

GOVERNMENT ARTS COLLEGE (AUTONOMOUS)

SALEM – 636007

NAAC Re-accredited with B Status

AFFILIATED TO PERIYAR UNIVERSITY

SYLLABUS FOR M.Sc., ZOOLOGY

CHOICE BASED CREDIT SYSTEM

(FOR THE STUDENTS ADMITTED FROM THE ACADEMIC YEAR 2021 -2022 ONWARDS)

DEPARTMENT OF ZOOLOGY

VISION

The Department of zoology is a nurturing field for student's holistic improvement and to inculcate the highest values of biological science including taxonomy, evolution, environment ,developmental biology and molecular science.

MISSION

- To motivate the students for their fruitful life.
- To develop the broad knowledge about the biology of animals.
- To impart entrepreneurial skills through application oriented subjects.
- To provide the best education for students to achieve their goals.
- To promote research and learning.
- To create awareness about health related problems by curriculum.

Program Educational Objectives (PEO)

The Program Educational Objectives for the Subject are as follows	
PEO1	Ensure acquiring the awareness on the basics of the zoology and to understand the different features and diversities in the animal kingdom - encouraging to provision the innovative solutions to make a global impact.
PEO2	Provides an expertise in the domain helpful for the higher education and research -with basic understanding of the subject, further education is made easier and skilful.
PEO3	Help gain a successful career in the different fields of biological sciences - up skilling and helping to analyze data scientifically and apply them for work-related research purposes.
PEO4	Enables the option to utilize the known knowledge for the human benefits and for society welfare - especially with the environmental sciences, anyone can understand socio-ecology.
PEO5	Help increase the entrepreneurial skills with bioethics in place and kick-start the professionalism aiding the industrial needs.

Program Specific Outcomes (PSO)

The Program Specific Outcomes for the Subject are as follows	
PSO1	Attain the basic knowledge of the zoology discipline, its prime concepts, and principles, related to various inter-disciplinary subjects, coupled with the biological sciences inclusive of theoretical and experimental information.
PSO2	Demonstrate the ability to create procedural knowledge, experiments, research works aiding and contributing to the development in/of the field.
PSO3	Recognition and realization of the substantiate, concerted conceptualization and use them for providing a qualitative outcome/benefit for the economical and/or social growth
PSO4	Show the competence required for the Major Elective subjects included and able to correlate the knowledge for various educational and industrial benefits to excel in different fields of work.
PSO5	Participate in the Research and Developmental programmes with ease and should be able to efficiently showcase the expertise in the specialization areas.

Program Outcomes

The Program Outcomes devised for the Subject of Zoology is as follows	
PO1	Show basic understanding of the academic and technical field of Zoology, its different learning areas and applications, and its link with related inter-disciplinary subjects.
PO2	Demonstrate the imperative knowledge as a professional in relation to the course in different fields of work inclusive of research and development, teaching, competitive examination mentors by recreating various experimental aspects of the subject.
PO3	Present the expertise in areas related to their individual specialization like genetic engineering, be able to understand the real time developmental works and researches in the respective domain.
PO4	Able to examine the present environmental conditions like Wildlife Management, Climatic changes, Global Warming, Energy Crisis and Natural resources depletion that are discussed as a paper to improvise the conceptual knowledge for identifying any problems related and help in creating the eco-friendly environment.
PO5	Based on the techniques and methodologies discussed in the vital topics like Cell Biology, Genetics, Molecular Biology, should be able to manifest the knowledge in research specific areas and studies related to the Zoology.
PO6	Able to communicate the concepts, constructs and techniques involved in a skilful way exhibiting the proficiency on the explanatory topics like animal evolution, animal behaviour, animal development and animal ecology.
PO7	Should be able to create a contextual contents and examples in the real time world based on the applications and discussions carried out in all the subjects like combining clinical laboratory techniques studied as part of Medical Parasitology and behaviours of the microbes studied as part of the Microbiology.
PO8	Improve the observational, computational, analytical, and ethical skills required for the research, development and professional fields discussed for evolving trends in molecular biology, micro-biology, cell biology, etc.,
PO9	Helps advancement in job, trades and employment with the help of knowledge about animal kingdom and helps create various opportunities in the educational, research and developmental, social entrepreneurial sectors related to the same. Also, provides enough knowledge for an individual to succeed the competitive examinations like CSIR, NET, GATE and TOEFL, etc..
P10	The Applied Zoology discipline helps by economizing the in-depth information gained by understanding different animal cultures and techniques/methods followed in enabling the industrial, social, and environmental benefits.

Course structure of M Sc Zoology
(Students admitted from the academic year 2021- 22 onwards)

GOVERNMENT ARTS COLLEGE (AUTONOMOUS) SALEM - 636 007							
PG & RESEARCH DEPARTMENT OF ZOOLOGY							
M.Sc Zoology							
For the candidates admitted from the academic year 2021-2022							
S. No	Course Code	Title of the Course	Hours to be handled	Credits	Marks		
					I.A.	S.E.	Max
SEMESTER - I							
1	21PZL01	Core Course – I : Invertebrata	6	6	25	75	100
2	21PZL02	Core Course – II : Chordata	6	6	25	75	100
3	21PZL03	Core Course – III : Cell and Molecular Biology	6	5	25	75	100
4	21PZLM1	Major Based Elective Course-I : Applied Zoology	6	5	25	75	100
	21PZLM2	Major Based Elective Course-I : Microbiology					
5	21RAC01	Research Acumen Course 1: Intellectual Property Rights	2	*	-	100	100
6	21PZLP1	Core Practical - I Invertebrates, Chordates , Cell and Molecular Biology	4	-	-	-	-
Total Credits and Marks			30	22			500
SEMESTER - II							
1	21PZL04	Core Course – IV : Genetics	6	5	25	75	100
2	21PZL05	Core Course – V : Developmental Biology	6	5	25	75	100
3	21PZL06	Core Course – VI : Immunology	6	5	25	75	100
4	21PZLM3	Major Based Elective Course- III : Medical Parasitology	6	5	25	75	100
	21PZLM4	Major Based Elective Course- IV : Biotechnology					
5	21RAC02	Research Acumen Course II : Research Writing	2	-	-	100	100
6	21PZLP1	Core Practical – I - Invertebrates, Chordates and Cell & Molecular Biology	-	4	40	60	100
7	21PZLP2	Core Practical – II - Genetics , Developmental Biology and Immunology	4	4	40	60	100
Total Credits and Marks			30	28			700

S. No.	Course Code	Title of the Course	Hours to be handled	Credits	Marks		
					I.A.	S.E.	Max
SEMESTER - III							
1	21PZL07	Core Course – VII : Animal Physiology	6	5	25	75	100
2	21PZL08	Core Course – VIII : Endocrinology	6	5	25	75	100
3	21PZL09	Core Course – IX : Animal Cell Culture Technology	6	5	25	75	100
4	21PPYZL	Interdisciplinary Course : Clinical Laboratory Techniques	2	2	25	75	100
5	21PZLP3	Core Practical – III : Animal Physiology, Endocrinology and Animal Cell Culture Technology	4	-	-	-	-
6	21PZLM5	Major Based Elective- V : Biochemistry	6	4	25	75	100
Total Credits and Marks			30	21			500
SEMESTER - IV							
1	21PZL10	Core Course – X : Ecology	6	5	25	75	100
2	21PZL11	Core Course – XI : Evolution	6	5	25	75	100
3	21PZL12	Core Course – XII : Applied Entomology	6	5	25	75	100
4	21PZL PR	Project	-	6	25	75	100
4	21RAC03	Research Acumen Course – III : Research and Publication Ethics	2	*	-	100	100
5	21PZLP3	Core Practical – III : Animal Physiology, Endocrinology and Animal Cell Culture Technology	-	4	40	60	100
6	21PZLP4	Core Practical – IV : Ecology, Evolution & Applied Entomology	4	4	40	60	100
Total Credits and Marks			30	29	--	--	700
Cumulative Credits and Marks				100			2400

CORE COURSE – I: INVERTEBRATA

Course Code	Course Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit
21PZL01	Core Course – I: Invertebrata	60 Hours	5 hours	-	5

Course Objectives:

- ❖ To understand the taxonomic position of phylum.
- ❖ To enlighten the students about the diverse forms of Invertebrate animals which belong to major phyla present around us.
- ❖ To help the students to distinguish various Invertebrate animals and to know the evolutionary sequence of them.

Course Outcomes:

On successful completion of the course, students will be able to		
CO1	Understand and be able to explain the various Invertebrates species, functional significance of their morphologies and behaviors.	Understand
CO2	Be able to understand the requirements for systematic position, general organization, and their affinities.	Analyze
CO3	Express understanding in the formal taxonomic descriptions, in principles of taxonomic precedence, revision and type specimen designation.	Remember
CO4	Construct phylogenies from suites of the taxonomic characters and be able to critically evaluate groupings based on the principles.	Create
CO5	Able to use different techniques, principles employed, and be well equipped with the data sets in various fields like R&D, teaching and Industries.	Apply

Unit - I

(12 hours)

Molecular Taxonomy –Based on protein, DNA & rRNA sequencing. Taxonomic levels and types. Zoological Nomenclature - Binomial and Trinomial. International Code of Zoological Nomenclature (ICZN). Law of priority- Applications - Recommendations for naming species. Principles and applications of DNA bar coding and phylogenetic analysis.

