THANTHAI PERIYAR GOVERNMENT ARTS AND SCIENCE COLLEGE

(AUTONOMOUS), TIRUCHIRAPPALLI-23.

DEPARTMENT OF ZOOLOGY- M.Sc. Zoology (CBCS)

PROGRAMME OUTCOMES (POs)

PO.NO.	On successful completion of M.Sc. Zoology programme in our institution, the post-graduates will be capable of
PO - 1	Comprehending the basic knowledge on the animal kingdom and their evolution. Perceiving the cytogenetic mechanism of cell at molecular level and principles of bio techniques.
PO - 2	Understanding the functional anatomy and life cycle of fauna. Applying the natural aspects of life for framing the technologies for the production of life saving products necessary to maintain the good health and the welfare of the society
PO - 3	Grasping the knowledge of commercially important organisms to develop the entrepreneurial skill for the uplifting the economic status of villagers.
PO - 4	Developing awareness over the protection of the environment through the nature oriented and eco-friendly sustainable practices.
PO - 5	Designing a research project, analysing interpreting and solving the problems statistically

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO.NO.	On successful completion of M.Sc. Zoology programme in our institution, the post-graduates will be able to
PSO - 1	Relate the structural, functional and ecological adaptations. Compare and contrast the anatomy of diversified species of invertebrate and chordate fauna. Classify the fauna and infer the taxonomic position so as to understand the evolutionary sequence.
PSO - 2	Observe, classify and distinguish the taxonomic characters of bacteria, viruses, insects. Analyze their economic importance and formulate the control measures. Understand the mechanism of immunity against the microbes and the importance of immunization schedule. Estimate the biochemical components of natural or biological samples.
PSO - 3	Correlate the cell structures with their physiological functions, Analyze the role of enzymes and hormones on various metabolic reactions. Understand the classical, microbial and human genetics Predict the characters of next generation with the genetic principles of heredity and interpret the different evolutionary processes.
PSO - 4	Apply the principles of microbiology, embryology, physiology and biotechnology to become entrepreneurs of environment friendly bio-industries like, dairy industry, organic pharma industry, poultry farming, vermicompost manufacturing, aquaculture, sericulture and apiary.
PSO - 5	Understand the molecular mechanism of embryological development and physiological systems Role of nutrition on the development of animals and immunity. Learn the importance of yoga and exercise for wellbeing. Apply the knowledge of genetic engineering and microbiology for the production of biologically important products.
PSO - 6	Assess the impact of climate change on biodiversity and adopt conservation strategies. Analyze the adaptations to different habitats. Estimate and evaluate the components of eCOsystem. Apply the measures of reducing pollution using bio products, microbes and bio techniques.
PSO - 7	Illustrate the data in diagrammatic and graphical representation. Compute and analyze the data collected in research using statistical tests of significance. Adopt safety measures to prevent laboratory hazards. Formulate a research problem, make a research design, perform the research and publish the results in peer reviewed journals.

THANTHAI PERIYAR GOVERNMENT ARTS AND SCIENCE COLLEGE (AUTONOMOUS), TIRUCHIRAPPALLI-23.										
GENERAL COURSE PATTERN FOR M.Sc., - ZOOLOGY (CBCS) - 2023-2024 ONWARDS										
SL. NO.	**PART**	**COURSE**		**COURSE TITLE**	**Exam Hrs.**	**Hrs.**	**Credits**	**CIA**	**Semester Exam**	**Total**
I SEMESTER										
1	-	Core	I	Structure and function of Invertebrates and Vertebrates		6	5	25	75	100
2	-	Core	II	Molecules and their interaction relevant to Biology		6	5	25	75	100
3	-	Core	III	Evolution		5	4	25	75	100
4	-	Core	IV	Ecology		5	4	25	75	100
5	-	Core	V - P	Practical CC - I to IV		6	4	40	60	100
6	-	SEC	I	Sericulture		2	2	25	75	100
TOTAL						30	24	165	435	600
II SEMESTER										
7	-	Core	VI	Cell Biology and Cytotechniques		5	5	25	75	100
8	-	Core	VII	Developmental Biology and Immunology		5	5	25	75	100
9	-	Core	VIII	General Microbiology		5	4	25	75	100
10	-	Core	IX-P	Practical CC - VI to VIII		5	4	40	60	100
11	-	CBE	I	Aquaculture		5	3	25	75	100
12	-	NME	I	Applied Plant Biotechnology / Immunology (For Botany Students)		3	2	25	75	100
13	-	SEC	II	Poultry Farming		2	2	25	75	100
TOTAL						30	25	190	510	700
III SEMESTER										
14	-	Core	X	Molecular Genetics		6	5	25	75	100
15	-	Core	XI	Basic and Applied Biotechnology		5	4	25	75	100
16	-	Core	XII - P	Practical CC - X and XI		5	4	40	60	100
17	-	CBE	II	Economic Entomology		4	4	25	75	100
18	-	CBE	III	Biostatistics and Bioinformatics		5	3	25	75	100
19	-	NME	II	Plant Physiology / Human Physiology (For Botany Students)		3	2	25	75	100
20	-	SEC	III	Medical Laboratory techniques		2	2	25	75	100
TOTAL						30	23	190	510	700
IV SEMESTER										
21	-	Core	XIII	Animal Physiology		6	4	25	75	100
22	-	Core	XIV-P	Practical CC- XIII		5	4	40	60	100
23	-	CBE	IV	Research Methodology and Publication Ethics		5	3	25	75	100
24	-	SEC	IV	Biocomposting		2	2	25	75	100
25	-	EA		Extension Activity		-	1	25	75	100
26	-	Project		Project work		12	4	25	75	100
TOTAL						30	18	165	435	600
GRAND TOTAL						120	90	710	1890	2600

Semester: I **Hours:6**

Core course: I Subject Code: **Credits:5**

STRUCTURE AND FUNCTION OF INVERTEBRATES AND VERTEBRATES

Course Objectives:

The learner will be able to

1. Understand the functional organization of invertebrates,
2. Study the affinities of minor phyla and affinities of prochordates.
3. Know the major classification of chordates.
4. Understand the functional modifications of different organs of chordates.
5. Infer the evolutionary importance of fossil animals.

Pre-requisite:		
Students should know the taxonomical classification of invertebrate animals in relation to their functional morphology.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to**:**		
1.	Remember the general concepts and major groups in animal classification, origin, structure, functions and distribution of life in all its forms.	**K1 & K2**
2.	Understand the evolutionary process. All are linked in a sequence of life patterns.	**K2 & K4**
3.	Apply this for pre-professional work in agriculture and conservation of life forms.	**K3 & K5**
4.	Analyze what lies beyond our present knowledge of life process.	**K4 & K6**
5.	Evaluate and to create the perfect phylogenetic relationship in classification.	**K5 & K6**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

UNIT-I

Evolutionary Tree- Levels of organization -Symmetry Organization: – Asymmetry, radial, andbilateral- Significance. Coelom: - Acoelomate, Pseudocoelomate and True coelomate – Locomotory organelles and locomotion in Annelids, Molluscs and Echinoderms. Nutrition in Polycheates and Prochordates. Respiration and Circulation in Arthropods and Molluscs.

UNIT-II

Structure and functions of different types of Excretory organs in Invertebrates (Annelids to echinoderms)- Types of nervous system: - Primitive types in Coelentrates and Advanced types in Annelids, Arthropods and Molluscs. Metamorphosis in Crustacean and Insects.

UNIT-III

Patterns of reproduction in invertebrates- larval forms and their significance- Phylogenicimportance of fossils - Trilobites, Ammonoids, Belemnoids, Nautiloids and Echinoderms. Minor phyla: Organization and affinities with Chetognatha, Rotifera, Sipunculida and Phoronida.

UNIT-IV

Major classification of Chordates (upto order) - Rules of Nomenclature- Principle characteristics of Prochordates- Affinities of Prochordates- Exoskeletal structures and their modifications in Fishes and Reptiles- Alimentary canal and associated glands. Gill and Cutaneous respiration in Fishes and Amphibia- Pulmonary respiration in Tetrapods.

UNIT-V

Types and evolution of heart and aortic arches- Types and evolution of Kidneys- Brain and spinal cord- Cranial nerves-visceral nerves- Autonomic nervous system and Sympathetic – Parasympathetic- Reproductive systems and Accessory glands. Vertebrate fossils: - Ostracoderms, Placoderms, Crossopterygians, Labyrinthodonts, Dinosaurs, Archaeopteryx andMesozoic animals.

UNIT-VI Self-study : Questions are not to be framed from this unit

1. Feeding, excretion and reproduction methods of different invertebrates.
https://r.search.yahoo.com/_ylt=AwrxyMwBHFli7xMAZAC7HAx.;_ylu=Y29sbwNzZzMEcG9zAzEEdnRpZAMEc2VjA3Ny/RV=2/RE=1650035842/RO=10/RU=https%3a%2f%2fwww.notesonzoology.com%2finvertebrates%2ffeeding-and- digestion-in-invertebrates-zoology%2f1981/RK=2/RS=dhSNzZjzre0izJ2P4dC.jFSLwcQ-

2. Significance of various larval forms of invertebrates.
https://r.search.yahoo.com/_ylt=Awrxysx7HFlikCEAlwm7HAx.;_ylu=Y29sbwNzZzMEcG9zAzIEdnRpZAMEc2VjA3Ny/ RV=2/RE=1650035964/RO=10/RU=https%3a%2f%2fwww.biologydiscussion.com%2finvertebrate-zoology%2farthropoda%2flarval-forms-found-in-crustacea-invertebrate-zoology%2f27738/RK=2/RS=GfiJ7NTF5SZG1e6u.zQZwp_SJek-

3. Evolutionary significance of fossils.
https://r.search.yahoo.com/_ylt=AwrxzMy6HllicngAAQ27HAx.;_ylu=Y29sbwNzZzMEcG9zAzMEdnRpZAMEc2VjA3Ny/ RV=2/RE=1650036538/RO=10/RU=https%3a%2f%2fourplnt.com%2fsignificance-fossils-revealing-evolution%2f/RK=2/RS=JJ9E.2Z6y9LcPnJwiNtzMkXs9kU-

Text Books:

1. Barners, R.D. 1982. Invertebrate Zoology, IV Ed,m Holt Saunders International Edition.
2. Barrington, EJW. 1979. Invertebrate structure and functions, II Ed., ELBS and Nelson.
3. Moore, R.C., Lolicker and Fischer, A.G. 1952. Invertebrate Paleontology, McGraw HillBook Co., Inc., N.Y.
4. E.L.Jordan and P.S. Verma 2006. Chordate Zoology. S.Chand& Company, New Delhi.
5. Waterman, A.J. 1971. Chordate structure and function, The Macmillan Company.

References:

1. Highnam K.C. and Hill, L. 1979. The Comparative Endocrinology of Invertebrates, ELBS& Edward Arnold (Publishers) Ltd.,London.
2. Hyman, L.H. 1967. The Invertebrates, Vol. I to VI, Mc Graw Hill Book Co., Inc., N.Y. 3.Kotpal, R.L, 2006. Minor phyla, 5th Edition, Rastogi Publications, Meerut.
3. Colbert, H. Edwin 1989. Evolution of the Vertebrates, II Ed., Wiley Eastern Limited, NewDelhi.
4. Harry Pough, John B. Heisher, William N. Mc Farland 1990. Vertebrate Lfe, MacmillanPublishing Co., N.Y.
5. Jollie, M. 1962. Chordate Morphology,Reinholt Publishing Corporation, N.Y.
6. Kent, G.C. 1976. Comparative anatomy of the Vertebrates Mc Graw Hill Book Co., Inc.,N.Y.
7. Welchert, C, K. 1965. Anatomy of the Chordates, Mc Graw Hill Book Co., Inc., N.Y.

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	M	S	L	S	M	S	M	M
CO2	S	S	L	S	S	S	M	M	M	S
CO3	M	M	M	S	M	S	S	S	S	L
CO4	S	M	S	M	S	M	S	S	S	M
CO5	M	S	S	M	M	S	M	L	S	M

*S - Strong; M - Medium; L-Low

Semester: I Subject Code: **Hours:6**
Core course: II **Credits:5**

MOLECULES AND THEIR INTERACTION RELEVANT TO BIOLOGY

Course Objectives:
The main objectives of this course are:

1. Students should know the fundamentals of biochemistry

Pre-requisite:
Understanding fundamental properties of elements, atoms, molecules, chemical bonds, linkages and structure, composition, metabolism and functions of biomolecules.

Expected Course Outcome:
On the successful completion of the course, student will be able to:

I	Learn the structure, properties, metabolism and bioenergetics of biomolecules	**K1 & K3**
II	Acquire knowledge on various classes and major types of enzymes, classification, their mechanism of action and regulation	**K1 & K2**
III	Understand the fundamentals of biophysical chemistry and biochemistry, importance and applications of methods in conforming the structure of biopolymers	**K2 & K3**
IV	Comprehend the structural organization of and proteins, carbohydrates, nucleic acids and lipids	**K2 & K4**
V	Familiarize the use of methods for the identification, characterization and conformation of biopolymer structures	**K5 & K6**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Units

I	Basics of biophysical chemistry and biochemistry: Structure of atoms, molecules and chemical bonds - Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).
II	Biomolecular interactions and their properties: Stabilizing interactions (Vander Waals, electrostatic, hydrogen bonding, hydrophobic interaction etc. - Composition, structure, metabolism and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).
III	Bioenergetics and enzymology: Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers - Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isoenzymes
IV	Structural conformation of proteins and nucleic acids: Conformation of proteins (Ramachandran plot, secondary, tertiary and quaternary structure; domains; motifs and folds) - Conformation of nucleic acids (A-, B-, Z-DNA), t-RNA, micro-RNA).
V	Stabilizing interactions in biomolecules: Stability of protein and nucleic acid structures - hydrogen bonding, covalent bonding, hydrophobic interactions and disulfide linkage.

