostic test. Tata McGraw-Hill Publishing Company Ltd., New Delhi.
6. Philip Evans., (1993). The family Medical BOOKS FOR REFERENCE Book the essential Guide to Health and Medicine. Published by Little Brown under the Black cat imprint, London.

ENTOMOLOGY

Semester: III **Hours: 6**

Code : 17PZO3E3B **Credits: 4**

COURSE OUTCOMES:

- Acquire knowledge about taxonomy of insects.
- Identify insects based on their morphological characters.
- Illustrate insect physiology.
- Distinguish agricultural pests.
- Gain knowledge on pest control methods.

UNIT I

Insect Taxonomy - Principles of Insect classification, Classification upto Orders, Insect collection and preservation. **(18 Hours)**

UNIT II

Insect Morphology - Types of antennae, mouthparts and legs - Thorax - Wings venation. Wings modification, spiracles - types, Genitalia - Structure and types. **(18 Hours)**

UNIT III

Insect physiology - Structure and physiology of digestive system, Circulation - Structure of heart, Component of Blood, Mechanism of circulation, aerial respiration, aquatic respiration, Reproductive system of male and female, Neuroendocrine system - Moulting and metamorphosis. **(18 Hours)**

UNIT IV

Pest of economic importance - Any four important pests of Rice, Sugercane, Grountnut, Coconut, Greengram, Blackgram - Pests of stored products, Internal feeders and External feeders, Insect associated with human beings - Mosquitoes and Housefly. **(18 Hours)**

UNIT V

Pest control - Methods - Natural control, cultural, mechanical, legal, biological and chemical classification of Insecticides based on mode of action, chemical nature - Organic and In-organic compounds - Synthetic pyrthroids - Integrated Pest Management (IPM). **(18 Hours)**

BOOKS FOR BOOKS FOR REFERENCE:

1. Vasantharaj David and T. Kumarasamy B., (1988). Elements of Economic Entomology, Popular Book Depot, Saidapet, Chennai.
2. Krishnan N. T. (1993). Economic Entomology, J.J. Publication, Madurai.
3. Wigglesworth, V.B., (1994). Insect Physiology, Chapman and Hall, London.
4. Mani, M.S., (1982). General Entomology Oxford and JBH publishing Co. New Delhi.
5. Rajinder Nagar, (1992). The insects: Structure, Function and Biodiversity, Kalyani Publisher, B1, Lidhiana.
6. Fenemore, P.G. and. Prakas B., (1997). Applied Entomology,Wiley Eastern Ltd., New York.
7. Nalina Sundari M.S. and Shanthi R., (2006). Entomology, M.J.P Publishers, Chennai.
8. Snodgrass, R.E., (1985). Principles of Insect Morphology. McGraw Hill and Co., New York.
9. Vasantharaj David, (2001). Elements of Economic Entomology, Popular Book Depot, Saidapet, Chennai.

PHYSIOLOGY

Semester: IV **Hours: 6**

Code : 17PZO4C09 **Credits: 5**

COURSE OUTCOMES:

- Summarize the physiology of digestive and endocrine systems.
- Relate respiratory organs and gas transport in different animals.
- Describe the structure and functions of human heart, and assess the cardiac defects.
- Ellucidate the organs of excretion, urine formation and osmotic regulation of multicellular animals.
- Understand the mechanism of muscular contraction, conduction of nerve impulse and the structure of sense organs.