Unit – II**(12 hours)**

Classification –Hierarchy and types. Classification of Invertebrates upto Orders. Organization of animals –Coelomates, Acoelomates and Pseudo coelomates. Organization - Symmetry, Asymmetry, radial, biradial and bilateral symmetry. Metamerism in invertebrates.

Unit - III**(12 hours)**

Minor Phyla of invertebrates - General characters with examples of Echiura, Lophophorata, Chaetognatha, Ctenophore, Phoronida, Pogonophora, Nemertinea, Rotifera, Brachipoda, Ectoprocta, Pentastomida, Onychophora, Tardigrada, Acanthocephala and Siphonoculata.

Unit - IV**(12 hours)**

Locomotion- ciliary movement and hydrostatic movement. Patterns of feeding in Invertebrates - Filter feeding in Polychaetes and Symbiotic nutrition. Patterns of reproduction –Asexual (fragmentation, fission and budding) and sexual. Larval forms of parasites (Helminths). Moulting of insects and its hormonal regulation.

Unit - V**(12 hours)**

Structural and functional genomics of *Caenorhabditis elegans* - biology, DNA extraction, sequencing and genome analysis. *Plasmodium vivax*; biology, DNA extraction, sequencing and genome analysis. Molecular diagnosis of protozoan diseases.

Text Books:

1. Ayyar, E.K. and T.N. Ananthakrishnan. 1995. A manual of Zoology. Vol. I (Invertebrata)
2. Kotpal, R.L. 1996. Modern TextBook of Zoology Invertebrates. Rastogi Publications,
3. Kotpal, R.L., Agarwal, S.K. and Khetarpal, R.P.R., 1989. Modern TextBook of New Delhi. Part I & II. Viswanathan Pvt. Ltd., Zoology, Rastogi Publications, Meerut.
4. Rastogi, V.B. 1984. Invertebrate Zoology. Kedar Nath Ram Nath Publications, Meerut.

Reference Books:

1. Barnes, R. D 1968. Invertebrate Zoology, 2nd Ed. Saunders, Philadelphia.
2. Barnes, R.D., 1974, Invertebrate Zoology, 4th Edition, Holt Saunders International
3. Barrington, E.J. W. 1969. Invertebrate Structure and Functions. English Language Book Society.
4. Barrington. E J W. 1967. Invertebrate structure and function, Nelson, London.

5. Borradile, L.A. Eastham, L.E.S. and J.T. Saunders. 1977 The Invertebrate Cambridge University Press.
6. Carter, G.S.A. 1969. General Zoology of Invertebrates. Sidewick and Jackson Ltd., London.Edition.
7. Gardinar, M.S. 1972 Biology of the Invertebrates, McGraw - Hill Book Co.,New York.
8. Hyman L.H. 1951 The Invertebrata, Vol I to VI. Mc Graw – Hill Book Co., New York.
9. Moore, R.C. Lalicker, C.G. and Fisher, A.G. 1952 Invertebrate Fossils. Mc Graw Hill Book Co., New York
- 10.Romer, A.S., 1979. Hyman's Comparative Vertebrate Anatomy, 3rd Edition, The University of Chicago Press, London.
- 11.Weischert, C.K., 1965. Anatomy of Chordates, McGraw Hill Book Co., Inc., N.Y.

Online Resources:

1. <http://animalkingdom.net/category/invertebrates/>
2. <http://webs.lander.edu/rsfox/invertebrates/>
3. www.biology4kids.com/files/invert_main

MAPPING WITH PROGRAM OUTCOMES										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S					M			S	
CO2	S					S	M			
CO3	S						L		S	
CO4						L	L			
CO5		S						M	S	

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

CORE COURSE - II: CHORDATA

Course Code	Course Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit
21PZL02	Core Course II: Chordata	60 Hours	5	-	5

Course Objectives:

- ❖ To Popularize The Students About Systemic Zoology With Reference To Chordates.
- ❖ To Educate The Students About Evolutionary Trends In Chordates Groups.
- ❖ To Enrich The Knowledge Of Students With Regards To Special Features Of Chordates.
- ❖ To Create Awareness Among The Students About The Economic Aspects Of Chordates.

Course Outcomes:

On successful completion of the course, students will be able to		
CO1	Understand the Ultra structure of cell and its functions.	Understand
CO2	Gain knowledge in Cellular communication	Apply
CO3	Develop the skill towards Protein engineering	Create
CO4	Apply appropriate analytical skills for cell manipulation studies	Evaluate
CO5	Create awareness about Cancer development and control mechanisms.	Analyze

Unit - I (12 hours)

Origin and Ancestry of Chordates - recent theories, classification of vertebrates. Protochordata-general features and evolutionary significance, Biology of Amphioxus, Evolution of Vertebrate groups-Agatha and Chondrichthyes.

Unit - II (12 hours)

Origin and evolution of Placoderms, Osteichthyes - General Features and Lateral line system. Migration of Fishes- Catadromous and Anadromous migration, Accessory Respiratory organs in Fishes, Fish scales and its significance. Economic importance of Fishes and its byproducts. Current scenario of fishery biology.

Unit - III**(12 hours)**

Origin and Evolution of Amphibians - Recent theories, Terrestrial adaptations of Amphibians Breeding behavior and Parental care in Amphibians, Adaptive Radiation in Amphibia, Origin, and evolution of Reptiles. Extinct Reptile. Golden age of reptiles. Mesozoic reptiles

Unit - IV**(12 hours)**

Origin and evolution of birds. Connecting link- Archaeopteryx, Aerial adaptations of Birds Mechanism of flight in birds, Courtship and Breeding behavior in Birds .Migration in birds Common Aquatic birds of India and its adaptations. The impact of climate change on birds populations.

Unit - V**(12 hours)**

Origin and evolution of Mammals , Aquatic mammals-Sea Otter, Seal, Sea lion and Dolphins Comparative Anatomy of Vertebrate heart , Comparative anatomy of Vertebrate brain .Dentition in mammals.. Economic importance of beneficial Mammals. Guidelines and significance of CPCSEA.- towards small mammal ethical committee.

Text Books :

1. R.L.Kotpal .2016. Modern Textbook of Zoology- Vertebrates. 4 th Edition, Rastogi Publications, Meerut – New Delhi.
2. Marshall, A.J and Williams. W.D (Ed).1995. Textbook of Zoology: Vertebrates-Ed. VOL.II, AITBS Publishers and distributors, India, 199
3. N. Armugam. 2015.Textbook of Vertebrates ARAS Publications, Tamilnadu, India.

Reference Books:

1. Young, J.Z.1981 The Life of Vertebrates, III rd Ed Clarendon Press Oxford.
2. William N McFarland, F and Harvey Pough Tom.J.C and Heiser, J.B.1979.Vertebrate Life. Collier-Macmillan Publishers, London.
3. Waterman. A.J. 1971. Chordate Structure and Function. McMillan Co. London.
4. Jolie, M. 1968. Chordate Morphology. East West Press. Pvt, Ltd,
5. Romer, A.S. and Parson, T.S. 1978 Vertebrate Body. W.B. Saunders Co., Philadelphia
6. Colbert, E.H. 1969. Evolution of Vertebrates. John Wiley and Sons Inc, New York.
7. Holstead. 1969. The Pattern of Vertebrate Evolution. Freeman and Co. San Francisco. U.S.A.
8. Hobart M. Smith, 1960. Evolution of Chordate Structure, Holt, Rinehart and Winston. Inc. New York.

Online Resources:

1. <http://www.yahoo.co.uk./science/biology/zoology>
2. <http://www.animaldiversity.com>
3. <http://www.librery.si.edu>
4. [http://www.Biology browser.com](http://www.Biologybrowser.com)
5. <http://www.enature.com>
6. <http://.www.ncbi.nih.gov>

MAPPING WITH PROGRAM OUTCOMES										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	L	M	L		L	L	L
CO2	S	S	S	M	M		L	S	M	S
CO3	M	M	S	L		L	S	S	L	L
CO4	S	L	S		L	S	M	S	L	L
CO5	L	L	S	L	M			S	S	S

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

CORE COURSE - III : CELL AND MOLECULAR BIOLOGY

Course Code	Course Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit
21PZL03	Core Course III: Cell and Molecular biology	60 Hours	5	-	5

Course Objectives:

- ❖ Understand the Structural and functional organization of cell and its organelles.
- ❖ Acquire knowledge about DNA replication, Cell division, cell cycle and Cancer.
- ❖ Understand the Protein synthesis and Gene expression
- ❖ Acquaint the knowledge of Molecular events happening in transcription and translation
- ❖ Appreciate molecular cell signaling, Cell communication and interactions mechanism

Course Outcomes:

On successful completion of the course, students will be able to		
CO1	Understand the Ultra structure of cell and its functions.	Understand
CO2	Gain knowledge in Cellular communication	Apply
CO3	Develop the skill towards Protein engineering	Create
CO4	Apply appropriate analytical skills for cell manipulation studies	Evaluation
CO5	Create awareness about Cancer development and control mechanisms.	Analyze

Unit - I

(12 hours)

Ultrastructure of cell. Organization and function of intracellular organelles. Membrane structure models and regulation of intracellular transport. Types and events of cell division. Cell cycle regulation and control mechanism.