Reading list

1. Berg, J. M., J. L. Tymoczko and L. Stryer 2002. Biochemistry. 5th Ed., W.H. Freeman & Co., New York, pp-1050.
2. Kuchel P.W. and G. B. Ralston. 2008. Biochemistry. McGraw Hill (India) Private Limited, UP, pp-580.
3. McKee T. and J. R. McKee. 2012. Biochemistry: The Molecular Basis of Life. (7th Edition). Oxford University Press, US, pp-793.
4. Nelson D.L. and M.M. Cox. 2012. Lehninger's Principles of Biochemistry. (6th Edition). W. H. Freeman Publishers, New York, pp-1158.
5. Satyanarayana U. and U. Chakrapani, 2006. Biochemistry. (3rd Edition). Books and Allied (P) Ltd. Calcutta, pp-695.

Recommended texts

1. Buchanan, B.B., W. Gruissem and R.L. Jones. 2015. Biochemistry and Molecular Biology of Plants. John Wiley and Sons Ltd., UK, pp-1280.
2. Murray, R.K., D.K. Granner, P.A. Mayes and V.W. Rodwell. 2003. Harper's Illustrated Biochemistry (26th Edition), The McGraw-Hill Companies, Inc., USA, pp-704.
3. Palmer, T. 2004. Enzymes. Affiliated East-West Press Pvt. Ltd., New Delhi, pp-416.
4. Voet D. and J.G. Voet. 2011. Biochemistry. (4th Edition). John Wiley & Sons (Asia) Pvt. Ltd., pp-1428.

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	M	S	L	S	M	S	M	M
CO2	S	S	L	S	S	S	M	M	M	S
CO3	M	M	M	S	M	S	S	S	S	L
CO4	S	M	S	M	S	M	S	S	S	M
CO5	M	S	S	M	M	S	M	L	S	M

*S - Strong; M - Medium; L-Low

Semester: I Subject Code: **Hours:5**

Core course: III **Credits:4**

EVOLUTION

Course Objectives:

The main objectives of this course are:

1. To critically analyze the concepts of evolution in order to
2. Understand the factors responsible for origin and generation of diversity among living beings and
3. To develop strategies for sustenance of life on this planet
4. To critically analyze the concepts of evolution in order to

Pre-requisite:

Students shall have basic knowledge on the diversity of animals, biology including morphological, anatomical, physiological and embryological features of various phyla and their environment.

Expected Course Outcome:

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

1.	To understand the concept of evolution. It provides a comprehensive account of evidences to support concept of evolution and different theories for exploring the mechanism of evolution.	**K1 & K3**
2.	Study the origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.	**K1 & K2**
3.	Understand the major events in the evolutionary time scale; Origins of unicellular and multi-cellular organisms.	**K2 & K3**
4.	Comprehend the origin of new genes and proteins; Gene duplication and divergence.	**K2 & K4**
5.	Appreciate the concepts and rate of change in gene frequency through natural selection, migration and random genetic drift	**K4 & K5**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Units

I	Emergence of evolutionary thoughts: Lamarck and Darwin – concepts of variation, adaptation, struggle, fitness and natural selection – Mendelism - Spontaneity of mutations - The evolutionary synthesis
II	Origin of cells and unicellular evolution: Origin of basic biological molecules - Abiotic synthesis of organic monomers and polymers - Concept of Oparin and Haldane - Experiment of Miller (1953) - The first cell - Evolution of prokaryotes - Origin of eukaryotic cells - Evolution of unicellular eukaryotes - Anaerobic metabolism, photosynthesis and aerobic metabolism
III	Paleontology and evolutionary history: The evolutionary time scale - Eras, periods and epoch - Major events in the evolutionary time scale - Origins of unicellular and multi cellular organisms - Stages in primitive evolution including *Homo sapiens*
IV	Molecular evolution: Molecular divergence - Molecular tools in phylogeny, classification and identification - Protein and nucleotide sequence analysis - Origin of new genes and proteins - Gene duplication and divergence

V	The mechanisms: Population genetics - Populations, Gene pool, Gene frequency - Hardy-Weinberg Law - concepts and rate of change in gene frequency through natural selection, migration and random genetic drift - Adaptive radiation - Isolating mechanisms – Speciation - Allopatricity and Sympatricity - Convergent evolution - Sexual selection - Co-evolution - Altruism and evolution

Reading list

1. Bergstrom, C. T. and L. A. Dugatkin. 2012. Evolution, Second MEDIA Edition. W.W. Norton & Company, International Student Edition, pp-756.
2. Jobling, M., E. Hollox, M. Hurles, T. Kivisild and C. T. Tyler Smith. 2014. Human Evolutionary Genetics. Second Edition. Garland Sciences, London, pp-650.
3. Veer Bala Rostogi, 2018. Organic Evolution (Evolutionary Biology), Thirteenth Edition Vinoth Kumar Jain, Scientific International (Pvt.) Ltd, New Delhi, pp-590.
4. https://www.flipkart.com/books/evolution~contributor/pr?sid=bks
5. http://www.evolution-textbook.org/
6. https://onlinelibrary.wiley.com/journal/15585646
7. http://darwin-online.org.uk/

Recommended texts

1. Strickberger. M. W. 2000. Evolution. Third Edition, Jones Bartlett Publishers, pp-722.
2. Hall B. K. and B. Hallgrimsson. 2014. Strickberger's Evolution. Fifth Edition, Bartlett Learning, An Ascend Learning Company, pp-642.
3. Barton, N.H., D. Briggs, J.A. Eisen David, D.B. Goldstein and N.H. Patel. 2007. Evolution. Cold Spring Harbor Laboratory Press, pp-833.

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	M	S	M	L	S	M	L	M
CO2	S	S	L	S	S	L	S	S	S	S
CO3	S	M	S	S	S	S	S	L	L	M
CO4	S	S	S	S	S	M	S	S	S	L
CO5	S	S	S	M	M	S	S	L	L	M

*S - Strong; M - Medium; L - Low

Semester: I Subject Code: **Hours: 5**
Core Course: IV **Credits: 4**

ECOLOGY

Course Objectives

The learner will be able to

1. Provide a fundamental knowledge of the environment.
2. Know the basics of ecological interactions.
3. Study the structure of a community.
4. Learn ecological energetics.
5. Create awareness on environmental management.

Pre-requisite:

Students should know about the fundamentals and studied the ecology of living organisms.

Expected Course Outcome:

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

1.	Learn about the ecosystem, biotic communities and utilizing the energy processing	**K2**
2.	Study the various community and population and population control	**K2 & K3**
3.	Understand the fundamentals of climatic conditions and its impact on environment	**K2 & K6**
4.	Realizing the nature of pollution and the ways for its control/reduction	**K4 & K5**
5.	Impact of environmental studies on solid waste management	**K2 & K6**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

UNIT- I

Ecology and Environment: Ecology: Scope – Concepts of ecology – Biome – Environment: Atmosphere: Composition and structure- Physical effects of wind- Hydrosphere: Effects on living organisms - Lithosphere: Soil profile and soil organisms. Biological effects of temperature and light –Thermocline – Ecological adaptations in animals: Aquatic – Amphibious and Terrestrial (Mesocoeles,Xerocoeles) conditions. Liebig's law of the minimum- Shelford's law of tolerance.

UNIT- II

Ecosystem and Ecological Interactions: Ecosystem: Components - Producer, Consumer, Decomposer, Transformer - Trophic levels. Ecosystem dynamics: Food chain - Food web - Ecological pyramids of number, biomass and energy - Productivity. Ecological interactions: Relationship among organisms -Positive interactions: Mutualism – Commensalism – Photo cooperation. Negative interactions: Exploitation – Antibiosis – Competition- Intraspecific and Interspecific – Gause's principle – Microclimate.

UNIT- III

Community Ecology: Community: Characteristics, composition and structure - Ecotone - Edge effect - Ecological niche: Spatial, Trophic and Multifactor niche - Ecological succession: Types of succession- Process of succession in hydrosere and lithosere. Population ecology: Population size and Density, Natality, Mortality – Growth and mortality curves, Regulation ofPopulation Size-Emigration, Immigration and Migration.

UNIT- IV

Ecological Energetics and Nutrient Cycling: Energy flow in an ecosystem: Single – channelenergy model and Y-shaped energy flow model -Nutrient cycles in ecosystems: Salient features

-Atmospheric cycles: Hydrological and Carbon cycles -Edaphic nutrient cycles: Nitrogen cycle, Cycles of mineral elements and micronutrients.

UNIT -V

Environmental Monitoring: Types of monitoring - Biological indicators of pollution – Biological monitoring programme – Environmental Impact Assessment - Role of microbes in soil reclamation-Principles of Remote Sensing and Geographical Information System **(**GIS) and its applications in Environmental Monitoring– Environmental management.

UNIT-VI: Self Study: Questions are not to be framed from this unit

1. Biogeography – https://www.britannica.com/science/biogeography#:~:text=biogeography%2C%20the%20study%20of%20the,responsible%20for%20variations%20in%20distribution.
2. Role of ecosystem in the environment – https://www.vedantu.com/biology/importance-of-ecosystem
3. Ecosystem modeling – https://en.wikipedia.org/wiki/Ecosystem_model
4. Indian environmental scenario – https://www.routledge.com/Environmental-Scenario-in-India-Successes-and-Predicaments/Mukherjee-Chakraborty/p/book/9780415705165
5. Agencies ofenvironmentalconservation- https://www.slideshare.net/sana1718/agencies-of-environmental-protection

Text Books

1. Sharma, P.D.2009. Ecology and Environment. Rastogi Publications.
2. Odum.P. 1985. Fundamentals of Ecology. Toppan Company.

Reference

1. Krishnan Kannan. 1997. Fundamentals of Environmental Pollution. Chand & Co.
2. Arumugam, N. 1983. Concepts of Ecology. Saras publications.

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	M	S	M	S	S	M	S
CO2	S	S	M	M	L	S	S	S	M	M
CO3	S	M	M	L	M	S	L	L	S	L
CO4	M	M	S	S	M	L	L	S	S	S
CO5	M	S	S	M	S	M	L	M	L	S

*S - Strong; M - Medium; L – Low

Semester: I

Subject Code:

Hours: 6

Core Course: V - P

Credits: 4

PRACTICAL - I (CC- I to IV)

LAB IN STRUCTURE AND FUNCTION OF INVERTEBRATES AND VERTEBRATES, EVOLUTION, ECOLOGY AND BIOCHEMISTRY

Course objectives:

The learner will be able to

1. Dissect various invertebrate and vertebrate specimens.
2. Relate the structure and classification of invertebrates and chordates.
3. Estimate various minerals present in different water samples.
4. Analyze and quantify various biochemical components of tissue and biological samples.

Pre-requisite:

Basic knowledge on the animals living in different habitats

Expected Course Outcome:

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

1.	Understand the structure and functions of various systems in animals	**K2 & K4**
2.	Learn the adaptive features of different groups of animals	**K1 & K2**
3.	Learn the mounting techniques	**K2 & K3**
4.	Acquire strong knowledge on the animal skeletal system	**K2 & K4**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Biology of Invertebrates and ChordatesDissection :

Prawn - Nervous system

Cockroach - Nervous system and Digestive system

Mountings : Nereis - Parapodium

Honey bee - Sting

Prawn - Appendages

Scales of Fishes

Specimens: Protozoa: *Amoeba proteus, Euglena,* **Porifera**: *Scypha* (Sycon), *Leucosolenia* **Coelenterata**: *Aurelia, Gorgonea* (Sea fan), **Platyhelminthes:** *Fasciola hepatica, Taenia solium.* **Annelida**: *Nereis, Cheatopterus,* **Arthropoda**: *Macrobrachium malcomsoni, Penaeus monodon, Lepisma* (Silver fish), *Periplanata americana, Apis indica* – Queen, Drone and Worker. **Mollusca**: *Pila globosa, Sepia.* **Echinodermata**: *Asteriasrubens* (Star fish), *Antedon* (Sealilly). **Hemichordata:** *Balanoglosus*. **Urochordata**: *Ascidia*. **Cephalochordata**: *Branchiostoma*. **Chordata - Chondrichthyes:** *Scoliodon sorrakowah, Pristis* (Saw fish). **Osteichthyes**: *Exocoetus* (Flying Fish). **Actinopterygii**: *Hippocampus* (Sea hourse), **Amphibia**: *Ambystoma*

(Tiger salamander), *Ichthyophis*, *Hyla* (Tree frog), *Rana hexadactyla*, **Reptiles**: *Chelonia mydas* (Green turtle), *Hemidactylus* (Wall lizard), *Najanaja.* (Cobra). **Aves**: *Columba livia*(Pigeon) and *Psittacula* (Parrot). **Mammals**: *Pteropus* (Fruit Bat), *Manis* (Ant eater), *Rattus rattus*.

Larval forms: Ephyra larva, Miracidium larva, Cercaria larva, Zoea larva, Bipinnaria larva and Axolotl larva. Tornaria larva.

Biochemistry:

1. Preparation of solutions: i) Molarity ii) Normality iii) Percentage solution (Demo)
2. Quantitative estimation of reducing sugars by Anthrone method.
3. Quantitative estimation of protein by Lowry *et al.* method.
4. Estimation of blood glucose level (GOD kit).
5. Estimation of blood cholesterol
6. Estimation of blood urea (DAM method) using commercially available kits
7. Separation of amino acids by Paper chromatography.

Spotters: ATP model, Hb model,

Environmental Biology

1. Estimations of Nitrites,
2. Estimations of Silicates,
3. Estimations of Phosphates
4. Estimation of Dissolved oxygen.
5. Estimation of Salinity,
6. Estimation of Alkalinity,
7. Estimation of Carbonates and Bicarbonates.
8. Estimations of Calcium in water samples.
9. Analysis of industrial effluent for TS, TDS, TSS.
10. Estimation of biological oxygen demand.
11. Calculation of net primary productivity of a pond.
12. Estimation of species using quadrate method.