UNIT I

Food and Digestion - Digestive tract - structure and functions, Secretary functions of the alimentary tract and the glands, Balanced diet and malnutrition. Sources, physiological role and deficiency symptoms of Vitamins. Structure and functions of endocrine glands - Pituitary, Thyroid, Parathyroid, Islets of Langerhans, Adrenal and Gonads. **(18 Hours)**

UNIT II

Respiration - Respiratory organs, Respiratory pigments, Functional anatomy of lungs, Air breathing fish, Insect respiration, Gas transport between the lungs and tissues, Respiratory quotient, Artificial respiration. **(18 Hours)**

UNIT III

Circulation - Types of heart, Functional morphology of human heart, factors affecting RBC production, Blood constituents, Blood flow, Haemodynamics, Haemopoiesis, Haemostasis, Cardiac cycle, Cardiac output, Regulation of heart beat, Blood pressure and related diseases, Electrical activity of heart (ECG), Coronary circulation, Cerebral circulation. **(18 Hours)**

UNIT IV

Excretion and Osmoregulation - Excretory products, Organs of excretion in different animals, Human kidney, Nephron, Urine formation, Renal disorders, Micturition and Dialysis. Osmotic regulation of multicellular animals - Fresh water, marine, estuarine and terrestrial animals. **(18 Hours)**

UNIT V

Neuromuscular and Sensory Physiology - Ultra structure of striated muscles, Composition and properties, Mechanism of muscular contraction, Central and Peripheral nervous system, Neuron - Types and structure, Neurotransmitters, Conduction of nerve impulse, Synapse, Neuromuscular junction, Electro Encephalogram (EEG). Sense organs - chemoreceptors, phonoreceptors, thermo receptors, photoreceptors. **(18 Hours)**

BOOKS FOR BOOKS FOR REFERENCE:

1. Knut Schmidt - Nielson, (1990). Animal Physiology Adaptation and Environment. Fourth edition, Cambridge University Press.
2. Eckert and Randall, (2000). Animal Physiology Mechanism and Adaptations. Second Edition, CBS Publishers and Distributors, New Delhi.
3. Nagabhushanam R. M., Kodarkar S. and Sarojini R., (2002). Text book of Animal physiology. Second Edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Ladd Prosser C., (1992). Comparative Animal Physiology. Third edition, Satish Book Enterprise Book Sellers and Publishers, Agra.
5. Goyal. Sastry, (2013-2014). Animal physiology. Sixth edition, Rastogi Publlicatons, Meerut, India.
6. Arti Sankhla,Vibha Batnagar Parul Choudhary, (2010). Human physiology an insight, Agrotech Publishing Academy,Udaipur.
7. Knut Schmidt-Niessen, (1997), Animal Physiology (Adaptation and environment). Fifth edition, Cambridge University Press, New Delhi.
8. Sobit. R.C., (2008). Animal physiology. Narosa Publishing House, New Delhi.
9. Dee Unglaub silverthorn, (2010). Human physiology an Intagrated approach (Fifth edition) Published by Peanson Education.
10. Biswas P.K., (2013). Hand book of Animal Physiology, Agrotech Press, New Delhi.
11. Margaret Stainer, Mary Forsling, (1990). Physiological process (An Introduction to mammalian Physiology, British Library cataloguing in Publicaton Data.
12. John Alcock, (1942). Animal Behaviour (Fourth edition) Sunder land, Massacnusetts.

BIOTECHNOLOGY

Semester: IV **Hours: 6**

Code : 17PZO4C10 **Credits: 5**

COURSE OUTCOMES:

- Apply the knowledge and techniques of biotechnology.
- Acquire an in depth knowledge on the applications of transgenesis.
- Evaluate the microbial biotechnology for the production of novel products.
- Acquire knowledge on environmental biotechnology.
- Apply biotechnology for human welfare.

UNIT I

Introduction to biotechnology - Scope and importance of Biotechnology, Future of biotechnology, Conventional Vs Modern Biotechnology, Enzymes useful for Genetic Engineering, Gene cloning vectors - plasmids, cosmids and phasmids. Rural biotechnology - white, blue, green and red. **(18 Hours)**

UNIT II

Animal and plant Biotechnology - Animal cell culture techniques and Plant tissue culture techniques. Transgenic plants - Herbicide resistant, Insect resistant, Virus resistant, Fungi and bacteria resistant. Stress tolerant, Cold tolerant and Drought tolerant. Transgenic animals and their Uses - Retroviral method, Microinjection method. Applications of transgenic animals. **(18 Hours)**