Unit-II**(12 hours)**

DNA replication, enzymes involved. DNA damage, repair mechanisms. Recombination and site-specific recombination. Transcription factors and machinery. RNA processing, RNA editing, splicing, structure and function of different types of RNA, RNA transport.

Unit-III**(12 hours)**

Protein synthesis and processing. Role of Ribosome. Genetic code. Structure of tRNA. Translational proof-reading, translational inhibitors, Post- translational modification of proteins. Control of gene expression at transcription and translation level. Gene expression and gene silencing.

Unit - IV**(12 hours)**

Cell communication and cell signalling – principles and role of cell adhesion molecules, gap junctions, extracellular matrix, integrins. Cell signalling - hormones and their receptors, cell surface receptor, signalling through G-protein coupled receptors, signal transduction. Secondary messengers, regulation of signalling pathways.

Unit-V**(12 hours)**

Stem cell technology; culture, types of cultures and their applications. Pathogenesis of cancer. Virus-induced cancer, metastasis, interaction of cancer cells with normal cells. oncogenes, tumor suppressor genes (P53 and INK4A gene), therapeutic interventions of uncontrolled cell growth. Apoptosis- definition, mechanism and significance.

Text Books :

- 1.Verma P.S and Agarwal V.K. (2016). Cell Biology S. Chand and Company Pvt. Ltd. I Edition
- 2.Gupta PK (2009) Cell and Molecular Biology.Rastogi Publications, Meerut.

Reference Books :

- 1.Alberts B, Johnson A, Lewis J, Raff M, Roberts K and Walter P (2009) Essential Cell Biology. Garland Science, New York
- 2.De Robertis EDP and De Robertis EMF (2001) Cell and Molecular Biology. Lippincott Williams and Wilkins, USA.

3. David Freifelder (1998). Molecular Biology. II Ed., Narosa Publishing House, New Delhi.

Online Resources :

1. <https://online.une.edu/science-prerequisites/cell-biology/>

2. <https://di.uq.edu.au/community-and-alumni/sparq-ed/cell-and-molecular-biology-experiences/introduction-cell-biology>

MAPPING WITH PROGRAM OUTCOMES										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	L	M	L		L	L	L
CO2	S	S	S	M	M		L	S	M	S
CO3	M	M	S	L		L	S	S	L	L
CO4	S	L	S		L	S	M	S	L	L
CO5	L	L	S	L	M			S	S	S

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

CORE COURE- IV: GENETICS

Course Code	Course Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit
21PZL04	Core Course – IV: Genetics	60 Hours	5	-	5

Course Objectives:

- ❖ Understanding inheritance biology from Mendel’s period to present.
- ❖ Understand and describe the central dogma of biology at the molecular level.
- ❖ Organizing ideas from genes to gene mapping.
- ❖ To enrich the knowledge about the scope and application of genetic knowledge.
- ❖ Obtain knowledge on Genomics, Proteomics and Drug discovery.

Course outcomes:

On successful completion of the course, students will be able to		
CO1	Understand the fundamental principles of Genetics	Understand
CO2	Create awareness about the fine structure analysis of genes	Remember
CO3	Gain knowledge in detection, identification and quantification of genetic disease	Analyze
CO4	Select and apply the appropriate genetic analytical skills and technique in research.	Apply
CO5	Develop the skill towards Breed improvement and Drug discovery.	Create

Unit - I

(12 hours)

Gene- fine structure. Gene mapping methods: Linkage maps, tetrad analysis, Mapping with molecular markers. mapping genes by interrupted mating. Inheritance of Mitochondrial genes, maternal inheritance. Human genetics: Principles and applications of Karyotyping – FISH and COMMET assay. genetic disorders. Human Genome Project and its applications.

Unit - II**(12 hours)**

Mutation - Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal and somatic mutants, insertional mutagenesis, site-directed mutations. Strain improvement of beneficial organism – DNA vaccination and cell therapy.

Unit - III**(12 hours)**

Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy, and their genetic implications. Recombination: Holiday model theory - Homologous and non-homologous recombination including transposition. Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction and sex-duction.

Unit - IV**(12 hours)**

Nutrigenomics – tenets, nutrition gene interaction. Gene diet diseases. Biological significance of genomic databases: GenBank, NCBI & DDBJ. Application of Genomics and Proteomics: Gene therapy-CRISPR/CAS9 Technology. Breeding in animals.

Unit - V**(12 hours)**

Gene manipulation: Molecular Marker and Drug discovery - Personalized Medicine. Genetics of cancer, Myocardial diseases, Muscular dystrophy, and obesity. Autoimmune diseases. Inborn errors of metabolism. Syndromes - Down's syndrome, Turner's syndrome and Klinefelter's syndrome.

Text Books:

1. Verma P.S and V.K. Agarwal (2008). Genetics. S. Chand and Company Private. Ltd. New Delhi.
2. Bernis Ananandharaj (2006). Genetics. Chrisolite Publications.

Reference Books:

1. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition, John Wiley and Sons Ltd. New York.
2. Snustad DP and Simmons MJ (2011) Principles of Genetics. 6th edition John Wiley and Sons.
3. Tamarin RH (2001) Principles of Genetics (2001) 7th edition, McGraw-Hill, New York.

Online Resources:

1. <https://www.coursera.org/learn/genetics-evolution>
2. <https://www.coursera.org/learn/genomics-research>
3. <https://www.genetics.org/>

MAPPING WITH PROGRAM OUTCOMES										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	S	L	M	M	M	L
CO2	S		S	S	M	S			M	M
CO3	M	M	M	L			S	M	L	L
CO4	L		M		S	M	S		S	S
CO5		L		M	S	M	S	S	S	L

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

CORE COURSE -V: DEVELOPMENTAL BIOLOGY

Course Code	Course Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit
21PZL05	Core Course – V: Developmental Biology	60 Hours	5	-	5

Course Objectives:

- ❖ The objective of this course is to provide a comprehensive understanding of the concepts of early animal development.
- ❖ To understand the methodologies specifically used to study the process of embryonic development in animals.

Course Outcomes:

On successful completion of the course, students will be able to		
CO1	The main aims with the course are to give the students' knowledge in developmental biology processes and molecular mechanisms	Remember
CO2	Students are able to know the broad phylogenetic relationships of animal phyla and some of the traits used to support current understanding of these evolutionary relationships.	Understand
CO3	To explain underlying developmental biology processes during tissue development and organogenesis including brain and nervous system	Apply
CO4	Understands the structure of the male and female reproductive systems.	Understand
CO5	Knows the role of hormones in the process of reproduction and understands the events in pregnancy and foetal development.	Apply

Unit - I**(12 hours)**

Gamete biology; Spermatogenesis - Spermiogenesis and spermatogenesis. physiological ripening of sperm spermatozoan - types of sperm. Oogenesis - previtellogenesis, vitellogenesis. Fertilization; Types – external and internal, Acrosomal reactions, cortical reaction of the Egg, physiological changes during fertilization. Reproductive cycles; oestrous cycle, menstrual cycle and menopause.

Unit - II**(12 hours)**

Cleavage - planes and patterns of cleavage, blastulation in frog and morula in mammals. Gastrulation in frog and mammals. Fate map - frog. Parthenogenesis- arrhenotoky, thelytoky, artificial parthenogenesis its significance. Transgenic sheep – Dolly.

Unit - III**(12 hours)**

Organogenesis- ectodermal organs - central nervous system and eye. Development of mesodermal organs - vertebral column, skull, paired limbs, and heart. Endodermal organs - development of lungs and liver.

Unit - IV**(12 hours)**

Placentation – types and formation. Organizer and induction - Spemann's experiments. Regeneration- types, laws and experimental evidences, factors influencing regeneration. Regeneration in frog. Neoteny- occurrence and significance of Neoteny.

Unit - V**(12 hours)**

Experimental embryology; Gradient theory-experimental evidences, Nuclear transplantation in amphibians. Embryo transplantation in human. Birth control, Infertility, Artificial insemination, Test tube babies, In Vitro Fertilization, Intrafallopian Transfer and Gamete Transfer. Concept and applications of organ on chip and human on chip.

Text Books:

1. An Introduction to Embryology by B. I. Balinsky, CBS College Pub, 5th Edn, 1981.
2. Chordate Embryology, Verma. P. S and Agarwal, V.K. S.Chand and Co. Ltd., New Delhi (1998). Bodmer,
3. De Beer, G.R. Embryos and Ancestors. Clarendon Press, Oxford.