Spotters: Environmental Biology

Food Chain, Food Web, Ecological pyramids, Wind Energy, Demography, Pollution (Air,water and soil)

Reference:

1. Rajan and Selvi Christy, 2012.Experimental Procedures in Life Sciences, Anjanaa BookHouse, Chennai.
2. Verma and Srivastava, 2018.Advanced Practical Zoology. S Chand and Company Limited,New Delhi.
3. Sinha, Chatterjee and Chattopadhyay. 2015.Advanced Practical Zoology Books and Allied (p) Ltd, Kolkata.
4. Hoar, W.S. 1968. General and Comparative Physiology, Prentice Hall.
5. Verma, P.S. Agarwal, V.K. and Tyagi, B.S. 1980. Chordate Embryology, S.Chand andCompany Ltd. New Delhi.
6. Welchert, C, K .1965. Anatomy of the Chordates, Mc Graw Hill Book Co., Inc., N.Y
7. Barrington, EJW. 1979. Invertebrate structure and functions, II Ed., ELBS and Nelson

***Practical record to be submitted during Practical Examination**

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	M	S	S	M	S	M	S
CO2	S	M	L	S	M	S	M	M	M	M
CO3	M	M	L	S	L	S	M	L	M	M
CO4	S	S	L	S	L	S	M	L	M	L
CO5	S	S	M	L	M	S	M	S	M	M

*S - Strong; M - Medium; L - Low

Semester: I **Hours:2**
SEC: I Subject Code: **Credits:2**

SERICULTURE

Course Objectives:

The main objectives of this course are:

1. Students should know basic concepts and techniques in Sericulture.

Pre-requisite:

Students should be aware of economic and cultural importance of sericulture.

Expected Course Outcome:

Upon completion of this course, Students would have

I	To understand the various practices in sericulture. To know the needs for sericulture and the status of India in global market.	**K2 & K3**
II	Able to apply the techniques and practices needed for sericulture.	**K1, K2 & K3**
III	To know the difficulties in sericulture and be able to propose plans against it.	**K5 & K6**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Units

I	Introduction to textile fibers; types- natural and synthetic fibers; sources of silk fiber- Tasar, Muga, Anaphe, Gonometa, Fagara, spider and mussel; properties and importance of silk fiber. History, development, status, characteristics and advantages of sericulture in India.
II	Host plants; Moriculture- distribution, morphology, propagation- seedling, cutting, grafting, layering and micropropagation methods, maintenance- irrigation, manuring and pruning, pests and diseases of mulberry.
III	*Bombyx mori*- morphology, anatomy, life cycle, geographical locations, larval moults, voltinism, indigenous and commercial races. Diapause. Egg-storage and transportation.
IV	*Bombyx mori*- morphology, anatomy, life cycle, geographical locations, larval moults, voltinism, indigenous and commercial races. Diapause. Egg-storage and transportation. Rearing houses and equipment. Rearing operations- disinfection, brushing, feeding and spacing. Moulting and spinning. Harvest. Rearing methods- chawki, lasso, showa, shelf-rearing, floor-rearing and shoot rearing. Diseases of *Bombyx mori*- protozoan, bacterial, viral and fungal. Pests of silkworm- Uzi fly, desmestids, mites, ants, nematodes, aves and mammals.
V	Physical and commercial characteristics of cocoons. Cocoon harvesting and marketing. Cocoon sorting, stifling, deflossing, riddling, cooking, brushing, reeling and re-reeling. Weaving. By-products of sericulture industry.

Reading list

1. G. Ganga and J. Sulochana Chetty. 2019. An introduction to sericulture, 2nd edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. M. Johnson and M. Kesary. 2019. Sericulture, Saras publication, Tamilnadu.
3. Singh, Amardev & Ravinder Kumar. 2013. Sericulture handbook Vol 1, Biotech.
4. M. Madan Mohan Rao. An Introduction to Sericulture, 2nd edition, BS Publications.

Recommended websites

1. https://agritech.tnau.ac.in/sericulture/
2. https://csb.gov.in/

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	L	L	L	L	L	M	S	L	L
CO2	L	M	L	M	L	M	M	S	M	L
CO3	M	S	L	L	L	M	L	L	M	S
CO4	M	S	M	S	M	M	L	L	S	S
CO5	M	M	L	M	M	L	L	L	L	M

*S - Strong; M - Medium; L- Low

Semester: II Subject Code: **Hours: 5**
Core Course: VI **Credits: 5**

CELL BIOLOGY AND CYTOTECHNIQUES

Course objectives:

1. To understand the ultrastructures and functions of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.
2. To realize involvement of various cellular components in accomplishing cell division.
3. To enable a successful performance in cell biology component of CSIR-UGC NET.
4. To understand the ultrastructures and functions of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.

Pre-requisite:

Students should have knowledge of the basic cellular structures and their salient functions in prokaryotic and eukaryotic cells.

Expected Course Outcome:

Upon completion of this course, students could

1.	Understand the general concepts of cell and molecular biology.	**K2**
2.	Visualize the basic molecular processes in prokaryotic and eukaryotic cells, especially relevance of molecular and cellular structures influencing functional features.	**K1 & K2**
3.	Perceive the importance of physical and chemical signals at the molecular level resulting in modulation of response of cellular responses.	**K3 & K4**
4.	Updated the knowledge on the rapid advances in cell and molecular biology for a better understanding of onset of various diseases including cancer.	**K5**
5.	Understand the general concepts of cell.	**K2**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

UNIT I

Introduction – Structure of prokaryotic and eukaryotic cell. Cell Theory; **Plasma Membrane:** ultra-structure and molecular organization – models of membrane structure - Properties. Intracellular junctions - tight junctions, gap junctions, plasmodesmata, desmosomes and hemidesmosomes. Cell adhesion molecules. Functions of plasma membrane. Cytoplasm: molecular composition.

UNIT II

Cytoskeleton: Microtubules - Structure, composition and dynamics. Microfilaments - Actin and Intermediate filaments. **Endoplasmic Reticulum:** ultrastructure, composition, types, origin and functions. **Golgi Complex:** ultrastructure, composition, types, origin and functions.

UNIT III

Mitochondria: Ultra Structural organization and functions –oxidation of carbohydrates – glycolysis, oxidative decarboxylation, Krebs cycle, respiratory chain and oxidative phosphorylation; adenosine triphosphate (ATP); β-oxidation of fatty acids; oxidation of proteins and other functions. **Ribosomes:** Structure, composition, types, functions and biogenesis. **Lysosome:** origin, composition, kinds and functions.

UNIT IV

Nucleus: Ultra structure of interphase nucleus - Chromonema cycle. Nuclear envelope – pore complex - functions. Nuclear matrix and nuclear proteins, Nucleosome ultra-structure and functions. **Nucleolus**: structure and its biogenesis. **Chromosomes:** ultra-structure, composition, types and functions. Giant chromosomes - Polytene and Lamp-brush chromosomes. Cell division and cell cycle. Cancer- Causes, diagnosis and treatment. Apoptosis. Roll of free radicals in ageing.

UNIT V

Cytotechniques: Concepts and methods of fixation, sectioning and staining of tissues for **Light microscopy**- **Electron microscopy**- Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM). **Cell Fractionation**- Analytical ultracentrifuge, Preparative ultracentrifuge and Density gradient centrifuge; **Chromatography**- Thin layer chromatography and Column chromatography, HPLC; **Autoradiography; Micrometry.**

UNIT VI- Self Study: Questions are not to be framed from this unit

1.Membrane function:

http://www.life.illinois.edu/biochem/455/Lab%20exercises/4Erythrocyte_Membranes/Cell

Membra neFeatures.pdf

2. Peroxisomes and Glyoxysomes:

https://www.semanticscholar.org/paper/Microbodies%3A-peroxisomes-and-

glyoxysomes-Tolbert-ssner/85fc06ac9442ebe8caef48b46625fb984bd7506f

3. Cell signalling: https://www.wiley-vch.de/books/sample/3527313974_c01.pdf

4. Centrioles and Basal Bodies:https://thebiologynotes.com/centrioles-and-basal-bodies/

5. Cilia and Flagella: https://microbenotes.com/cilia-and-flagella-structure-and-functions/

Text Books:

1. Gupta P.K. 2005. Cell and Molecular Biology, Rastogi Publications, India.

2. Verma P.S. and V.K. Agarwal. 2005. Cell Biology, Himalaya Publishing House, Bombay.

References:

1. De Robertis, E.D.P and E.M.F. De Robertis. 1998. Cell and Molecular Biology. 8thEdn. HongKong.
2. Gerald Karp, 1996. Cell and Molecular Biology, John Wiley and sons, USA.
3. Powar, C.B. 1997. Cell Biology. Himalaya Publishing House, Bombay.
4. Ajoy Paul, 1960. Cell and Molecular Biology, India.
5. Kuttikan, A.M. 1987.Cell Biology. Fourth Edition. JAC Publications, Kanyakumari.

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	L	L	L	L	S	S	S	M	M	M
CO2	M	M	M	S	S	S	S	M	S	M
CO3	S	S	S	M	M	S	M	M	L	S
CO4	M	M	S	L	S	S	L	M	S	S
CO5	S	M	M	S	S	S	S	M	S	S

*S - Strong; M - Medium; L - Low

Semester: II Subject Code: **Hours: 5**
Core Course: VII **Credits: 5**

DEVELOPMENTAL BIOLOGY AND IMMUNOLOGY

Course Objectives:

The learner will be able to

1. Provide a fundamental knowledge of the gametogenesis, fertilization and cleavage.
2. Gain knowledge about organogenesis, organizer and regeneration.
3. Know the types of immunity, immune cells and structure of antigen and antibody its reactions.
4. Analyze the immune response, process of vaccination and MHC.
5. Know the process of hypersensitivity, transplantation and tumour immunology.

Expected Course Outcome:

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

1.	Define the concepts of embryonic development	**K1**
2.	Observe various stages of cell divisions under microscope	**K2 & K3**
3.	Understand the formation of zygote	**K4**
4.	Differentiate the blastula and gastrula stages	**K4 & K5**
5.	Learn the distinguishing features of three different germ layers and formation of various tissues and organs	**K4**
6.	Various basic concepts in immunology and organization of immune systems.	**K2**
7.	Mechanisms of immune response in health and their defects in various diseases.	**K2 & K4**
8.	The application of immunological principles in biomedical sciences including blood transfusion, tissue grafting and organ transplantation.	**K3 & K5**

UNIT-I

Structure of Sperm and Egg:**Gametogenesis:** Spermatogenesis – Oogenesis – hormonal control of Oogenesis. **Fertilization:** Physical and chemical factors involved in fertilization – Activation – Theories of activation – Significance of fertilization- **Cleavage:** Mechanism of cleavage – Plane and patterns of cleavage – Holoblastic and meroblastic cleavage. Amphibian blastulation and gastrulation. Morphogenetic movements. – Fatemap of frog.

UNIT-II

Organogenesis – Ectoderm- formation of central nervous system- Neurulation- Neural tube, Neural crest and development of brain- developmentof eye. Mesoderm - development of heart and kidney: Endoderm- development of digestive systems in frog. **Organiser** – Spemann and Mangold experiment – Neural induction – Theories of induction. **Regeneration:** Stimulus and suppression of regeneration. Types of regeneration - Plannaria – amphibian regeneration. Formation of extra embryonic membranes in Chick. Placentation in Mammals.

UNIT III

Introduction to immune system. Natural and Acquired immunity and responses – Lymphoid system: Primary and secondary lymphoid organs, tissues. **Cells of immune system**: lymphoid lineage, myeloid lineage. **Molecules**- complements, acute phase proteins, interferon, lymphokines and cytokines. **Antigens:** Types of antigens – super antigen –properties of antigen (antigenicity). T cell and Bcell epitopes, haptens, adjuvants and carriers. **Antibodies**: Ultra structure of immunoglobulin,types, paratopes, characteristics and functions.

UNIT IV

Immune response- Humoral and cell mediated immune response – cell mediated effectors functions. Primary and secondary immune modulation. Complement pathways -Classical, Alternate and Lectin. **Vaccines**: Principle, types - antigen as vaccines, subunit vaccines, recombinant vaccines, anti- idiotypic antibodies as vaccines-vaccination schedule for children. Immune response against bacterial (TB), parasite (Malaria), Viral (HIV and Covid) infections.

UNIT V

Major Histocompatibility Complex (MHC): Genomic organization, Classes of MHC molecules, Structure and functions of peptide binding- Ag presentation & binding in human. **Hypersensitivity:** Definition and classification; Types- I, II, III, IV and V. **Transplantation immunology:** Types of grafts- Allograft rejection- Prevention of graft rejection. **Tumour immunology:** Tumour antigens- Immune response to tumours- Immunotherapy to tumours - Tumour vaccines. Autoimmune disorders**. Immunodeficiency-** inherited and acquired.

UNIT-VI-Self-study: Questions are not to be framed from this unit

1. Test tube baby: https://www.urmc.rochester.edu/MediaLibraries/URMCMedia/fertility-center/documents/in-vitro-fertilization-consent.pdf
2. Human organogenesis https://media.medfarm.uu.se/play/attachmentfile/video/977/handouts2.pdf
3. Apoptosis: https://wou.edu/chemistry/files/2020/03/Apoptosis.pdf
4. Cutaneous associate lymphoid tissue-https://onlinelibrary.wiley.com
5. Foetus as allograft- https://onlinelibrary.wiley.com

Text books:

1. Verma, P.S. Agarwal, V.K. and Tyagi, B.S. 1980. Chordate Embryology, S.Chand andCompany Ltd. New Delhi.
2. Balinsky. B.I and Fabian B.C.2012. An introduction to Embryology, Fifth edition, CBScollege publisher.
3. Rao, C.V.2006. Immunology. Narosa Publishing House, New Delhi.
4. Kannan, I. 2007. Immunology, MJP Publishers, Chennai.
5. Arumugam, N.*et al*., 2005. Immunology and Microbiology, Saras Publications, Kanyakumari.

Reference:

1. Scott F. Gilbert, 2016. Developmental biology- 11th Edition.,. Oxford University Press,London
2. Suresh C.Goel, H.P.H Rastogi, V.B.and Jayaraj, M.S. 2002. Principles of AnimalDevelopmental Biology
3. Berill N.J, 1992. Developmental biology, Tata McGraw Hill Publishingcompany ltd.New Delhi.
4. Twymann, R.M.2003. Developmental biology, Viva Books Private Ltd. New Delhi.
5. Arora, M.P. 1992. Embryology, Himalaya Publishing House, New Delhi.
6. Berry, A.K.2013. An introduction to Embryology, EMKAY Publications, New Delhi.
7. J anis Kuby. 1997.Immunology. W.H. Freeman& company, New York.
8. Ivan M. Roitt*et al*., 2011. Essential Immunology. XII Edition, Wiley- BlackwellPublishers.UK.
9. Shetty, N. 2006. Immunology. New Age International (P) Limited, Publishers. New Delhi.