UNIT III

Microbial biotechnology - Strain improvement for industrially important secondary metabolites, Bioprocess and fermentation technology. Downstream processing. Technology of Enzyme production. Microbial production of Antibiotics - Penicillins and Tetracyclines. **(18 Hours)**

UNIT IV

Environmental biotechnology - Pollution monitoring and measurement - General bioassays, cell biological assays, Molecular biological assays. Biosensors, Bioremediation - Soil and Ground water, Biofuels, Ore leaching, Biological control of pests and pathogens. **(18 Hours)**

UNIT V

Biotechnology for human welfare - Genetic Engineering for human welfare, Human peptide hormones, vaccines, Gene Therapy, DNA profiling, Gene bank, Clone bank, Genetically modified food, Human embryonic stem cell. Intellectual property rights, Patenting biological material. **(18 Hours)**

BOOKS FOR BOOKS FOR REFERENCE:

1. Dubey R.C., (2001). A Text book of Biotechnology. S. Chand and company Ltd., New Delhi.
2. Gupta P. K., (2003).Elements of Biotechnology, Rastogi Publications.
3. Sathiyanarayan U., (2005). Biotechnology. Books and Allied Pvt. Ltd., Kolkata, India.
4. Kumaresan V., (2005). Biotechnology. Saras Publication, Nagercoil.
5. Singh B. D., (2006). Biotechnology. Kalyani Publishers, New Delhi.
6. Ignacimuthu, (1997). Plant Biotechnology. Tata MC Graw Hill Publication Company Ltd., New Delhi.

PHYSIOLOGY AND BIOTECHNOLOGY - LAB

Semester: IV **Hours: 6**

Code : 17PZO4P04 **Credits: 5**

COURSE OUTCOMES:

- Understand the method of osmoregulation in fishes.
- Demonstrate the effect of temperature on physiological activities.
- Explain the process of extraction, Isolation and purification of DNA.
- Obtain knowledge on the working principles of Gel Electrophoresis.
- Develop Skill in the preparation of haemin, urate crystals and isolation of nitrogen fixing symbiotic bacteria from root nodule.

PHYSIOLOGY:

1. Experiment on salt gain in fish.
2. Experiment on salt loss in fish.
3. Preparation of Haemin crystals.
4. Oxygen consumption in fish in relation to temperature.
5. Opercular movements in fish in relation to temperature.
6. Study of ureate crystals in malphigian tubules of cockroach.

BIOTECHNOLOGY:

1. Isolation and purification of DNA from goat liver.
2. Separation of DNA fragments using Agarose Gel Electrophorosis (AGE).
3. Separation of protein using Polyacrylamide Gel Electrophorosis (PAGE).
4. Thin layer Chromatography (TLC).
5. Isolation of nitrogen fixing symbiotic bacteria from root nodule.
6. Enzymatic disaggregation of cells from a tissue (Spleen).

PROJECT

Semester: IV **Hours: 12**

Code : 17PZO4R01 **Credits: 6**

COURSE OUTCOMES:

- Choose to specialize in a particular field in Biology
- Apply laboratory techniques and mastery of basic laboratory skills in inter disciplinary fields of Biology
- Master the art of critical thinking, associated cognitive skills in the formulation of a problem, data gathering and analysis and interpretation of results to address practical questions in Biology.
- Adhere the ethical standards of Biological research and communicate research findings in a variety of formats.
- Achieve collaborative skills through working with peers.

Group project 2 students per group (if odd number of students 3 in one group)

COMPREHENSIVE EXAMINATION

Semester: IV **Hours: 12**

Code : 17PZO4A01 **Credits: 2**

COURSE OUTCOMES:

- Analyse critically with an attitude for continued self directed learning.
- Gain awareness on career options in the Biological sciences.
- Apply a broad based foundation of knowledge to crack competitive exams.
- Acquire the skills to communicate effectively and to present ideas clearly and coherently to specific audience in both written and oral forms.