Reference Books:

1. Developmental Biology – Scott F. Gilbert – 8 th Edition, Sinauer Associates Inc., 2006
2. Principles of Development – L. Wolpert – 4th Edition, Oxford University Press, 2011.
3. Essential Developmental Biology- J.M.W. Slack – 2nd Edition, Blackwell Publishing, 2006
4. Modern Embryology, Saunders International student edition, Philadelphia.3 Edition 1981.

Online Resources:

1. <https://embryology.med.unsw.edu.au/embryology/index.php/>
2. http://dx.doi.org/10.1136/gut.47.suppl_4.iv12

MAPPING WITH PROGRAM OUTCOMES										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S		M	L				L	S	S
CO2	S	L		S				L	S	S
CO3								L	S	S
CO4	L				M			L	S	M
CO5	L			L				L	S	S

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

CORE COURSE- VI: IMMUNOLOGY

Course Code	Course Name	Lecture(L)	Tutorial (T)	Practical (P)	Credits
21PZL06	Core Course – VI: Immunology	60 Hours	5	-	5

Course Objectives:

- ❖ Demonstrate basic knowledge of the organization and function of the immune system.
- ❖ Helps to know the characteristics of antigens and antibodies
- ❖ To realize the nature of antigen-antibody reactions
- ❖ To understand the ability of our immune system to defend against invading pathogens in a logical fashion.
- ❖ Describes the immune defense system
- ❖ Understand the basic elements of innate immune mechanism
- ❖ The study of immunology will enable the student to gain knowledge about the defense mechanisms of the human body.

Course Outcomes:

On successful completion of the course, students will be able to		
CO1	The student will be able to demonstrate a comprehensive and practical understanding of basic immunological principles	Understanding
CO2	Learners will be able to know the cellular ontogeny and organ involvement in immunity.	Evaluating
CO3	The student will be able to identify the role of antigen presenting cells, lymphocytes, and phagocytic cells in immune responses.	Remembering
CO4	The students should be able to conceptualize how the innate and adaptive immune responses coordinate to fight against invading pathogens	Analysing
CO5	The students should be able to determine immune responses such as hypersensitivity reactions, transplantations or autoimmune diseases.	Applying
CO6	The students should be able to improve existing vaccines and able to discuss current immunology issues.	Creating

Unit - I**(12 hours)**

Immunity - Innate immunity- Phagocytosis, Intercellular killing, Extra cellular killing. Acquired immunity. Structure of lymphoid organs - primary and Secondary. Cells of immune system and their role. Lymphocyte traffic. Immune response - Clonal selection theory, Mechanism of lymphocyte activation.

Unit - II**(12 hours)**

Antigen and Immunogenicity-Antegenic determinants, Epitopes, Haptens, Super Antigens. Immunoglobulins-Basic structure. Classes of immunoglobulin (IgG,IgM,IgA,IgE and IgD). Antigen-Antibody reactions- invitro, invivo and its applications. Monoclonal Antibodies-production of hybridomas and its Applications.

Unit - III**(12 hours)**

Complement system- Components and activation pathways. Major Histocompatibility Complex- Genetic organization, Classes of MHC, Structure and functions of MHC antigens. HLA system in Man. Organization and expression of Ig genes-Ig gene structure, Multigene organization of Ig gene. Differential expression of Ig genes. Opsonization.

Unit - IV**(12 hours)**

Cell mediated immune response-T cells- generation, types & activation. T Helper cells. Activation of TH cells & CTLs. Memory T Cell. B cells- generation, types and activation. B cell memory. Structure of T-cell receptor and B-cell receptor complex.Cytotoxic T lymphocyte activity.Natural killer cells. Antibody class switching. Programmed Cell Death. Autoimmunity.

Unit - V**(12 hours)**

Cytokines and immune response-Cytokines-Definition,Classes-Lymphokines, Interleukins, Chemokines. Classification- structural and functional cytokines. Cytokine receptors. Significant role of cytokines. Hypersensitivity - Anaphylaxis and Delayed type hypersensitivity. Immune response to infection agents- Intra and extracellular bacteria, parasites & viruses.

Text Books:

1. Immunology by Kuby W. H. Freeman & Co. Fourth edition.
2. Basic Immunology by Abul K. Abbas and Andrew H. Lichtman, W.B. Saunders Company.
3. Immunology by Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne. Published by W.H. Freeman & Company.
4. Immunology by Ivan Roitt, Jonathan Brostoff, and David Male. Mosby, London.6th Edition.
5. Immunology by Dulsy Fatima,N. Arumugam Published by Saras Publication.
6. Essentials of Immunology by S.K. Gupta, Published by Arya Publications.
7. Advanced Immunology by David K. Male, Published by Lippincott Williams & Wilkins.
8. Fundamental Immunology by William E Paul, Publisher: Lippincott Williams and Wilkins.
9. Immunology, by Nandini Shetty, New Age International publishers.
10. Immunology by Fathimunisa B,Kindle edition.
11. Textbook of Immunology by Arvind Kumar, The Energy and Resources Institute, TERI

Reference Books:

1. Immunobiology - the immune system in health and disease, by Charles Janeway and Paul. Travers. Garland Publishing, Inc. Fifth edition.
2. Cellular and molecular immunology, by Abul Abbas, Andrew Lichtman, and Jordan Pober. Saunders publications. The fourth edition.
3. Essential Immunology by Ivan Roitt, ELBS Edition.
4. A Handbook of Practical and Clinical Immunology by Talwar, CBS;2 edition.
5. Monoclonal Antibodies: Methods and Protocols by Hardcover, Humana; 2007 edition.
6. The HLA Complex In Biology And Medicine A Resource Book ,by Narinder K Mehra, Jaypee Brothers Medical Publishers; first edition.
7. Introduction to Immunology, by Janet M. Decker, Wiley-Blackwell publishers.
8. Medical Immunology, by Tristram Parslow, McGraw-Hill Education / Medical; 10 edition.
9. Immunology,by Richard A. Golds, W.H.Freeman & Co Ltd; 5th Revised edition edition
10. Immunology by Sulabha Pathak, Anshan Ltd; 3rd edition edition.
11. Innate Immunity,by R. Alan B. Ezekowitz, Humana; 2003 edition
12. Cytokines and Colony Stimulating Factors by Dieter Körholz (Editor), Wieland

Kiess (Editor).

13. Aging, Immunity, and Infection by Joseph F. Albright, Humana; 2003 edition.

14. Review of Medical Microbiology and Immunology, by Warren Levinson , McGraw-Hill Education / Medical; 14 edition.

MAPPING WITH PROGRAM OUTCOMES										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	-	M	-	S	-	-	M	-	S
CO2	S	-	S	-	M	-	-	M	L	S
CO3	-	-	-	-	S	-	-	-	M	S
CO4	S	-	S	-	M	-	-	-	M	S
CO5	M	-	M	-	M	-	-	M	M	S
CO6	S	-	M	-	-	-	-	S	M	S

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

MAJOR BASED ELECTIVE COURSE- I: APPLIED ZOOLOGY

Course Code	Course Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit
21PZLM1	Major Based Elective Course-I: Applied Zoology	60 hours	5 hours	-	4

Course Objectives:

- ❖ The course is unique in highlighting the commercial and industrial significance/value of animals.
- ❖ It discusses the techniques/methods of rearing of animals for commercial usage and the prerequisites for their successful maintenance and sustenance.

Course Outcomes:

On successful completion of the course, students will be able to		
CO1	Understand silkworms rearing and their products.	Understand
CO2	Understand the Bee keeping equipment and apiary management.	Understand
CO3	Understand dairy animals' management, the breeds and diseases of cattle and learn the testing of egg and milk quality.	Analyse
CO4	Understand the Poultry science, aquaculture, vermicompost and their economic importance and different diseases.	Analyse
CO5	Learn the different animal cultures in a residential areas or industrial areas as a hobby or for the catering the marketing needs.	Apply

Unit - I**((12 hours))**

Vermiculture: Biology of *Eudrilus eugeniae*- Rearing of earthworms, Bedding, Essential parameters for Vermiculture, Equipments , devices used in vermiculture, Vermicompost Technology. Methods and products. Methods of Harvesting (Manual & Mechanical). Vermiwash Collection, Composition and use. Economic Importance of Vermiculture.

Unit - II**((12 hours))**

Sericulture: Types of silk, Silkworms and their host plants, Structure of silk gland and secretion of silk, Biology of *Bombyx mori*. Spinning, harvesting and storage of cocoons. Parasites and parasitoids of mulberry and silk worms .Importance of silkworm hybrids. Applications of silk proteins in tissue engineering.