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	L	S	M	L	M
CO2	S	S	S	S	S	L	S	S	S	S
CO3	S	M	S	S	S	S	S	L	L	M
CO4	S	S	S	S	S	M	S	S	S	L
CO5	S	S	S	M	S	S	S	L	L	M

*S - Strong; M - Medium; L – Low

Semester: II Subject Code: **Hours: 5**
Core Course: VIII **Credits: 4**

GENERAL MICROBIOLOGY

Course objectives:

The learner will be able to

1. Familiar with the foundation concepts of history of Microbiology.
2. Understand the structure and functions of a typical prokaryotic cell.
3. Understand, learn and gain skills of isolation, culturing and maintenance of pure culture.
4. Know various Culture media and their applications.
5. Recognize conceptual basis for understanding pathogenic microorganisms and the mechanisms by which they cause disease in the human body.

Expected Course Outcome:

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

1.	Learn the techniques of studying bacterial growth curve and factors effecting growth curve.	**K1**
2.	Realize the importance of national and international microbial culture collection centres.	**K2 & K3**
3.	Know general bacteriology and microbial techniques for isolation of pure cultures ofbacteria	**K4**
4.	Understand the epidemiology of infectious agents including how infectious diseases are transmitted.	**K4 & K5**
5.	Identify microorganisms from the various water sources to check the potability of water.	**K4**

UNIT – I

History and Scope of Microbiology: Salient features of Bacteria, Virus, Actinomycetes and Fungi. Structure of *E. coli* – Reproductive methods in bacteria - recombination, Conjugation – Transformation and Transduction. Structure and reproduction of Virus (T4 phage). Distinguishing characters of Mycobacterium – Distinguishing characters of Penicillium.

UNIT – II

Bacterial growth and Nutrition: Nutritional types of Bacteria – Growth factors – Culture of microorganisms – Types of culture media – Sterilization techniques - cultural characteristics of bacteria – methods of maintenance of culture – Isolation of pure culture – Culture collection centers (India and International) — Colony morphology – Bacterial growth curve – Factors affecting bacterial growth.

UNIT – III

Microbial Ecology: Formation of different layers of soil and soil microflora – Stratification and microflora of Fresh water and Marine habitats – Water purification in municipal water supply – Microbiological analysis of water purity (MPN index, Membrane filtration, Biological Oxygen Demand) — Stratification of atmosphere – Aero microflora – Dispersal of microbes – Extremophiles –Temperature, pH and Salinity.

UNIT – IV

Food Microbiology: Sources and contamination of food - Food spoilage – Spoilage of canned foods, cereals, fruits, vegetables, meat and fish – Food poisoning – Food intoxication –

Staphylococcal poisoning and Botulism – Food infection – Salmonellosis – Mycotoxin produced by fungi – Aflatoxin in stored food and grains – Food preservation – principles of food preservation – Packing materials – Methods of food preservation – High temperature, Canning, Freezing, Dehydration, Chemical preservation and radiation – Microbial standards of food safety – Role of FAO, WHO, FDA, FSSAI and EPA.

UNIT – V

Medical Microbiology: Pathogenesis, clinical diagnosis, epidemiology and prophylactic measures of the following Bacterial diseases (Cholera and Tuberculosis) – Fungal diseases (Candidiasis and Microsporum) - Viral diseases (Dengue and chikungunya) – Protozoan diseases (Amoebiasis and Malaria) – Antibiotics -Introduction and Mechanism of Penicillin and Tetracycline. Antibiotic resistance in bacteria.

UNIT – VI – Self Study: Questions are not to be framed from this unit

1. Extra-terrestrial life- Existing life evidence in space https://r.search.yahoo.com/_ylt=Awrx1clfFllisSQAmwO7HAx.;_ylu=Y29sbwNzZzMEcG9zAzMEdnRpZAMEc2 VjA3Ny/RV=2/RE=1650034400/RO=10/RU=https%3a%2f%2fwww.livescience.com%2falien-discoveries- 2020.html/RK=2/RS=O.hpnFal3CzG869C6C_UnltjepA-
2. Control of Communicable Diseases During Epidemics & Pandemics https://r.search.yahoo.com/_ylt=AwrxyxSQF1li3SEANAu7HAx.;_ylu=Y29sbwNzZzMEcG9zAzIEdnRpZAMEc2 VjA3Ny/RV=2/RE=1650034705/RO=10/RU=https%3a%2f%2fdcps.duvalschools.org%2fcms%2flib%2fFL01903 657%2fCentricity%2fDomain%2f4440%2fAdministrative%2520Procedures%2520-%2520Control%2520of%2520Communicable%2520Diseases%2520During%2520Epidemics%2520%2520Pandemics.pdf/RK=2/RS=D1aYOE9UDsJz.HnfRviZifeyv50-
3. How oil spills affect microorganisms in the oceans https://r.search.yahoo.com/_ylt=Awrx1MmpGFliHAUAsRG7HAx.;_ylu=Y29sbwNzZzMEcG9zAzQEdnRpZAM Ec2VjA3Ny/RV=2/RE=1650034986/RO=10/RU=https%3a%2f%2fwww.nature.com%2farticles%2fnrmicro2404/ RK=2/RS=JXtT6jGNLT5PPi6ICNgEM5ds4tU-
4. Importance of microbiology in daily life. https://r.search.yahoo.com/_ylt=AwrxzhUUGlliHEAA4wC7HAx.;_ylu=Y29sbwNzZzMEcG9zAzIEdnRpZAMEc 2VjA3Ny/RV=2/RE=1650035349/RO=10/RU=https%3a%2f%2ftargetstudy.com%2farticles%2fimportance-of- microbiology.html/RK=2/RS=h_27LUR98nYykRFFW7fY1P6yBCQ-

Test Books

1. R.C. Dubey, D.U. Maheshwari, 2005. A Text book of Microbiology. S. Chand and CompanyLtd
2. P.D. Sharma. 1998. Microbiology, Rastogi Publ., Chennai, India.
3. Vijaya Ramesh, 2005. Environmental Microbiology, M.J. Publ., Chennai. India

Reference:

1. Ananthanarayana and Paniker, 2017. Text Book of Microbiology, Orient and Longman, NewDelhi.
2. Pelczar M.J., Chan E.C.S and Krieg N.R., 1993. Microbiology, McGraw Hill BookCompany, New York.

3. Atlas R.M., 1988. Microbiology – fundamentals and applications, Macmillan Publishing Company, New York.
4. Salle A.J., 1974. Fundamental Principles of Bacteriology, Tata McGraw-Hill Publishing Company Limited, New Delhi.
5. Benson Harold J, 2005. Microbiological Applications, WCB McGraw – Hill, New York
6. Brock T.D. and Madigan M.T., 2006. Biology of Microorganisms, Prentice Hall, Upper Saddle River, NJ, USA.

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	S	S	S	M	S	S	S
CO2	S	S	M	S	S	S	M	M	S	S
CO3	S	M	M	S	S	S	S	S	S	M
CO4	M	S	M	M	S	S	S	S	S	M
CO5	M	S	S	S	M	S	M	S	S	M

*S - Strong; M - Medium; L - Low

Semester: II Subject Code: **Hours: 5**
Core Course: IX-P **Credits: 4**

PRACTICAL-II (CC- VI to VIII)

LAB IN CELL BIOLOGY AND CYTOTECHNIQUES, DEVELOPMENTAL BIOLOGY AND IMMUNOLOGY AND GENERAL MICROBIOLOGY

Course Objectives:
The learner will be able to

1. To Learn the various microbiological culture techniques
2. Practical course aims at demonstrating significant cellular and biological principles, quantitative and analytical approaches that enable the students to translate the theoretical foundation in cell biology, immunology and developmental biology into practical understanding.

Pre-requisite:
Students should have acquired basic knowledge relevant to this particular lab course.

Expected Course Outcome:
Upon completion of this lab course, students

1.	Acquire knowledge to differentiate the cells of various living organisms and become awares of physiological processes of cells e.g. cell divisions, various stages of fertilization and embryo development.	**K2**
2.	Understand and observe as well as correctly identify different cell types, cellular structures using different microscopic techniques.	**K3**
3.	Develop handling - skills through the wet-lab course.	**K6**
4.	Culture microbes and identify and study its morphology.	**K1 & K2**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Cytology and Cytological Techniques

1. Micrometry – Measurement of any cell using ocular and stage micrometers.
2. Buccal Smear Preparation-Squamous epithelial cells and Barr body.
3. Blood Smear in Man-Various cell types
4. Salivary gland of Chironomous Larva-Giant Chromosomes
5. Micro techniques – Tissue fixation – processing – sectioning – spreading – staining.

Spotters: Epithelial - Simple columnar, Ciliated, Squamous and Glandular.
Muscles: Striated, Non - striated and Cardiac. Tissues - Nerve tissue,
Connective tissue, Bone tissue. Compound Microscope and Camera Lucida.

Developmental Biology

1. Mounting of Chick Blastoderm.
2. Pregnancy test using kit.
3. Observation of sperm motility in Bull semen.

Slides : 1. Frog - Egg, Cleavage, Blastula, Gastrula, Yolk plug stages.
2. Chick - Developmental stages 24, 48, 72 and 96 hours.
3. Human placenta and Uterus.

Immunology

1. WIDAL test for typhoid detection
2. Ouchterlony's Double immunodiffusion
3. Demonstration of Ig G by precipitation ring test
4. Demonstration for hemagglutination

Spottres : Lymph node, Lymphocytes, Vaccine, ELISA, RIA. Immunoglobulin Model.

General Microbiology

1. Sterilization procedures
2. Preparation of culture media
3. Serial dilution and pour plate method and determination of colony number.
4. Identification of bacteria based on colony morphology and colony counting.
5. Culture techniques: Culture inoculation, Broth culture, spread plate, Streak plate, Slant culture.
6. Identification of bacteria by Simple staining method.
7. Identification of bacteria by differential (Gram) Staining method.
8. Hanging drop preparation of Lactic acid bacteria.
9. Enumeration of microorganisms from soil.

Spotters: Petri plate, Autoclave, Bacterial colony counter, Inoculation loop,Laminar Airflow Chamber.

Reference:

1. John Davey and J. Michael Lord. 2003. Essential Cell Biology: A Practical Approach Volume 1: Cell Structure (Practical Approach Series) 1st Edition. Oxford University Press; 1 edition (August 7, 2003).
2. Sambrook, J., Russell, D. W., & Russell, D. W. (2001). Molecular cloning: a laboratory manual (3-volume set).
3. Chaitanya K.V. 2013. Cell and Molecular Biology: A Lab Manual. Prentice Hall India Learning Private Limited.
4. Gunasekaran. P. 2007.Laboratory Manual in Microbiology.Medical microbiology, New Age International.
5. Stephen A. 1990. Laboratory Manual: Microbiology Principles and Applications. Norrell Prentice Hall.
6. James G. Cappuccino. 2013.Microbiology: A Laboratory Manual-, Natalie Sherman Pearson Education.
7. Mohammed Iftekhar. 2015.Bioinformatics Practical Manual.Createspace Independent Publishing Platform.
8. Jean-Louis Lassez, Ryan Rossi, Stephen Sheel. 2016.Introduction to Bioinformatics Using Action Labs- Published by Lulu.com.
9. Jayaraman. J.1981.Laboratory Manual in Biochemistry: Published by Wiley Eastern.
10. Naren Kumar Dutta. 2005. Fundamentals of Biochemistry: A Practical Approach.
11. Henry M. Zeidan, William V. Dashek. 1996.Experimental Approaches in Biochemistry and Molecular Biology.

***A Record of laboratory work should be submitted at the time of practical examination**

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	S	S	S	S	L	L	M
CO2	S	S	S	S	S	M	M	M	M	M
CO3	S	S	M	S	S	L	S	M	L	M
CO4	M	M	L	M	L	M	M	S	M	L
CO5	S	S	M	L	S	M	L	S	S	S

*S - Strong; M - Medium; L – Low

Subject Code:

Semester: II **Hours: 5**
Core Based Elective Course: I **Credits: 3**

AQUACULTURE

Course objectives:

The learner will be able to

1. Understand the present status of aquaculture and various culture systems.
2. Analyze the culture techniques of commercially important cultivable aquatic species.
3. Know the construction and management of freshwater and marine fish pond.
4. Realize the recent commercially important cultivable specie and its technologies in aquaculture.
5. Know various organization related to aquaculture.

Pre-requisite:

Students should know the fin fishes and shell fishes of commercially important candidate species.

Expected Course Outcome:

Upon completion of this course, Students would have

I	To develop knowledge on the fish farm and their maintenance. Understand the methods of fish seed and feed production and develops knowledge on hatchery techniques	**K1 & K2**
II	To apply the knowledge about different culture methods in aquaculture and gain knowledge on fish and shrimp breeding techniques and larval culture	**K3 & K4**
III	Identifies the different fishes diseases, diagnosis and their management strategies. Understands Ornamental fishes and central aquaculture organizations	**K5 & K6**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

UNIT- I

Definition, History of Aquaculture; Concept of Blue Revolution; Present status of aquaculture in the world, India with special attention to Tamil Nadu. - **Types of Aquacultures** - Freshwater, Brackishwater and Mariculture; Monoculture, Polyculture, Composite culture, Monosex culture and Integrated fish farming. - Culture systems: Ponds, Raceways, Cages, Pens, Rafts and water recirculating systems; Culture practices: Traditional, extensive, modified extensive, semi-intensive and intensive culture of fish and shrimp.

UNIT- II

Major cultivable fish, prawn and molluscan species for aquaculture and their commercial importance. Criteria for the selection of species for culture. Breeding techniques for fish and prawn. Seed collection from natural sources- Bundh breeding-induced breeding – hypophysation - hybridization - hatchery techniques for shrimp seed production - transport of fish seed.

UNIT- III

Freshwater fish farming: Culture of Indian Major carps - Design and construction of aquafarms - Criteria for the selection of site for freshwater pond farms - Design and construction of a freshwater fish farm and hatchery. Design and construction of a freshwater prawn (*Macrobrachiumrosenbergi)* farm and hatchery. Functional classification of ponds – head pond, hatchery, nursery, rearing, production, stocking and quarantine ponds. Water quality management. Common diseases and their management in fish culture.

UNIT- IV

Marine and Brackish water fish farming: *Penaeus vannamei* (Marine) and *Lates calcarifer* (Brackish water) - pond construction - seed collection - nursery management - feeding – water quality management. Crab fattening - Culture of Seaweeds and its economic importance – Mussel farming, pearl oyster culture. Common diseases and their management in prawn culture.

UNIT- V

Recent technologies in aquaculture. Biofloc technology – Immunostimulant for aquaculture – Probiotics, symbiotic for aquaculture – Value added aquaculture products and their importance - Integrated fish farming: Paddy cum fish culture; duck cum fish culture; fish cum cattle farming. Organization related fish culture-MPEDA, CMFRI, CIBA and CIFRI and their role in fishery development.

UNIT- VI Self Study: Questions are not to be framed from this unit

1. Culture of Sea Cucumber in India: http://aquafind.com/articles/Sea-Cucumber.php
2. Culture and values of Sea Urchin: https://vikaspedia.in/agriculture/fisheries/marine-fisheries/culture-fisheries/culture-of-shell-fishes/sea-urchin-culture
3. Rotifer culture and its application: https://www.fao.org/3/x3980e/x3980e07.htm
4. Production and preservation of Artemia: http://www.ciba.res.in/Books/ciba0170.pdf
5. Cryopreservation of fish gametes: https://www.dfid.stir.ac.uk/afgrp/greylit/TR058.pdf

Text book:

1. Pillai TVR, Kutty MN. 2005. Aquaculture- Principles and Practices (II Edition).

Reference:

1. Jhingran VG, 1982. Fish and fisheries of India, Hindustan Publishing Corp-
2. Rath RK. 1993.Freshwater aquaculture, Scientific Publishers.
3. Pandey and Shukla, 2007. Fish and fisheries (II Edition), Rastogi Publishers.
4. Santhanam. P, Ramanathan. N and Jegatheesan. G, 1990. Coastal Aquaculture in India.
5. N. Arumugam, 2018. Aquaculture: Saras Publications.

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	M	S	S	S	M	M	S
CO2	S	S	S	M	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	S	S	M
CO4	S	S	M	S	S	S	S	M	M	S
CO5	S	S0	M	S0	M	S	M	L	S	S

*S-Strong; M-Medium; L-Low

SEMESTER - II
NON MAJOR ELECTIVE – I
(For I M.Sc. Zoology Students)
APPLIED PLANT BIOTECHNOLOGY

Hours: 3
Credits: 2
Code:

Course Objectives	Learning Outcomes
To understand the basic techniques of genetic engineering in plants	Learn the details of various enzymes and vectors involved in genetic engineering
To know the various techniques involved in plant tissue culture	Understand the significance of plant tissue culture
To learn the basic concepts in IPR	To understand the various components of IPR

Unit I

Plant tissue culture: Introduction, totipotency. Culture media – types, role of hormones. Callus induction, subculture. Regeneration – organogenesis and embryogenesis. Types of cultures – callus, cell suspension, protoplast. Applications of plant tissue culture.

Unit II

Agrobacterium and crown gall tumours. Mechanisms of T-DNA transfer to plants. Ti-plasmid based vectors for plant transformation – *Agrobacterium* mediated transformation.

Unit III

Genetic engineering in plants: Methods of transformation - Direct DNA transfer - Particle bombardment (biolistics), electroporation and micro injection. Selectable markers and reporter genes.

Unit IV

Application of Plant genetic Engineering: Insect resistance – Bt cotton. Golden Rice. Introduction to Biosafety and Bioethics.

Unit V

Intellectual property rights: Introduction – Types of protection: Patent, Trade mark, Copy right, Trade secret and GI. Case studies – Neem and Turmeric. The Protection of Plant Varieties and Farmer's Rights Act 2001.

Text Books

1. Slater, Scott and Fowler. 2008, Plant Biotechnology, Oxford University Press.
2. S. Ignacimuthu: Plant Biotechnology, Oxford & IBM Publishing Co., New Delhi.
3. P. Parihar. 2015. A text book of Biotechnology, Argobios Publications, Jodhpur.

Reference Books:

1. R.C. Dubey. 2015. A text book of Biotechnology, S.Chand & Co., New Delhi.
2. Chrispeels, M.J. and Sadava, D.F. 1994. Plants, Genes and Agriculture, Jones and Bartlett.
3. Primrose, S.B. 1999, Molecular Biotechnology, Panima publishing corporation, New Delhi.

Hours: 3

Non-Major Elective Course: I Subject Code: **Credits: 2**

(For I M.Sc., Botany Students)

IMMUNOLOGY

COURSE OBJECTIVES

The learner will be able to

1. Understand the history and basics about immunology.
2. Know the structure of antigen and antibody its reactions and MHC.
3. Analyze the different antigenic reaction and its impacts.
4. Know the process of hypersensitivity and tumour immunology.
5. Explains about different immunotechniques.

Expected Course Outcome:

Students would have acquired clear knowledge on

1.	Various basic concepts in immunology and organization of immune systems.	K2
2.	Mechanisms of immune response in health and their defects in various diseases.	K2 & K4
3.	The application of immunological principles in biomedical sciences including blood transfusion, tissue grafting and organ transplantation.	K3 & K5
4.	Vaccinology and its importance in disease management	K3

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

UNIT I

Introduction to Immunology, Types of immunity- Innate and acquired immunity. Active and passive immunity. Immune responses; Humoral and cell mediated immunity.

UNIT II

Lymphoid organs- primary lymphoid organs- secondary lymphoid organs- Cells of immune system; Cells of lymphoid lineage and Cells of myeloid lineage.

UNIT III

Antigen, Types of antigens, properties; Antibodies: Basic structure of immunoglobulin, types of immunoglobulin, biological properties.

UNIT IV

Auto immune diseases- Heamolytic, Pernicious anemia, Rheumatoid arthritis. Vaccines-principles and its types. Vaccination schedule-Infant, Children and pregnant mother.

UNIT V

Transplantation immunology.-Types of grafts-Mechanism of grafts rejection. Hypersensitivity reactions-immunotherapy-Immunity against infections-Tuberculosis -HIV.

UNIT-VI-SELF STUDY (Questions are not to be framed from this unit)

1. Dendritic cells and its classification- https://onlinelibrary.wiley.com
2.MHC in mice- https://onlinelibrary.wiley.com
3. IDDM –type I diabetes- https://www.chp.edu › diabetes
4.Erythroblastosis foetalis - https://www.msdmanuals.com › abnormalities - of - pregnancy
5.MLR cellular assay- https://www.proimmune.com › mixed-lymphocyte-reaction

TEXTBOOKS

1. **Fatima , D. and Arumugam N. (2001)**. Immunology , Saras Publication , Kanyakumari
2. **Kannan, I. (2007)**. Immunology, MJP publishers, Chennai.

REFERENCES

1. **Shetty , N.(2006).**Immunology, New Age International Private ltd., Publishers, New Delhi.
2. **Shastry, N.V. (2005)**. Principles of Immunology, Himalaya Publishing House, New Delhi.
3. **Rao, C.V. (2006)**. Immunology, Narosa Publishing house, New Delhi.
4. **Janis Kuby. (1997)**.Immunology.W.H.Freeman & company, New York.

Ivan M. Roitt *et al*.,(1998). Essential Immunology. XII Edition, Wiley- Blackwell Publishers.UK.

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	S	S	S	M	S	S	S
CO2	S	S	M	S	S	S	M	M	S	S
CO3	S	M	M	S	S	S	S	S	S	M
CO4	M	S	M	M	S	S	S	S	S	M
CO5	M	S	S	S	M	S	M	S	S	M

*S - Strong; M - Medium; L - Low

Semester: II Subject Code: **Hours: 2**

SEC: II **Credits: 2**

POULTRY FARMING

Course Objectives:

The main objectives of this course are:

1. Students should know basic concepts in Poultry farmings.

Pre-requisite:

Students should be aware of economic and cultural importance of Poultry farming.

Expected Course Outcome:

Upon completion of this course, Students would have

I	To understand the various practices in Poultry farming. To know the needs for Poultry farming and the status of India in global market.	**K2 & K3**
II	To be able to apply the techniques and practices needed or Poultry farming.	**K1, K2 & K3**
III	To know the difficulties in Poultry farming and be able to propose plans against it.	**K5 & K6**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Units

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

Reading list

1. Sreenivasaiah., P. V., 2015. Textbook of Poultry Science. 1st Edition. Write & Print Publications, New Delhi 2.
2. Jull A. Morley, 2007. Successful Poultry Management. 2nd Edition. Biotech Books, New Delhi"
3. Hurd M. Louis, 2003. Modern Poultry Farming. 1st Edition. International Book Distributing Company, Lucknow."
4. Life and General Insurance Management"

Recommended texts

1. Ismail, S.A., 1997. Vermitechnology, The biology of earthworms, Orient Longman, India.
2. http://www.asci-india.com/BooksPDF/Small%20Poultry%20Farmer.pdf
3.https://nsdcindia.org/sites/default/files/MC_AGR-Q4306_Small-poultry-farmer-.pdf_
4. http://ecoursesonline.iasri.res.in/course/view.php?id=335
5. https://swayam.gov.in/nd2_nou19_ag09/preview

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	L	L	L	L	L	S	S	L	L
CO2	S	L	M	M	S	M	M	M	S	S
CO3	S	M	M	M	S	S	S	S	M	M
CO4	S	S	S	L	S	S	S	S	S	S
CO5	S	S	M	S	S	S	M	L	S	M

*S - Strong; M - Medium; L – Low

Semester: III Subject Code: **Hours: 6**
Core Course: X **Credits: 5**

MOLECULAR GENETICS

Course Objectives:

The learner will be able to

1. Describe the "fundamental dogma" of genetic data transmission.
2. Explain the connection between chromosomes, genes, and DNA.
3. Differentiate between hypotheses on how DNA replication works and explain how it does.
4. Draw a diagram illustrating the processing of mRNA transcripts before to translation and explain why it occurs.
5. Show how we can be sure the "genetic code" isn't overlapping or redundant.

Pre-requisite:

Students should have knowledge of the Genetic material and their salient functions in prokaryotic and eukaryotic cells.

Expected Course Outcome:

Upon completion of this course, students could

1.	Explain the organization and functions of genetic material in the living system.	**K1 & K2**
2.	Understand various sequential processes in protein synthesis	**K1 & K2**
3.	Explicate the structures and functions of chromosomes and identify the diseases caused by the chromosomal abnormalities.	**K2 & K4**
4.	Able to distinguish lytic and lysogenic cycle and explain the mechanisms of genetic recombination of the microbes.	**K2 & K5**
5.	Understand the general concepts of cell and molecular biology.	**K2**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

UNIT-I

History of Molecular genetics. Properties and evolution of genetic material, flow of genetic information. Watson and Crick model for DNA Replication - replication units, replication origin and replication fork, fidelity of replication - Denaturation and renaturation of double helix. Semiconservative replication - The Meselson and Stahl experiment- Enzymology of DNA.

UNIT- II

Transcription - Prokaryotic RNA polymerase, sigma factors, initiation and termination. Eukaryotic RNA polymerases and their promoters. Processing of transcripts RNA synthesis in prokaryotes - RNA editing, splicing, polyadenylation. RNA synthesis and processing in Eukaryotes. Enzymatic Synthesis of RNA. Promoter, Initiation, Elongation and Termination phase, Anti-termination and attenuation.

UNIT III

Regulation of gene expression - Regulation of transcription initiation - Operon and regulation -Positive and negative regulation - Enhancers and promoters – Lac, Trp. Gene regulation in Eukaryotes. Transcription factors: types. DNA binding motifs - Regulation by attenuation and anti-termination - Post transcriptional regulation - Alternative splicing - Transport and targeting of RNA - Post-transcriptional gene silencing - Translational control and targeting of proteins - Mechanism of steroid hormone and stress induced gene expressions.

UNIT-IV

Characteristics of genetic code and Wobble Hypothesis. Protein synthesis and processing and Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination. Aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proof-reading, translational inhibitors, post- translational modification of proteins.

UNIT-V

Human molecular genetics: Pedigrees - gathering family history, pedigree symbols, construction of pedigrees, presentation of molecular genetic data in pedigrees. Techniques in human chromosome analysis - Human karyotype: banding, nomenclature of banding - Common syndromes due to structural alterations (translocations, duplications, deletions, microdeletion, fragile sites). Common chromosome abnormalities in cancer. Basics in genetics of feotal wastage - Basics of Pharmacogenetics and ecogenetics. Human genome project.

UNIT-VI Self Study: Questions are not to be framed from this unit

1. History of genetics - https://en.wikipedia.org/wiki/History_of_genetics
2. The Invention of PCR - https://bitesizebio.com/13505/the-invention-of-pcr/
3. Genetic Disorders - https://www.genome.gov/For-Patients-and-Families/Genetic-Disorders.
4. Transgenesis-https://www.sciencedirect.com/topics/medicine-and-
5. Nucleic acid hybridization (molecular hybridization) - https://www.youtube.com/watch?v=vYfzt5Wtiwg

Text book

1. A.V.S.S. Sambamurty., 2007. Molecular Genetics. I.K. International Publishing house.
2. Gupta. P.K.2003. Genetics. Rastogi Publishers. Meerut.
3. G.S. Stent and Richard Calendar., 1986. Molecular Genetics (Second edition) CBS.