Unit - III**((12 hours))**

Aquaculture: Type of Fisheries - Fresh water, Brackish Water and Marine. Pre and Post stocking management: Fertilization, carrying capacity, artificial feeding. Mono and Poly culture, Fish breeding techniques. Oyster culture and its biological significance. Fish preservation. Fish Diseases: Bacterial and fungal,

Unit - IV**((12 hours))**

Poultry Farming: Classification of Fowls based on their use – Broilers and Commercial layers. Principles of poultry breeding, Management of breeding stock and broilers, Processing and preservation of eggs. Poultry diseases - Viral, Bacterial, Fungal, Protozoan and Preventions.

Unit - V**((12 hours))**

Dairy Management: Introduction, Dairy farm and its management. Preservation of semen and artificial insemination in cattle, Induction of early puberty and synchronization of oestrus in cattle, Cattle diseases - Viral, Bacterial, Fungal, Protozoan and Preventions. Dairy by products.

Text Books:

1. Shukla, G.S. and Upadhyaya, V.B. (1999-2000). Economic Zoology (Rastogi Publishers).
2. Narasimhanna, M. N. Manual of Silkworm Egg Production;, CSB, Bangalore 1988.
3. Jhingran. V.G. Fish and fisheries in India.,
4. Khanna. S.S, An introduction to fishes

Reference Books:

1. Santanam, B. et al, A manual of freshwater aquaculture,
2. Boyd. C.E. & Tucker.C.S, Pond aquaculture water quality management,

3. Hafez, E. S. E. (1962).Reproduction in Farm Animals. Lea &Fabiger Publisher
4. Dunham R.A. (2004).Aquaculture and Fisheries Biotechnology Genetic Approaches.
5. Sengupta, K. A Guide for Bivoltine Sericulture; Director, CSR & TI, Mysore 1989.
6. Krishnaswamy,S Improved Method of Rearing Young age silkworm;CSB,Bangalore,1986
7. Ranganathan L.S, Vermicomposting technology- soil health to human health

Online Resources:

- 1.<http://www.fishbase.org>
- 2.<http://www.thefishsite.com>
3. www.fao.org/fishery/species/search/en
- 4.www.poultryhelp.com
- 5.www.eggcom.com <http://www.dpichi>

MAPPING WITH PROGRAM OUTCOMES										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S		M	L				L	S	S
CO2	S	L		S				L	S	S
CO3								L	S	S
CO4	L		L				L	S		
CO5									S	

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

MAJOR BASED ELECTIVE COURSE- II: MICROBIOLOGY

Course Code	Course Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit
21PZLM2	Major Based Elective Course-II: Microbiology	60 hours	5 hours	-	4

Course Objectives:

- ❖ To study the structure and Taxonomy of various microbe groups.
- ❖ To acquire a basic knowledge of the environmental, medical and industrial important microbes in particular in order to have an integrated approach in biology.
- ❖ To know the basics of sterilization and culture methods in microbiology.

Course Outcomes:

On successful completion of the course, students will be able to		
CO1	Acquired knowledge and understanding the fundamentals of Microbiology.	Remember
CO2	Competent enough to use microbiology knowledge and skills to analyze problems involving microbes.	Analyze
CO3	Understanding the concepts of applications of microbiology in various fields including medical, food, industrial, environmental and others.	Apply
CO4	Distinguish the behaviors of the different microbes and their straining techniques.	Understand
CO5	Developed a broader perspective of the discipline of microbiology to enable the student to identify challenging societal problems and plan the professional carrier to develop innovative solution for such problems.	Create

Unit-I**(12 hours)**

Microbial diversity-Concept of microbial species, significance, Classification of microorganisms- classification of bacteria, structure of E.Coli, Classification of fungi, structure of Pencillium , Virus- structure of Bacteriophages.

Unit -II**(12 hours)**

Sterilization Techniques - dry heat, moist heat, filtration, Tyndallization, pasteurization, Radiation disinfection. Culture techniques - media preparation - Aerobic and anaerobic culture techniques - Wet mount, hanging drop, Staining methods and staining techniques - acid fast stain, spore stain, capsule stain, staining for pure and mixed cultures.

Unit -III**(12 hours)**

Microbial ecology, Biogas production, Sewage treatment-small scale and large scale, Microbial leaching, Biodegradation of Xenobiotics and heavy metals, Biofiltration, Biodeterioration and Microbial plastics.

Unit -IV**(12 hours)**

Pathogenic microbes – viral diseases - Corona, SARS- symptoms, control , prevention and treatment, Bacterial diseases- Gonorrhea and Syphilis – prevention ,control and cure , Gastric ulcers-Helicobacter pylori ,Antimicrobial chemotherapy - Antibiotics - Source - Classification and mode of action.

Unit -V**(12 hours)**

Industrial microbiology - Commonly used fermentation products in India. Products of industrial microbiology - Penicillin, fuel ethanol and protease. Food and Dairy microbiology - Microbes in food - Role of microbes in food production. Dairy and non-dairy products - fermented foods and alcoholic beverages. Pharmaceuticals-Production of Vaccines.

Text Books:

3. R.C.Dubey and D.K.Maheshwari.2008. A Text book of Microbiology, S. Chand and Company Ltd, Ram nagar, New Delhi.
4. Pelczer, M.J., Reid, R.D. and Chan, E.C.S. 1996. Microbiology. Tata McGraw Hill Co., Ltd. New Delhi.
3. Ananthanaryanan, T. and Paniker, J.C.K. 2000. Text Book of Microbiology Oriental Longman Ltd., Madras.

Reference Books:

1. Tortora, G.J., Funke, R.B. and Case, C.L. 1992. Microbiology - An Introduction. The Benjamin / Cummings Publishing Co., Inc. Sydney.
2. Black, J.G. 1999. Microbiology - Principles and Explorations. John Wiley and Sons Inc.New York.
3. Atlas, R.M. 1995. Principles of Microbiology. Mosby - Year Book Inc.
4. Prescott L.M. Harley J.O. Klein D.A. 1990. Microbiology. WCB Publishers, Sydney.
5. Ahmed, M. and Basumatary. S.K. 2006. Applied Microbiology. MJP Publishers, Chennai.

Online Resources:

1. www.Wikipedia.com
2. www.sciencedirect.com
3. www.who.int
4. www.nature.com
5. www.researchgate.net

MAPPING WITH PROGRAM OUTCOMES										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S		M	L				L	S	S
CO2	S	L		S				L	S	S
CO3								L	S	S
CO4	L		L				L	S		
									S	

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

MAJOR BASED ELECTIVE COURSE- III: BIOTECHNOLOGY

Course Code	Course Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit
21PZLM3	Major Based Elective Course- III: Biotechnology	60 hours	5 hours	-	4

Course Objectives:

- ❖ Learn the scope and concepts of Biotechnology.
- ❖ Get skills in Biotechnology
- ❖ Study the importance of enzymes in rDNA technology,
- ❖ Understand the principles and significance of gene cloning.
- ❖ Become familiar with the gene transfer technology and transgenics.

Course Outcomes:

On successful completion of the course, students will be able to		
CO1	To understand the overall concept of biotechnology and its scope in relation to the Zoology	Understand
CO2	To be able to explain the DNA technology and about the plasmids and cosmids.	Understand
CO3	To be able to distinguish the different techniques involved in the study of biotechnology for industrial needs	Apply
CO4	To be able to explain the Gene characteristics and cloning methods	Analyze
CO5	To use or identify the techniques and methods for the commercial requirements that benefits the society.	Create

Unit-I (12 hours)
Biotechnology – Definition – Scope and importance of biotechnology. Recombinant DNA technology. Restriction endonucleases, DNA ligases. Vectors – plasmid and cosmids.

Unit-II (12 hours)

Cloning– Steps involved in gene cloning method. Screening of recombinant DNA. Construction of genomic and cDNA libraries. Gene therapy- types and methods. Methods of immobilization.

Unit-III (12 hours)
Fractionation techniques - Ultracentrifuge, Chromatographic separation. Cryopreservation technique. Microinjection. Electroporation and particle bombardment technic. Blotting technique- southern and northern , Polymerase Chain Reaction (PCR).

Unit-IV (12 hours)

Basic design of the Fermentor system. Fermentation processes – Inoculum preservation, Production processes. Batch and continuous fermentation. Downstream process – Separation of cell biomass and insoluble ingredients.

Unit-V (12 hours)

Transgenic animals – Transgenic sheep, Human Genome Project and its perspectives. Biosafety - IPR, copyrights, Trade secrets, Trademark – Patent – Conditions for patenting.

Text Books:

1. Singh, B.D., 2004, Biotechnology, Kalyani Publishers, New Delhi. Gupta, P.K. 2004.
2. Elements of Biotechnology, Rastogi Publications, Meerut, India.
3. Kumar, H.D. 2000. Modern Concepts of Biotechnology, UBS publishers Ltd, New York

Reference Books:

1. Tortora, G.J., Funke, R.B. and Case, C.L. 1992. Microbiology - An Introduction. The Benjamin / Cummings Publishing Co., Inc. Sydney.
2. Black, J.G. 1999. Microbiology - Principles and Explorations. John Wiley and Sons Inc. New York.
3. Atlas, R.M. 1995. Principles of Microbiology. Mosby - Yearbook Inc.
4. Prescott L.M. Harley J.O. Klein D.A. 1990. Microbiology. WCB Publishers, Sydney.
5. Ahmed, M. and Basumatary. S.K. 2006. Applied Microbiology. MJP Publishers, Chennai.

MAPPING WITH PROGRAM OUTCOMES										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S		M	L				L	S	S
CO2	S	L		S				L	S	S
CO3								L	S	S
CO4	L		L				L	S		
									S	

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

MAJOR BASED ELECTIVE COURSE - IV: MEDICAL PARASITOLOGY

Course Code	Course Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit
21PZLM4	Major Based Elective Course - IV: Medical Parasitology	55 hours	5 hours	-	4

Course Objectives:

- ❖ The objective of this course is to introduce parasitology to the student.
- ❖ The student will learn to identify and classify parasites, as well as correlate their presence with disease states.

Course Outcomes:

On successful completion of the course, students will be able to		
CO1	Understand the Basic morphology and life cycles of parasites causing diseases in human.	Understand
CO2	Identify the different parasites based on their structure and importance in the parasitology.	Remember
CO3	Identify the different behaviour of the parasites and be able to provide diagnosis for any of the diseases reported.	Apply
CO4	Analyse the different treatments based on the parasite's morphological methods.	Analyze
CO5	To study the parasites and produce or create drugs and medicines that help in treating various diseases	Create

Unit - I**(12 hours)**

Introduction to Parasitology: Types of Parasites, hosts. and Vectors (mechanical and biological vector) Host parasite relationship.

Unit - II**(12 hours)**

Entamoeba histolytica, Giardia intestinalis, Trypanosoma gambiense, Leishmania donovani, Plasmodium vivax- Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment.

Unit - III**(12 hours)**

Parasitic Platyhelminthes: Fasciolopsis buski, Schistosoma haematobium, Taenia solium and Hymenolepis nana - Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment.

Unit - IV**(12 hours)**

Parasitic Nematodes: Ascaris lumbricoides, Ancylostoma duodenale, Wuchereria bancrofti and Trichinella spiralis - structure, life cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment.

Unit - V**(12 hours)**

Parasitic Arthropoda: Biology, importance and control of ticks, mites, Pediculus humanus (head and body louse), Xenopsylla cheopis and Cimex lectularius.

Text Books:

1. Arora, D. R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributor.
2. E.R. Noble and G.A. Noble (1982) Parasitology: The biology of animal parasites. V Edition, Lea & Febiger
3. Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) Biology of Disease. Taylor and Francis Group.
4. Parija, S. C. Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & distributors, Medical Books Publishers, Chennai, Delhi
5. K. D. Chatterjee (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd

Reference Books:

1. General parasitology-Thomas C Cheng.
2. Medical parasitology-Markell and Voges.
3. Foundation of parasitology-Roberts,Janovy.
4. Baily and Scott's diagnostic microbiology, 13th ed, Patricia Tille, Elsevier
5. Basic clinical parasitology. Edit. FA Neva & HW Brown. Prentice-Hall International Inc.Latest edition.

Online References:

1. <http://www.dpd.cdc.gov/DPDx/>
2. <http://www.rph.wa.gov.au/labs/haem/malaria/>
3. <http://www.medtraining.org>.

MAPPING WITH PROGRAM OUTCOMES										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S		M	L				L	S	S
CO2	S	L		S				L	S	S
CO3								L	S	S
CO4	L		L				L	S		
									S	

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

CORE PRACTICAL –I : INVERTEBRATA, CHORDATA & CELL AND MOLECULAR BIOLOGY

Course Code	Course Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit
21PZLP1	Core Practical - I: Invertebrata, Chordata & Cell and Molecular Biology	-	-	40 hours	4

INVERTEBRATA

1. Dissection: Nervous System of Earthworm.
2. Study of prepared slides of mouth part of Honeybee and Mosquito to relate structure and function.

Mounting:

1. Appendages of Prawn
2. Mouth parts of Butterfly and Housefly.

CHORDATA

1. Study of the following specimen to bring out their affinities: Amphioxus, Balanoglossus, Ascidia and Peteromyzon.
2. Study of the following specimens with reference to their adaptive features for their respective modes of life. Echeneis, Ichthyophis, Hyla, Draco, Pigeon, Bat.

CELL AND MOLECULAR BIOLOGY

1. Micrometry: (A) Camera Lucida (b) Stage Micrometer (C) Ocular
2. Preparation of mitosis stage in Onion root tip.
3. Identification of different stages of meiosis in grasshopper testis.
4. Mounting of polytene chromosome in chironomous larva.
5. Identification of muscle tissues, skeletal tissues, epithelial tissues, nervous tissues and reproductive tissue.
6. Cellular organelle Separation by Centrifugation technique.
7. Isolation of DNA.
8. Electrophoresis separation of DNA (AGE).

CORE PRACTICAL –II : GENETICS, DEVELOPMENTAL BIOLOGY AND IMMUNOLOGY

Course Code	Course Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit
21PZLP2	Core Practical – II: Genetics, Developmental Biology, and Immunology	-	-	40 hours	4

GENETICS

- Recording of Mendelian traits in Man.
- Drosophila – Culture.
- Study of mutants in Drosophila.
- Male and female identification of Drosophila.
- Human Karyotype – Normal – Male and Female.
- Chromosomal abnormalities – (Turner & Klinefelter syndrome).
- Pedigree analysis – Colour blindness, Polydactyly, Haemophilia.
- Blood Grouping ABO & Rh

DEVELOPMENTAL BIOLOGY

- Mount- 24 hrs Chick embryo
- Mount- 48 hrs Chick embryo
- Mount- 72 hrs chick embryo

SPOTTERS

- Mammals- Ovum
- Mammals – Sperm
- Blastula – Frog
- Frog – Tadpole
- Chick gastrula
- Placenta types

IMMUNOLOGY

- Hemagglutination assay for ABO blood group typing and determination of Rh factor.
- Perform Immuno-electrophoresis from the given sample.
- Enumeration of WBC from the given sample.
- Identifications- Primary lymphoid organs, Secondary lymphoid organs in rat.

CORE COURSE – VII: ANIMAL PHYSIOLOGY

Course Code	Course Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit
21PZL07	Animal Physiology	60 hours	5	-	5

Course Objectives:

- ❖ To give an insight about the cellular basis of physiological functions
- ❖ To familiarize about how the structure-functional relationships.
- ❖ To provide a course of study in mammalian systems physiology, building on knowledge of basic physiological principles
- ❖ To have an enhanced knowledge and appreciation of mammalian physiology

Course Outcomes:

On successful completion of the course, students will be able to		
CO1	Develop understanding of blood vascular system	Understand
CO2	Develop the fundamental concepts of physiology of respiration	Understand
CO3	Understand the physiology of sense organ and its defects	Understand
CO4	Familiarize students with renal physiology	Analyzing
CO5	Develop basic understanding of muscle neurol physiology	Understand

Unit – I

(12 hours)

Blood and its components, Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, haemoglobin, haemostasis. Structure of myogenic heart, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure – neural and chemical regulation.

Unit – II

(12 hours)

Respiratory physiology - Structures- Respiratory gases - uptake - respiratory pigments . Transport of respiratory gases. O₂ and CO₂ - dissociation curves. Basic concepts of environmental stress and strain.

Unit – III

(12 hours)

Structure of eye, physiology of vision, visual elements and pigments, photo chemistry of vision – Eye defects – myopia, hyperopia, presbyopia, astigmatism, cataract – Structure of ear and mechanism of hearing

Unit – IV**(12 hours)**

Excretory physiology - Ultra structure of nephron, - Mechanism of excretion – Formation of urine- Excretory products, synthesis and elimination . (Dialysis, stone formation)

Unit – V**(12 hours)**

Muscle contraction- theories- molecular mechanism of muscle contraction.

Neural physiology - Neurons – structure and types .Nerve impulse transmission- resting and action potential. Neurotransmitters - mechanism of neural transmission – Neuro degenerative disorders (Epilepsy, Alzheimer's disease, Parkinson's disease)

Text Books:

1. Echert R and Randall D. 1987. Animal Physiology, CBS Publishers and Distributors, New Delhi.
2. Mariakuttikan A. 2011. Animal Physiology. Saras Publication, Nagerkoil.
3. Verma, P.S., Agarwal N.K. and Thyagi B.S. 1980. Animal Physiology. S. Chand & Co. New Delhi.

Reference Books:

1. Hall J.E. 2013. Text Book of Medical Physiology, Elsevier Inc.
2. Dawson H. 1964. General physiology, Little Brown Co. Boston.
3. Kim Barrett , Susan Barman , Scott Boitano , Heddwen Brooks.2015. Ganong's Review of Medical Physiology, 25th Edn. Lange Medical Book
4. Guyton.A.C and Hall.J.E.2011.Textbook of Medical Physiology,12th Edn.Saunders, Elsever

MAPPING WITH PROGRAM OUTCOMES										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M				M			S	
CO2	S	M				S	M			
CO3	S	S					L		S	
CO4	M	S				L	L			
CO5	M	S						M	S	

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

CORE COURSE VIII: ENDOCRINOLOGY

Course Code	Course Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit
21PZL08	Endocrinology	60 hours	5	-	5

Course objectives:

- ❖ The course is designed to provide an understanding to structures and function of endocrine glands
- ❖ This course aims to study the endocrine system in terms of structure, function and its role in regulating metabolism, growth and reproduction.