References:

1. Gardner, E J. 1984. Principles of Genetics. Jhon Wiley and Sons Ltd. New York.
2. Ross C. Hardison. 2005. Working with Molecular Genetics. online textbook, Pennsylvania State University (BMB400). http://www.personal.psu.edu/faculty/r/c/rch8/workmg/workmolecgenethome.html
3. Singh BD.2006. Fundamentals of genetics. Kalyani Publishers. Lucknow.
4. Tom Strachan and Andrew P Read. 2010. Human Molecular genetics 4th Edition, Tailor and Francis Group, New York.
5. Levin B, Gene IX. 2014. Jones and Bartlett Publishers.

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	L	L	S	S	S	L	M	S
CO2	S	M	M	M	S	M	M	M	L	S
CO3	M	S	L	L	M	S	M	L	S	L
CO4	S	M	S	M	M	S	S	S	S	S
CO5	S	S	S	M	E	S	M	S	M	M

*S - Strong; M - Medium; L - Low

Semester: III Subject Code: **Hours:5**

Core Course: XI **Credits: 4**

BASIC AND APPLIED BIOTECHNOLOGY

Course Objectives:

The learner will be able to

1. Understand the basics of recombinant DNA technology.
2. Elaborate the extensive role of biotechnology in fields of agriculture.
3. Enlist industrial applications of biotechnology.
4. Enumerate the process of bioremediation.

Pre-requisite:

Basic knowledge on biotechnology

Expected Course Outcome:

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

1.	Understand the principle and application of rDNA technology for the welfare of human being.	**K1 & K3**
2.	Differentiating the embryonic and adult stem cells	**K3 & K4**
3.	Explicate the agricultural and Industrial bio- technology and its uses.	**K2 & K4**
4.	Claim the rights for the protection of their invention done in their project work.	**K1 & K3**
5.	Identify criterias' to fit one's own intellectual work in particular form of IPRs	**K4 & K5**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

UNIT I

Recombinant DNA Technology: Tools for rDNA technology: Enzymes: Restriction endonucleases, Ligases, SI nucleases, DNA Polymerases, Reverse transcriptase – Steps involved in genetic engineering: Methods of plasmid and DNA isolation – Insertion of DNA fragment into vector – Cutting and joining of DNA strands – Construction of rDNA- Gene therapy: Types of gene therapy and methods of gene transfer-- Applications of DNA fingerprinting in forensic science-- Transgenic animals: Methods – Embryonic stem cell method and pronucleus method – Transgenic mouse,sheep and fish.

UNIT II

Medical Biotechnology: Stem cell definition, origin and hierarchy, stem cell properties-Characterization, potency and differentiation, niche of stem cell, overview of different stem cell types (embryonic stem cells, adult stem cells and induced pluripotent stem cells). Adult stem cells: Mesenchymal stem cells (MSCs) - sources, properties (plasticity, homing and engraftment), potency and characterization; Haematopoietic stem cells (HSCs) - sources, properties, potency and characterization; steps involved in production of induced pluripotent stem cells (iPSCs); role of Yamanaka factor in iPSCs.

UNIT III

Agricultural Biotechnology: Biofertilizers: Bacterial: Rhizobial, *Azotobacter* and *Azospirillum* inoculants - Green manuring - Cyanobacterial inoculants: Algalization - *Azolla*-Mycorrhizal fungi - Benefits of biofertilizers – Role of biopesticides in pest management.

UNIT IV

Industrial and Microbial Biotechnology: Fermentation technology: Types of Fermenters and Media - Production of Vitamin B12 –Production of Amino acid: L-Glutamate - Production of organic compounds by microbial fermentation: Ethanol – Single Cell Protein (SCP): *Spirulina* - Enzyme Technology: Production of amylase and its applications.

UNIT V

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad - Genesis and Development - the way from WTO to WIPO - TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations - Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications.

UNIT VI: Self Study: Questions are not to be framed from this unit

1. Genetic engineering and Biosafety – https://www.fao.org/fileadmin/user_upload/gmfp/docs/Biosafety%20Brochure.pdf
2. Recent trends in medical biotechnology – https://www.expansionsolutionsmagazine.com/recent-and-emerging-trends-in-biotechnology/
3. Biofertilizers in India – https://geographyandyou.com/biofertilisers-in-indian-agriculture/
4. Bioremediation of dyes – https://www.slideshare.net/MubbaraArshad/bioremediation-ppt-238159770
5. Hazards of environmental engineering – https://biocyclopedia.com/index/biotechnology/biotechnology_and_environment/environmental_biotechnology/biotech_eb_hazards_of_enviromental_engineering.php

Text books:

1. Dubey, R.C. A Textbook of Biotechnology. 2014. 5th Edition, S. Chand & Co. Ltd. Ram Nagar, New Delhi, India.
2. Gupta, P.K. Biotechnology and Genomics. 2009. Rastogi Publication, Meerut, India.

References:

1. Das, H.K. Text book of Biotechnology. 2006. Wiley Dream Tech, India Pvt. Ltd. New Delhi, India.
2. Ramawat, K.G and Shily Goyal. Comprehensive Biotechnology. 2009. S. Chand & Co. Ltd. Ram Nagar, New Delhi, India.

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	M	S	S	S	M	M	S
CO2	S	S	S	M	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	S	S	M
CO4	S	S	M	S	S	S	S	M	M	S
CO5	S	S0	M	S0	M	S	M	L	S	S

*S-Strong; M-Medium; L-Low

Semester: III Subject Code: **Hours: 5**

Core Course XII - P **Credits: 4**

PRACTICAL-III (CC- X and XI)

LAB IN MOLECULAR GENETICS AND BASIC AND APPLIED BIOTECHNOLOGY

Course Objectives:

The learner will be able to

1. Understand antigen-antibody reaction using different experiment.
2. Know the structure of lymphoid organs.
3. Quantify genetic materials from unknown samples.
4. Isolate DNA and protein using appropriate techniques.
5. Know the various biotechnological techniques and its principles.

Pre-requisite:

Students should have acquired basic knowledge relevant to this particular lab course.

Expected Course Outcome:

Upon completion of this lab course, students

1.	Acquire knowledge to isolation and estimation of genetic material.	**K2**
2.	Understand and observe as well as correctly identify different cell types, cellular structures using different microscopic techniques.	**K3**
3.	Develop handling - skills through the wet-lab course.	**K6**
4.	Learn the method of isolating DNA and RNA using electrophoresis.	**K1 & K2**
5.	Acquire skills to perform human karyotyping and chromosome mapping to identify abnormalities	**K1 & K2**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Molecular Genetics

Human Karyotype – Normal male and female and syndromes, Sickle cell anaemia, DNA and RNA type.

Basic and Applied Biotechnology

1. Standard graph preparation for DNA and RNA
2. Isolation of DNA from human saliva
3. Quantitative estimation of DNA
4. Quantitative estimation of RNA
5. Agarose gel electrophoresis of DNA using horizontal submarine gel system.
6. Separation of protein by SDS-poly acrylamide gel electrophoresis (SDS-PAGE).

Spotters

Monoclonal antibodies, DNA finger printing, DNA chip, Cell line, Knockout mouse Biofuels, Probiotics, Bioremediation, SCP, GM Food.

Course Outcome:

The learners can

1. Perform various antigen-antibody reactions by doing different experiments.
2. Recognize principles of antigen-antibody reaction by various tests.
3. Able to distinguish different lymphoid organs.
4. Identify common biotechnological techniques and its applications.
5. Able to estimate and separate protein and DNA using molecular techniques.

Reference:

1. Palanivelu. P. 2000. Analytical biochemistry and Separation Techniques. Kalaimani printers, Madurai.
2. Laemmeli., U.K. 1970. Cleavage of structural protein during the assembly of the head of Bacteriophage-T4. Nature, 227; 660-685.
3. Sambrook J.E. and Fritsch.F and Maniatis.T. 1989. Molecular cloning. A Laboratory Manual. Spring Harbour Laboratory, New York.
4. Janarthanan.S. and Vincent.S. 2007. Practical Biotechnology – Methods and Protocols. University Press, Hyderabad.

Practical record to be submitted during Practical Examination

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	S	S	S	S	L	L	M
CO2	S	S	S	S	S	M	M	M	M	M
CO3	S	S	M	S	S	L	S	M	L	M
CO4	M	M	L	M	L	M	M	S	M	L
CO5	S	S	M	L	S	M	L	S	S	S

*S - Strong; M - Medium; L – Low

Subject Code:

Semester: III **Hours: 4**
Core Based Elective Course: II **Credits: 3**

GENERAL AND ECONOMIC ENTOMOLOGY

Course Objectives:
The learner will be able to

1. Understand the classification of Insects based on general characteristics.
2. Know the insect morphology and physiology
3. Realize the importance of economics and economical loss due to insect pest in agriculture
4. Learn the insect pest of public health, diseases and management.
5. Aware of various control measures of insect pests.

Pre-requisite:

The students with a basic background in biological sciences with a special emphasis on the study of insects including systematic, beneficial insects, destructive insects, integrated pest management and insects of medical and veterinary importance.

Expected Course Outcome:

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

I	Understand taxonomy, classification and life of insects in the animal kingdom.	**K1 & K2**
II	Know the life cycle, rearing and management of diseases of beneficial insects.	**K2 & K3**
III	Know the type of harmful insects, life cycle, damage potential and management of pests including natural pest control	**K2 & K3**
IV	Recognize insects which act as vectors causing diseases in animals and human.	**K2 & K4**
	Overall understanding on the importance of insects in human life.	**K2 & K6**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** -Create

UNIT-I- INSECT TAXONOMY AND MORPHOLOGY

Basics of insect classification. Salient features of the insect orders with common south Indian examples- General characteristics of Insects.
Morphology - Head-Origin, structure and modifications. Thorax- sutures of tergum, sternum and pleuron. Wings- structure and modifications, venation. Legs: Structure and modifications. Abdomen- Segmentation and appendages.

UNIT-II- INSECT PHYSIOLOGY

Structure and physiology of integumentary, digestive, circulatory, excretory, respiratory, nervous, reproductive and endocrine system- Metamorphosis.

UNIT-III- AGRICULTURAL ENTOMOLOGY

Biology, damage caused and control methods of pest of Paddy (Yellow Stem Borer: *Scirpophaga incertulas*, Thrips: *Stenchaetothrips biformis*, Sugarcane Borer: *Chilo infuscatellus Snellen*, Red rot: *Colletotrichum falcatum*), Coconut (Rhinoceros beetle *Oryctes rhinoceros*, Bark Borer: *Xyleborus parvulus*) Groundnut (Red hairy Caterpillars: *Amsacta albistriga*, Bud Borer: *Anarsia ephippias)* Brinjal (Shoot and Fruit Borer: *Leucinodes orbonalis*, Stem Borer: *Euzophera perticella)* and Primary Storage pests (Rice weevil : *Sitophilus oryzae*, Pulse Beetle: *Callosobruchus chinensis*).

UNIT-IV- ARTHROPODS OF PUBLIC HEALTH IMPORTANCE

Anthroponotic diseases: *Plasmodium falciparum, Wuchereria bancrofti, Trypanosoma brucei*. Zoonotic diseases: *Leptospira interrogans, Yersinia pestis*. Public health Nuisance: Cockroach, Housefly, Wasps, beetles, and spiders.

UNIT-V- INSECT PEST MANAGEMENT

Natural and artificial control of insect pests- Cultural, Mechanical, Physical and legal methods- Biological control- Parasitoids, Predators. Chemical methods – Pesticides- Organochlorines, organophosphates, pyrethroids. - Insect Growth Regulators (IGR). Applications of Pheromones and Chemosterilants in pest managements – Biopesticides- Integrated Pest management (IPM).

UNIT-VI Self Study: Questions are not to be framed from this unit

Social insects- culture methods- economic values-Beneficial and harmful insects.
Present pest control strategies.
https://www.biologydiscussion.com/invertebrate-zoology/insects/economic-importance-of-insects/27749
https://www.heraldandnews.com/news/local_news/five-integrated-pest-management-control-strategies/article_96d3919d-0ad7-5b09-aac9-915d762f0039.html
https://www.britannica.com/animal/social-insect

Text Books:

1. Vasantharaj David, B. and Kumaraswami, T., 1982, Elements of Economic Entomology, Popular Book Depo, Chennai.
2. Ambrose Dunston P., 2004, The Insects: Structure, Function and Biodiversity, Kalyani Publishers, Ludhiana.

Reference Books:

1. Chapman, R.F., 1998, The Insects: Structure and Function, Cambridge University Press.
2. Nayar, K.K., T.N. Ananthakrishnan, and B.V. David, 1986, General and Applied Entomology, Tata McGraw Hill Publishing House, New Delhi.
3. Wigglesworth, V.B., 1979, Principles of Insect Physiology, 9th Ed. Chapman & Hall, London.
4. M.S. Nalinasundari and R. Santhi, 2008. Entomology, MJP Publishers, Chennai-5

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	M	S	M	M	M	S	L	M
CO2	S	S	M	S	S	S	S	S	S	L
CO3	S	M	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	M	S	M	M
CO5	S	S	S	M	M	S	M	L	S	M

*S - Strong; M - Medium; L-Low

Semester: III Subject Code: **Hours:5**
Core Based Elective: III **Credits: 3**

BIOSTATISTICS AND BIOINFORMATICS

Course Objectives:
The learner will be able to

1. Gain wide knowledge on probability in solving real life problems.
2. Interpret various statistical tests application in biology.
3. Understand the basis of sequence alignment
4. Expose to online free sequence alignment tools.
5. Know about the sequence of steps involved in drug discovery.

Pre-requisite:

Students should be aware of importance of analysis of quantitative and qualitative information from biological studies.

Expected Course Outcome:

Upon completion of this course, Students would have

I	Clear understanding of design and application of biostatistics relevant to experimental and population studies.	**K2 & K3**
II	Acquired skills to perform various statistical analyses using modern statistical techniques and software. Basis of bioinformatics	**K3 & K4**
III	Knowledge on the merits and limitation of practical problems in biological/ health management study as well as to propose and implement appropriate statistical design/ methods of analysis.	**K5 & K6**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

UNIT-I:

Probability: Definition, basic laws of probability, sample space and sample points, trial and event, mixed or compound or joint events. **Types of probability**: Classical or mathematical, statistical or empirical. **Theorem of probability:** Addition theorem and multiplication theorem. **Theoretical distribution-** Binomial, poisson and normal. **Hypothesis:** Definition, test of significance. Type-I, Type-II errors, p-values

UNIT-II (Problems should be asked)

Standard Error: Definition, Standard error of Standard deviation (Ungrouped and Grouped data). **Students t test**: single mean and two samples mean- Assumption, properties and applications of t-distributions. **Chi square test:** characteristics, condition, significance. **Correlation analysis:** Merits, types and **measures of correlation:** Scatter diagram method, Karl Pearson correlation coefficient, spearman rank correlation coefficient.