Course outcomes:

On successful completion of the course, students will be able to		
CO1	Understand the structures and function of endocrine glands	Understand
CO2	Gain knowledge in hormone research and general classes of chemical messengers	Apply
CO3	Develop the skill towards endocrine glands and its secretions.	Create
CO4	Apply appropriate information about common endocrine disorders, metabolic regulations, and metabolic abnormalities, and their management.	Evaluate
CO5	Create awareness about disorders and its control mechanisms.	Analyze

Unit – I

(12 hours)

Hormones – Classification – synthesis-circulation in blood- modification and degradation. Mechanism of hormone action. Feedback control. Pituitary hormones and their biological functions.

Unit – II

(12 hours)

Pancreatic hormones- cell types of Islet of Langerhans. Insulin-structure- synthesis-biological functions and mechanism of action. GI tract Hormones-secretin, gastrin, cholecystokinin-biological action, regulation, secretion

Unit – III

(12 hours)

Thyroid hormones- synthesis-secretion-transport –biological functions. Parathyroid hormone-biological functions. calcitonin-biological functions. Regulation of calcium and phosphorous metabolism.

Unit – IV**(12 hours)**

Adrenal hormones- Glucocorticoids- Mineralocorticoids – synthesis-secretion-biological effects-pathophysiology. Adrenal Medulla- catecholamines- synthesis- biological effects-pathophysiology

Unit – V**(12 hours)**

Gonadal hormones- synthesis-secretion-biological effects- ovarian cycle. Pregnancy-biochemical changes in pregnancy.

Text books:

1. Victor W. Rodwell, David A. Bender, Kathleen M. Botham, Peter J. Kennelly, Anthony Weil. P. 2018. Harper's Illustrated Biochemistry, 31st Edn, McGraw-Hill Education
2. Chandra S Negi 2009. Introduction to Endocrinology. Prentice Hall India Learning Private Limited

Reference Books:

1. Shlomo Melmed, Ronald Koenig, Clifford Rosen, Richard Auchus, Allison Goldfine 2019. Williams Textbook of Endocrinology, 14 th Edn, Elsevier

MAPPING WITH PROGRAM OUTCOMES										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	L	M	L		L	L	L
CO2	S	S	S	M	M		L	S	M	S
CO3	M	M	S	L		L	S	S	L	L
CO4	S	L	S		L	S	M	S	L	L
CO5	L	L	S	L	M			S	S	S

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

CORE COURSE IX: ANIMAL TISSUE CULTURE TECHNIQUES

Course Code	Course Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit
21PZL09	Animal Tissue Culture Techniques	60 hours	5	-	5

Course Objectives:

- ❖ To provide theoretical and practical knowledge, required for dealing with animal cell and tissue cultures
- ❖ Knowing and understanding the cell culture problems and possibilities.
- ❖ To equip students with culture techniques and scope of animal tissue culture.

Course Outcomes:

On successful completion of the course, students will be able to		
CO1	Understand media constituents and media formulation strategies for animal cell culture.	Understand
CO2	Knowing and understanding the principles of cell culture techniques	Understand
CO3	Develop proficiency in animal cell culture and the maintenance of cell lines.	Application
CO4	Design and present results of a cell-culture-based experiment	Application
CO5	Apply cell and molecular techniques to in vitro situations.	Application

Unit – I

(12 hours)

Brief history of animal cell culture, Different type of cell culture media, growth supplements, serum free media, balanced salt solution, other cell culture reagents, culture of mammalian cells, tissues and organs.

Unit – II

(12 hours)

Laboratory equipments for animal cell culture - Laminar -Flow Hood, Inverted microscope, humid CO₂ Incubator. Culture vessels, multi well plates, Flasks, Stirrer bottles and bioreactors.

Unit – III

(12 hours)

Types of culture - primary culture, secondary culture, continuous cell lines, suspension cultures-Cell cloning and selection; Cell synchronization-embryonic and adult stem cell culture.

Unit – IV

(12 hours)

Biology and characterization of the cultured cells, measurement of growth, measurement of viability and cytotoxicity. Scale up of animal cell culture, cell cloning.

Unit – V**(12 hours)**

Applications of Animal Cell Culture-Cancer Research, vaccine manufacture, gene and stem cell therapy, production of human and animal vaccines and pharmaceutical proteins, IVF Technology, toxicology studies.

Text Books:

1. Dubey. R .C. 1993. A Textbook of Biotechnology. S. Chand Publishing
2. Verma, A. S. and Singh, A. (2014). Animal Biotechnology. Academic Press, Elsevier, USA.
3. Butler, M. (2004). Animal Cell Culture and Technology. Taylor and Francis. New York, USA.
4. Davis, J. M. (2008). Basic Cell Culture. Oxford University Press. New Delhi.

Reference Books:

1. Ian freshney.R.2005. Culture of Animal Cells: A Manual of Basic Technique, 5th Edn. 5 John Wiley & Sons, Inc.
2. Martin Clynes.1998. Animal cell culture techniques, Springer, Berlin, Heidelberg
3. Davis, J. M.2011. Animal Cell Culture: Essential Methods, 1st Edn.John Willy and Sons Ltd. USA
4. Animal Cell Culture- A Practical Approach.2000. Ed., John R. W. Masters, Oxford University Press

MAPPING WITH PROGRAM OUTCOMES										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	L	S	L	L	M	L	M	S	L
CO2	S	M	M	M	L	S	M	M	L	L
CO3	S	M	S	M	M	M	L	M	S	M
CO4	M	M	S	S	M	L	L	S	L	M
CO5	L	S	M	S	M	S	L	M	S	S

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

**INTRDISCIPLINARY COURSE- MEDICAL PHYSICS AND CLINICAL LABORATORY
TECHNIQUES**

Course Code	Course Name	Lecture(L)	Tutorial(T)	Practical(P)	Credit
21PPYZL	Medical Physics and Clinical Laboratory Techniques	20	5	-	2

Course objectives:

- ❖ To understand the general concepts in radiation and its interaction and dose measurement.
- ❖ To apply the physics concepts in clinical trials.
- ❖ To educate scientifically the principles of radiation and its effect in the medical field.
- ❖ To acquire a basic knowledge on the laboratory techniques.
- ❖ Recognize the role of the clinical laboratory scientist in the assurance of quality health care.

Course outcomes:

On successful completion of the course, students will be able to		
CO1	Identify medical radiation related instrumentation and apply techniques associated with diagnostic imaging and radiation oncology	Remember
CO2	Employ independent learning strategies to self-evaluate and update professional knowledge of innovations in medical radiation physics	Understand
CO3	Identify the biological effects of radiation and its application for radiation safety and for radiation treatment	Remember
CO4	Evaluate clinical laboratory data by interpreting laboratory results and relating the data to various disease states.	Apply
CO5	Operate as a vital member of the medical laboratory team by collaborating effectively.	Apply

Unit - I

(5 hours)

Basic concepts in Dosimetry: Surgical Diathermy- Short wave Diathermy- Microwave Diathermy- Ultrasonic Diathermy- Anesthesia machine.

Unit - II**(5 hours)**

Magnetic Resonance Imaging (MRI): MRI – contrasts in MRI – Physiological and functional MRI– MRI safety–future MRI applications. CT and MRIR radiotherapy: CT based treatments imulation and planning–MRI in Radiotherapy

Unit - II**(5 hours)**

Treatment planning in radiation therapy: photon beam treatment planning-electron beam treatment planning.

ELISA, ECG, Echocardiography. Pregnancy test. Auto immune disease – Rheumatoid arthritis

Unit - III**(5 hours)**

Collection of blood samples. Haematological tests – Clinical significance of total RBC , WBC , Differential count , Platelet count and Haemoglobin content - Red cell indices and its significance (MCV, MCH and MCHC).

Unit - IV**(5 hours)**

Methods and clinical significance of ESR. Urine Analysis, Routine examination and analysis for albumin, glucose, ketones and bile pigments. Analysis of stools and microscopic examination for parasites. Sedimentation and Flotation methods.

Text Books:

1. Introduction to Medical Physics – Muhammad Maqbool – Springer International Publishing(2017).
2. Biomedical Instrumentation- Dr. M. Arumugam- Anurada Agencies Publishers (2017)
3. Baker F.J. And Silverton R.E 1998. Introduction to Medical Laboratory Technology. Hodder Arnold Publication.