UNIT-III (Problems should be asked)

Regression Analysis: Objectives, types (simple and multiple regression). Regression line and linear regression, assumption underlying single linear regression. Regression equation, regression coefficient. **Analysis of Variance** - One-way classification and two-way classification. Statistical software's -SPSS.

UNIT-IV:

Sequence Alignment: PSA and MSA, Local and global alignment, BLAST, FASTA. **Homology and Similarity:** orthologs, paralogs and xenologs.**Phylogenetic analysis:** Evolutionary tree- Special features of trees. **Types of trees**- rooted and unrooted trees. Dendrogram, cladogram, phylogram, monopyletic, parapyletic.**Approaches used in**

phylogenetic studies: phenetic, cladistics and evolutionary systematic approaches.

UNIT-V

Drug Discovery: History, Evolution and Development Approaches-Target identification and validation, Identification and optimization of lead compounds, Clinical trials phase I, II and III. **Pharmacogenomics**-prospects and uses. Introduction to personalized medicine.

UNIT-VI: Self Study:**Questions are not to be framed from this unit**

1. What is SPSS and its importance in Research and Data analysishttps://johnnoels.medium.com/what-is-spss-and-its-importance-in-research-data-analysis-5f109ab90da1
2. Statistical methods in biology: Design and analysis of experiment and regression.https://www.researchgate.net/publication/332818045_Statistical_Methods_in_Biology_Design_and_Analysis_of_Experiments_and_Regression
3. A reference guide for tree analysis & visualizationhttps://www.ncbi.nlm.nih.gov/pmc/articles/PMC2844399/
4. Modern tools and techniques in Computer –aided drug designhttps://www.sciencedirect.com/science/article/pii/B9780128223123000114

TextBooks:

1. Veer Bala Rastogi,2015.Biostatistics,Ane'sStudentPublication.
2. Attwood,T.K and Parry–Smith, D.J .2004 .Introduction to Bioinformatics. Pearson Education (Singapore).

Refrence:

1. Sokal,R.R and Rohlf,F.J,1981.Introduction to Biostatistics,WH Freeman and co, USA.
2. Veer Bala Rosrogi. 2007, Fundamental of Biostatistics.Ane Books India, Chennai.
3. Ramakrishnan, P. 1995. Biostatistics. Saras Publications, Kanyakumari.
4. Prasad,S.2001.Elements of Biostatistics .Rasogi Publication, Meerut.
5. Bliss G I.1970. Statistics in Biology.McGraw Hill Book Company,Vol I and II
6. Zoe Lacroix and Terence Critchlow.2 003. Bioinformatics. Morgan Kaufmann Publishers, San Francisco.

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	M	S	M	S	M	S	M	M
CO2	S	S	M	S	S	S	S	S	S	L
CO3	S	M	S	S	S	S	M	L	S	M
CO4	S	S	S	S	S	M	M	S	L	M
CO5	S	S	S	M	M	S	S	S	S	S

*S - Strong; M - Medium; L-Low

Subject Code:

Semester: III **Hours: 3**
Non-Major Elective Course: II **Credits: 2**
(For II M.Sc., Botany Students)

HUMAN PHYSIOLOGY

COURSE OBJECTIVES

1. To study about the nutrition and respiration among animals.
2. To understand the structural and functional aspects of circulatory and muscular systems.
3. To understand the basic principles of excretion & osmotic- ionic regulation.
4. To study about the nerve physiology and receptors.
5. To understand the basic principles endocrine glands and reproductive physiology

Pre-requisite:

Students should know the fundamentals of structure and functions of organs and organ systems of Humans.

Expected Course Outcome:

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

1.	Understand the functions of different systems of man	**K1**
2.	Learn the comparative anatomy of heart structure and functions	**K2**
3.	Know the transport and exchange of gases, neural and chemical regulation of respiration	**K2 & K4**
4.	Acquire knowledge on the organization and structure of central and peripheral nervous systems and reproduction.	**K3 & K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

UNIT I: DIGESTION & RESPIRATION

Structure of digestive system in man. Digestion absorbtion and assimilation in man. Respiratory organ in man. Respiratory pigment: Haemoglobin-Structure and function. Transport of oxygen and carbon di oxide in man.

UNIT II: CIRCULATION & MUSCLE PHYSIOLOGY

Structure and function of Human heart, Cardiac cycle, Cardiac rhythm, Blood Pressure and Heart failure - Composition and functions of blood – Blood Groups and Coagulation of blood. Muscles - Types, Ultra structure of skeletal muscle, Mechanism of muscle contraction.

UNIT III: EXCRETION & OSMOTIC AND IONIC REGULATION

Structure and function of human kidney and Nephron- mechanism of urine formation – Electrolytes and Water balance, Thermoregulation in man.

UNIT IV: NERVE PHYSIOLOGY & RECEPTORS

Structure of human Brain -Types of neurons - nerve impulse and its transmission- Neuromuscular junction – mechanism of synaptic transmission- Structure and Physiology of Receptors: Optic, Auditory, Gustatory, Tango receptors in man.

UNIT V: - REPRODUCTIVE PHYSIOLOGY

Structure and function of Testis and Ovary-Endocrine control of Reproduction-Male and female hormones- hormonal control of menstrual cycle in humans. Pregnancy-Plancenta-Paturition and Lactation in humans.

UNIT VI: SELF-STUDY (Questions are not to be framed from this unit)

1. Respiratory disorders - respiratory disorders - Books - NCBI (nih.gov)
2. CVD -Cardio-vascular disease - PubMed (nih.gov)
3. Micturition -Micturition - an overview | ScienceDirect Topics
4. Animal communication - Animal communication (article) | Ecology | Khan Academy
5. Estrus cycle - The Female Rat Reproductive Cycle: A Practical Histological Guide to Staging - F. Russell Westwood, 2008 (sagepub.com)

TEXTBOOKS

1. **Goyal A, Sasthry KV, (2004).**Animal Physiology, Rastogi Publications.
2. **Hoar, W.S, (1983)** General Comparative Physiology, Prentice Hall of India,.27
3. **Mariakuttikan, (2005)**, Animal Physiology, Saras Publications, Nagercoil.
4. **P.S Verma and V.K.Agarwal S. (1980)**, Animal Physiology, S. Chand & Co. Ltd. New Delhi.

REFERENCES

1. **Rastogi SC**, **(2001).** Essentials of Animal Physiology, New Age International Publication.
2. **Parameshwaran R, Anathakrishnan, (1980).**Outline of Animal Physiology, TN, Anantha Subramaniam K.S., Viswanathan Publishers, Pvt, LTD.
3. **Sasthry K.V., (2003).**Animal Physiology and Biochemistry, Rastogi Publications.
4. **Wilson J.A., (1984).**Principles of Animal Physiology, MacMillan.
5. **Prosser C.L., (1985).** Brown FA, Comparative Animal Physiology, Saunders W.B.
6. **Nagabushanam, R., (1991).** Animal Physiology, S. Chand & Co.

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	M	S	M	L	S	M	S	S
CO2	S	S	M	S	S	S	S	M	S	S
CO3	S	M	S	S	S	M	L	S	M	S
CO4	S	S	S	S	S	L	M	S	S	M
CO5	S	S	S	M	M	M	M	L	L	M

*S - Strong; M - Medium; L - Low

SEMESTER - III
NON MAJOR ELECTIVE – II
(For II M.Sc Zoology Students)
PLANT PHYSIOLOGY

Hours: 3
Credits: 2
Code:

Course Objectives	Learning Outcomes
The fundamental processes involved in plant metabolism were included	Students can appreciate and understand a plant by knowing its intricate working mechanisms.
The principles of plant functioning will be taught	Students will get research interest by studying the aspects in depth.
Environmental physiology is also included to understand stress physiology	The syllabus incorporates the content of various competitive exams and will enable the students to face them effectively

Unit I

Absorption of water – Ascent of sap – Transpiration, factors affecting transpiration.

Unit II

Photosynthesis: Light reaction – Cyclic and Non- cyclic photo phosphorylation. C3, C4 cycles and CAM pathways and their distinguishing features – Pentose Phosphate Pathway and its significance.

Unit III

Photoperiodism. Phytochrome and its action on flowering. Vernalization: mechanism and its practical application. Fruit ripening. Plant senescence.

Unit IV

Nitrogen metabolism – source of nitrogen, nitrogen assimilation in higher plants – Nitrate Reductase and Nitrite Reductase.

Unit V

Stress physiology – water stress, Heavy metals stress, salt stress and heat stress.

Text Books

1. Jain V.K. (1990) – Plant Physiology – S. Chand & Co. New Delhi.
2. Malik. C.P., and Srinivastra, (1995) – Plant Physiology.
3. Verma,S.K., 1999, A Text book of Plant Physiology, S. Chand & Co, New Delhi.

Reference Books

1. Delvin. R.M. (1969) – Plant Physiology – Holt, Rinehart & Winston & Affiliated east west, Press (P) Ltd., New Delhi.
2. S. Salisbury. F.B. & C.W. Ross – (1999) Plant Physiology – CBS Publishers & Printers, New Delhi.
3. Noggle, G.R. and Frintz, G.J., 1976, Introductory Plant Physiology, Prentaice-Hall,India.
4. L.G. paleg and D.aspinall (Eds). The Physiology and Biochemistry of Drought Resistance in Plants**.** Academic Press Australia. 1981.

Subject Code:

Semester: III **Hours: 2**
SEC: III **Credits: 2**

MEDICAL LABORATORY TECHNIQUES

Course Objectives:

The main objectives of this course are:

1. Students should understand the different protocols and procedures to collect clinical samples.

Pre-requisite:

Students should have a basic knowledge about medical laboratories and the works carried out by them.

Expected Course Outcome:

Upon completion of this course, Students would have

I	Understand protocols and procedures to collect clinical samples for blood analysis and to study human physiology.	**K2 & K3**
II	Explain the characteristics of clinical samples and demonstrate skill in handling clinical equipment.	**K3, K4 & K5**
III	Evaluate the hematological and histological parameters of biological samples.	**K3, K4, K5 & K6**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Units

I	Laboratory safety - toxic chemicals and biohazards waste- biosafety level- good laboratory practice - hygiene and health issue - physiology effect of alcohol, tobacco, smoking & junk food & its treatment - biomedical waste management.
II	Composition of blood and their function- collection of blood & lab procedure-haemopoiesis-types of anaemia- mechanism of blood coagulation- bleeding time- clotting time-determination of hemoglobin-erythrocyte sedimentations rate- packed cell volume- Total count of RBC & WBC- Differential count WBC- blood grouping and typing- haemostasis-bleeding disorder of man - Haemolytic disease of newborn, Platelet count, reticulocytes count, Absolute Eosinophil count.
III	Definition and scope of microbiology- structure and function of cells - parasites - Entamoeba- Plasmodium- Leishmania and Trypanosome-Computer tomography (CT scan) - Magnetic Resonance imaging - flowcytometry - treadmill test - PET.
IV	Cardiovascular system- Blood pressure - Pulse - regulation of heart rate, cardiac shock. Heart sounds, Electrocardiogram (ECG) - significance - ultra sonography- Electroencephalography (EEG).
V	Handling and labelling of histology specimens - Tissue processing - processing of histological tissues for paraffin embedding, block preparation. Microtomes – types of microtome-sectioning, staining - staining methods - vital staining - mounting- problems encountered during section cutting and remedies - Frozen section techniques- freezing microtome.

Reading list

1. Godker, P. B. and Darshan, P, Godker, 2011. Text book of medical Laboratory Technology, Mumbai.
2. Guyton and Hall, 2000. Text Book of medical Physiology, 10th edition, Elseiner, New Delhi.
3. Mukerjee, K.L, 1999. Medical Laboratory Technology- Vol,I,II,III. Tata MC GrawHill, New Delhi.
4. Sood, R, 2009. Medical Laboratory technology, Methods and interpretation.

Recommended texts

1. Manoharan,A, and Sethuraman, 2003. Essential of Clinical Heamatology, Jeypee brothers, New Delhi.
2. Richard, A, McPherson, Mathew, R, Pincus, 2007. Clinical and management by laboratory methods, Elsevier, Philadelphia.Published by Tata McGraw-Hill Education Pvt. Ltd.,
3. Ochei. J., A. Kolhatkar (2000). Medical Laboratory science: Theory and practice, Published by Tata McGraw-Hill Education Pvt. Ltd, First edition.

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	M	M	L	L	M	M	L	M
CO2	S	S	M	S	S	S	L	M	S	S
CO3	M	S	S	S	S	S	S	S	S	L
CO4	S	S	M	M	L	M	L	M	M	S
CO5	M	M	S	S	M	S	L	L	S	S

*S - Strong; M - Medium; L-Low

Semester: IV Subject Code: **Hours:6**
Core course: XIII **Credits:4**

ANIMAL PHYSIOLOGY

Course Objectives:

The main objectives of this course are:

1. Students acquire the basic knowledge on physiology of different organs in animals and human.
2. Understand the functions of different systems such as digestion, excretion, blood circulatory system, respiration and nervous system of animal relating them to structure and functions of various organs.

Pre-requisite:

Students should know the fundamentals of structure and functions of organs and organ systems of animals.

Expected Course Outcome:

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

1.	Understand the functions of different systems of animals	**K1**
2.	Learn the comparative anatomy of heart structure and functions	**K2**
3.	Know the transport and exchange of gases, neural and chemical regulation of respiration	**K2 & K4**
4.	Acquire knowledge on the organization and structure of central and peripheral nervous systems	**K3 & K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

UNIT – I: DIGESTIVE AND RESPIRATORY SYSTEM

Digestive system: Digestion: Mechanical process of digestion-Buccal Digestion – Deglutition-Gastric Digestion-Intestinal Digestion-Absorption – Defecation- BMI and BMR. **Respiratory system**: Internal and external respiration-Respiratory organs among animals -respiratory pigments- exchange of gases -RQ - neural and chemical regulation of respiration.

UNIT – II: BLOOD AND CARDIOVASCULAR SYSTEM

Blood: Plasma – Formed elements of blood- Haemopoiesis and Erythropoiesis- General functions of blood - blood coagulation. **Cardiovascular System**: Anatomy of human heart – Blood vessels: Arteries, Veins and Capillaries- Heart beat - Cardiac cycle – Cardiac rhythm. Principle of ECG - Blood pressure and neural and chemical regulation.

UNIT – III: EXCRETORY SYSTEM, OSMOTIC AND THERMOREGULATION

Excretion: Kidney – Nephron-Mechanism of urine formation-Regulation of urine formation-Composition of urine – Diuresis – Micturition – Nephritis. **Osmoregulation:** Osmoconformers and Osmoregulators - Regulation of water balance -Electrolyte balance–Acid-base balance-Acidosis and Alkalosis. **Thermoregulation**: Thermo-conformers and Thermo regulators-Lethal temperature - Effect of cold – acclimatization- stress adaptation.

UNIT – IV: NERVOUS SYSTEM, EFFECTORS AND SENSE ORGANS

Nervous system: Brain and Spinal cord - Autonomic, Sympathetic and Parasympathetic nervous system – Neurons – Neurotransmitters-Nerve impulse-action potential–transmission of nerve impulse-Reflex action neural control of muscle tone and posture. **Effectors**: Types of muscle- Properties and Ultra structure of skeletal muscle- Physiology of muscle contraction-Theories of muscle contraction and relaxation. Structure and function of Sense **organs**: Gustation, Olfaction, Vision, Hearing, and Touch.

UNIT – V: ULTRA STRUCTURE OF MALE AND FEMALE REPRODUCTIVE SYSTEM*

Reproductive System: Male reproductive organs, Spermiation, Semen- Secretion and composition - Secondary sexual characters in male-Hormonal control. Female reproductive organs - Secondary sexual characters in female – Growth of Graafian follicles, Ovum-hormonal control. Puberty, menarche, menopause. Ovulation – Implantation-Pregnancy, Parturition, and Lactation-hormonal control. Sexual cycles: Oestrous and Menstrual cycle - Hormonal control. Disorders of Ovary: PCOD.

*With reference to human

UNIT – VI: Self Study: Questions are not to be framed from this unit

1.	Bioluminescence in animals	https://www.youtube.com/watch?reload=9&v=9HXXQBz6Vv0 https://www.nationalgeographic.org/encyclopedia/bioluminescence/
2.	Physiology of stress	https://www.ncbi.nlm.nih.gov/books/NBK541120/ https://samples.jblearning.com/0763740411/Ch%202_Seaward_Managing%20Stress_5e.pdf
3.	Adaptations to high altitude	https://www.coursera.org/lecture/mountains-101/4-3-adaptation-of-high-altitude-peoples-QqTLE
4.	Neuromuscular disorders	https://www.maxhealthcare.in/our-specialities/neurology/conditions-treatments/neuromuscular-diseases
5.	Hormone receptors	https://www.sciencedirect.com/topics/neuroscience/hormone-receptor

Text Books:

1. Sherwood, L., Klandorf, H, and Yancey, P.H. 2008. Text Book of Animal Physiology.Cengage Learning India Pvt., Ltd.
2. Hoar, W.S. 1968. General and Comparative Physiology, Prentice Hall.
3. Verma.P. S, Tyagi.B.S and Agarwal.V.K. 2018. Animal Physiology, S. Chand and CompanyLimited, New Delhi
4. Mariakuttikan, A., 2011, Animal Physiology. SARAS Publication, Nagercoil.

Reference:

1. Hill R.W., Wyse G.A. and Anderson, M., 2008. Animal Physiology., 2nd Ed., SinauerAssociates, Inc Publisher, Massachusetts.
2. Moyes, C.D. and Schulte, P.M. 2007. Principles of Animal Physiology. Pearson Education,Dorling Kindersley Publication. New Delhi.
3. Guyton, A.C. 2000. Textbook of Medical Physiology.W.B. Saunders Company,Philadelphia, London, Toronto and IgakuShoin/Saunders (Tokyo).
4. Prosser, C.L. 1973. Comparative Animal Physiology. 3rd Ed., W.B. Saunders &Co.Philadelphia.

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	M	S	M	L	S	M	S	S
CO2	S	S	M	S	S	S	S	M	S	S
CO3	S	M	S	S	S	M	L	S	M	S
CO4	S	S	S	S	S	L	M	S	S	M
CO5	S	S	S	M	M	M	M	L	L	M

*S - Strong; M - Medium; L - Low

Semester IV | Subject Code: | **Hours:5**

Core Practical: XIV-P | **Credits:4**

PRACTICAL - IV (CC- XIII)

LAB IN ANIMAL PHYSIOLOGY

Course objectives:

The learner will be able to

1. Estimate oxygen consumption of fish.
2. Analyze the enzyme activity in saliva.
3. Compute salt loss and gain in fishes.

Pre-requisite:

Students should acquire the basic knowledge relevant to a particular lab course.

Expected Course Outcome:

Upon completion of this lab course, the students

1.	Acquire ability to perform/ demonstrate various basic concepts in physiology as well as applications of research methods for quantitative/ qualitative analysis of biochemical components.	**K3 & K4**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Animal Physiology

1. Oxygen consumption and respiratory rate in aquatic animal (Fish).
2. Human salivary amylase activity in relation to pH.
3. Estimation of Salt loss and salt gain in fish.

Principles and applications of the following instruments

Kymograph, Spectrophotometer, Sphygmomanometer, ECG and Retinogram.

Slides: Neurons, Nephrons, Cardiac Muscle and Striated and Non-striated muscle.

Reference:

1. Rajan and Selvi Christy, 2012.Experimental Procedures in Life Sciences, Anjanaa Book House, Chennai.
2. Verma and Srivastava, Reprint 2018.Advanced Practical Zoology.S Chand and Company Limited, New Delhi.
3. Sinha, Chatterjee and Chattopadhyay. Reprint 2015.Advanced Practical Zoology.Books and Allied (p) Ltd, Kolkatta.

Practical record to be submitted during Practical Examination

Field Visit / Tour Report to be submitted during Practical Examination.

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	M	S	L	S	M	S	M	M
CO2	S	S	L	S	S	S	M	M	M	S
CO3	M	M	M	S	M	S	S	S	S	L
CO4	S	M	S	M	S	M	S	S	S	M
CO5	M	S	S	M	M	S	M	L	S	M

*S - Strong; M - Medium; L-Low

Semester: IV Subject Code: **Hours: 5**

Core Based Elective: IV **Credits: 3**

RESEARCH METHODOLOGY AND PUBLICATION ETHICS

Course Objective:

The learner will be able to

1. Understand the philosophy of science and ethics, research integrity and publication ethics.
2. Identify research misconduct and predatory publications.
3. Understand indexing and citation databases, open access publications.
4. Know the research metrics like Citations, h-index, impact Factor, etc.
5. Understand the usage of plagiarism tools.

Pre-requisite:

Students should know the fundamentals of basic methods employed in experimental biology.

Expected Course Outcome:

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

1.	Understand the implications of GLP	**K1**
2.	Learn the working principles of different instruments	**K2**
3.	Gain the knowledge on techniques of research design	**K2 & K4**
4.	Acquire knowledge on the basic publication ethics. Retrieve research articles from known resources	**K3 & K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**- Create

UNIT – I

Principles, Types and application of Electrophoresis – Gel Documentation; 2D Electrophoresis; **Principles and applications** - pH meter and Flame photometer. **Cell culture techniques**: Culture media preparation and cell harvesting methods. Cell proliferation measurements and Cell viability testing.

UNIT – II

Radioisotope and mass isotope techniques in biology: Sample preparation for radioactive counting, Autoradiography and Magnetic Resonance Imaging (MRI) – Geiger Muller Counter, Scintillation counter- Carbon dating. **Energy value of biological material**: Wet combustion; Bomb calorimeter – estimation of calorific value.

UNIT – III

Fundamentals of Research: - Aim, scope and Objectives of research problems; Classification of research; **Research process** – Prioritizing the problem – Selection and analysis. Formulate hypothesis; Formulation of objectives; **Research design** – Execution- Data processing – Data analysis – Interpretation and report writing; Preparation of research paper; Dissertation; Refereed and Non- refereed journals; Impact factor; Citation index; Copyright; Patent. Bibliographic databases. i10 index, H Index, IPR, ISBN, Plagiarism.

UNIT – IV

Publication Ethics: definition, introduction and importance; Best practices/standards setting initiatives and guidelines: COPE, WAME; Publication misconduct: definition, concept and types. Violation of publication ethics.

UNIT – V

Open access publications and initiatives; SHERPA/RoMEO online resource to check publisher copyright. Software tool to identify predatory publications developed by SPPU; Journal Finder/Journal suggestion tools viz JANE, Elsevier, springer journal suggester. Use of plagiarism software like Turnitin, Urkund and other open-source software tool.

UNIT- VI Self Study : Questions are not to be framed from this unit

Recent advances in Medical Imaging-

https://online.ahu.edu/blog/infographic/imaging technology/#:~:text=Artificial%20and%20augmented%20intelligence,Portable%20and%20wearable%20scannes

1. Patenting procedure in India –
http://ipindia.gov.in/writereaddata/images/pdf/oatent-office-procedures.pdf

2. Authorship –
https://research.uq.edu.au/research-support/ethics-integrity-and-compliance/research-integrity/authorship#:~:text=Authorship%20signifies%20that%20an%20individual,is%20attributed%20accurately%20and%20responsibly.

3. Conflicts of interest –
https://compliance.ucf.edu/understanding-conflict-of-interest/#:~:text=What%20is%20a%20Conflict%20of,seriously%20that%20they%20are%20regulated.

4. Complaints and appeals - https://publicationethics.org/appeals

Textbooks

1. Guramani, N. 2009. Research Methodology for Biological Sciences. MJP Publishers, Chennai.
2. Kothari, C. R. 2008. Research Methodology- Methods and Techniques. New Age International Publishers, New Delhi – 110002.
3. Vijayalakshmi, G., Sivapragasam, C. 2008. Research Methods Tips and Techniques. MJP Publishers, Chennai – 600005.

Reference:

1. Case C L and Johnson T R, 1984. Laboratory Experiments in Microbiology. The Benjamin Cummings Pub. Co., London.
2. Fritschen L J and Gay L W, 1979. Environmental Instrumentation. Springer Verlag, New York.
3. Humason G L,1979, Animal Tissue Techniques. IV Edition, Freeman W H and Co., San Francisco.
4. Osterman A, 1984. Methods of Protein and Nucleic acid Research. Springer Verlag, New York.
5. Plumber D T, 1971. An Introduction to Practical Biochemistry., Tata Mc Graw Hill Co.
6. Pranab Kumar Banerjee, 2008.Introduction to Biophysics. S. Chand
7. Research Ethics: 2011. A Handbook of principles and procedures. Cardiff school of Education.
8. Melinda Dooly, Emilee Miire and Claudia Vallejo *et al.*, 2017, Research Ethics by ERIC, France.
9. Pranas Žukauskas, JolitaVveinhardt. 2018.A Guide to Research Ethics, university of Minnesota Philosophy and Paradigm of Scientific Research ©. (https://creativecommons.org/licenses/by-nc/4.0/), http://dx.doi.org/10.5772/intechopen.70628
11. Best Practice guidelines on publishing Ethics. 2006.http://exchanges.wiley.com/ ethics guidelines.

Publishing Ethics: Academic Research, Cambridge University Press,Version 3.0 Lastupdated June 2020. https://publicationethics.org/cat

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	M	S	L	S	M	S	M	M
CO2	S	S	L	S	S	S	M	M	M	S
CO3	M	M	M	S	M	S	S	S	S	L
CO4	S	M	S	M	S	M	S	S	S	M
CO5	M	S	S	M	M	S	M	L	S	M

*S - Strong; M - Medium; L-Low

Subject Code:

Semester: IV **Hours: 2**
SEC: IV **Credits: 2**

BIOCOMPOSTING

Course Objectives:

The main objectives of this course are:

1. To highlight the importance of biocomposting in waste management.
To enable students for setting up biocompost units and bins for waste reduction.

Pre-requisite:

Students should have a basic understanding of biological process of decomposition.

Expected Course Outcome:

Upon completion of this course, Students would have

I	Gained knowledge on the process of biocomposting	**K1, K2 & K3**
II	The ability to demonstrate biocomposting techniques for various end applications like solid waste management, industrial waste recycling using sugarcane bagasse, etc.	**K3, K4 & K6**
III	Knowledge, gain on the economic cost of establishing small biocompost units in the cottage industry.	**K3, K5 & K6**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Units

I	Biocomposting - Definition, types and ecological importance.
II	Types of biocomposting technology - Field pits/ground heaps/ tank/large-scale/batch and continuous methods.
III	Preparation of biocompost pit and bed using different amendments.
IV	Applications of biocompost in soil fertility maintenance, promotion of plant growth,value added products, waste reduction, etc.
V	Establishments of small biocompost unit - project report proposal for Self Help Group (Income and employment generation).

Reading list

1. Bikas R. Pati& Santi M. Mandal (2016). Recent trends in composting technology.
2. Van der Wurff, A.W.G., Fuchs, J.G., Raviv, M., Termorshuizen, A.J. (Editors). 2016. Handbook for Composting and Compost Use in Organic Horticulture.
3. BioGreenhouse COST Action FA 1105,

Recommended websites

www.biogreenhouse.org

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	M	L	L	M	L	M
CO2	S	M	M	M	M	M	L	L	M	M
CO3	S	S	S	S	S	S	L	M	M	S
CO4	S	L	L	M	M	S	M	S	S	M
CO5	M	L	L	L	S	M	M	M	M	S

*S - Strong; M - Medium; L- Low