Reference Books:

1. Attix FH(1986)Anintroductiontoradiologicalphysicsandradiationdosimetry,Wiley.
2. BortfeldT, BiirkelbachJ, Boesecke R, Schlegel W (1990a) Methods of image reconstruction from projections applied to conformation radiotherapy. Phys Med Biol 35(10):1423–1434.
3. Surgery Stereotact Funct Neuro surg 69:124–128.
4. Antonuk L E et al (1996)Megavoltageimagingwithalarge-area,flat-anel, Amorphous silicon imager. Int J Radiat Oncol Biol Phys 36:661–672.
5. HendeeWR,RitenourER(2002)Medicalimagingphysics,4thedn.Wiley-Liss.xix,NewYork.

6. Mukherjee K.L. 2003. Medical Laboratory Technology – A Procedure Manual for Routine Diagnostic Tests, Vol. I, II & III .Jaypee Brothers, New Delhi
7. RamanikSood - Medical Laboratory Technology ; Jaypee Brother’s MedicalPublishers

Online Resources:

1. <https://www.webmd.com/pain-management/what-is-diathermy>
2. <https://www.nibib.nih.gov/science-education/science-topics/magnetic-resonance- imaging-mri>
3. <https://www.healthline.com/health/echocardiogram>

MAPPING WITH PROGRAM OUTCOMES										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	L	S					L	
CO2	S	L	S	L						L
CO3	S	L	L	L			L			
CO4	L	L	S	S						
CO5	S	L	S	L						L

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

MAJOR BASED ELECTIVE – VI : BIOCHEMISTRY

Course Code	Course Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit
21PZLM5	Major Based Elective : Biochemistry	60 hours	5		5

Course Objectives:

- ❖ The course provides an introduction to the structure of biomolecules with emphasis on the techniques used for structure determination and analysis.
- ❖ The course covers basic aspects of sample preparation for analysis and aims to enlighten the students how structural information can be utilized for better understanding of biological processes.

Course Outcomes:

On successful completion of the course, students will be able to		
CO1	Understand about the importance and scope of biochemistry. Understand the structure and biological significance of carbohydrates	Understand
CO2	Understand the biological significance of amino acids and proteins	Understand
CO3	Express understanding in the formal taxonomic descriptions, in principles of taxonomic precedence, revision and type specimen designation.	Remember
CO4	Learn measurement of enzyme activity and its kinetics.	Create
CO5	To know about the importance of vitamins and its role in human welfare	Apply

Unit - I (12 hours)

Introduction, scope and importance of Biochemistry. Carbohydrates: Biological importance. Classification - Reducing and non-reducing sugars, monosaccharides, Oligosaccharides (Disaccharides), polysaccharides .

Unit - II (12 hours)

Proteins: Composition and Biological significance. Amino acids , classification and properties, Physiological importance of essential and non-essential amino acids.

Unit - III (12 hours)

Lipids: Biological significance. Fatty acids- Types (saturated and unsaturated). Classification of lipids - Triglycerides, Phospholipids, Sphingolipids, Cholesterol.

Unit - IV (12 hours)

Enzymes: Nomenclature and classification, general properties, Mechanism of enzyme action. Kinetics (determination of K_m and V_{max} using Michaelis-Menten). isoenzymes.

Unit - V**(12 hours)**

Vitamins - Classification - Fat soluble and water soluble , sources and deficiencies and symptoms in Man.

Textbooks:

1. Ambika Shanmugam , 2016. Fundamentals of biochemistry for medical students. 8th Edn Wolters Kluwer India Pvt. Ltd
2. Jain J.L. Jain, S and Jani.N 2005, Fundamentals of biochemistry.S,chand & Co. New Delhi.

References:

1. David L. Nelson, Michael M. Cox. 2021. Lehninger Principles of Biochemistry, 8th Edn.W.H.Freeman & Co Ltd
2. Stryer.M. 2017 Biochemistry, M. 4th Edn. McGraw-Hill.
3. Geoffrey L Zubay 1998 Principles of Biochemistry. Wm. C. Brown Publishers.

MAPPING WITH PROGRAM OUTCOMES										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	L	M	L		L	L	L
CO2	S	S	S	M	M		L	S	M	S
CO3	M	M	S	L		L	S	S	L	L
CO4	S	L	S		L	S	M	S	L	L
CO5	L	L	S	L	M			S	S	S

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

CORE COURSE X : ECOLOGY

Course Code	Course Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit
21PZL10	Ecology	60 hours	5	-	5

Course Objectives:

- ❖ To know the local and geographical distribution and abundance of organisms.
- ❖ To study the temporal changes in the occurrence, abundance and activities of organisms.
- ❖ To know the behavior of organisms under natural conditions.
- ❖ To study inter-relation between organisms in populations and communities.

Course Outcomes:

On successful completion of the course, students will be able to		
CO1	Understand the structural adaptation and functional adjustments of organisms.	Understand
CO2	Learns about the biological productivity of Nature and how this best serve mankind.	Remember
CO3	To observed conservation and management of natural resources and pollution.	Analyzing
CO4	Understand the reason of extinct animals, national park and wild life sanctuary.	Analyzing
CO5	classification and characteristics of pollution and its effects	Apply

Unit - I (12 hours)

Scope of Environmental Biology, Ecological factors- Light, water, Ecosystem-Components of ecosystem, types of ecosystem, food chain, food web and ecological pyramids of pond and forest ecosystem, Ecological succession.

Unit - II (12 hours)

Population ecology- characteristics of population, population density, natality, mortality, age distribution and population growth. Community ecology- ecological indicators, biome types of India. Biogeochemical cycles- Carbon cycle, nitrogen cycle and phosphorus cycle.

Unit - III (12 hours)

Habitat ecology- Fresh water, habitat, marine, water habitat, estuarine habitat and terrestrial ecology.

Unit - IV**(12 hours)**

Natural resources- wildlife- Conservation and management. Forestry- Deforestation. Pollution- Noise pollution, Radioactive pollution. Biodiversity. Bioconservation- sustainable ecodevelopment

Unit - V**(12 hours)**

Remote sensing and its application. Non conventional source of sources of energy. Toxicity effects- types of toxicity, classification of toxicants and applications of toxicology.

Text Books:

1. Agarwal, K.C.,1989.Environmental Biology. Agro Botanical Publishers, India.
2. Gupta, P.K and Salunka, D.K. 1985. Modern toxicology. Vol I and II, Metropolitan, New Delhi.
3. LU, F.C. 1985. Basic Toxicology. Hemisphere Publication. Corporation, Washington, N.Y.London
4. Pal, B.P.,, 1982 Environmental Conservation and Development, Nataraj Publishers, Dehra Dun, India.
5. Sharma, P.D., 1995. Environmental Biology and Toxicology. Rastogi and Company, Meerut, India.
6. Sood, A. 1999. Toxicology. Sarup & Sons, New Delhi.
7. Trivedi P.R., & Gurdeepraj., 1992. Environmental Biology. Akashdeep Publishing House, New Delhi.

Reference Books:

- 1.Break Mely, W. 1980. Chemicals in the Environment. Marshal Dokker INC,Newyork.
- 2.Butler, G.C. 1978. The Principles of Ecotoxicology Scope. 12, ICSO Scope,John wiley and sons, Chicheater.
3. Pandey G.N. and Carney, G.C. 1989. Environmental Engineering. Tata McGrawHill Publishing Co., Ltd.
4. Subramanian, M.A, Toxicology: Principles and methods, MJP Publishers,Chennai.

MAPPING WITH PROGRAM OUTCOMES										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	L	M	L		L	L	L
CO2	S	S	S	M	M		L	S	M	S
CO3	M	M	S	L		L	S	S	L	L
CO4	S	L	S		L	S	M	S	L	L
O5	L	L	S	L	M			S	S	S

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

CORE PAPER XI: EVOLUTION

Course Code	Course Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit
21PZL11	Evolution	60 hours	5	-	5

Course Objectives:

- ❖ The main objective of this course is to create a deep understanding of how evolution works.
- ❖ To inculcate the impact of ecological and evolutionary processes viz; the role of genetic variation, heredity, natural selection, evolution of modern humans and their biology.
- ❖ To study the diversity and similarity among organisms, characteristics and adaptations of organisms. They also study how organisms change over time
- ❖ To predict how comparative anatomy of living organisms provides evidence of evolution.
- ❖ To understand that natural selection is one of several processes that can bring about evolution.
- ❖ The students will be able to summarize how mass extinctions have affected the evolution of life on earth.
- ❖ The students will be able to understand how scientists use fossil evidence and radiometric dating to determine the relative ages and absolute ages, respectively, of previous life forms.
- ❖ The students will be able to know how biological molecules such as proteins and DNA are considered evidence of evolution.

Course Outcomes:

On successful completion of the course, students will be able to		
CO1	Students should be able to understand biological evolution which means that many of the organisms, which inhabit the Earth today, are different from those that inhabited it in the past	Understand
CO2	Students will be able to explain the mechanism for evolution	Remember
CO3	Explain the phylogenetic relatedness among organisms	Analyzing
CO4	Describe Darwin's theories and how the principles of natural selection can lead to speciation.	Analyzing
CO5	Describe the major patterns in the fossil record, geological events and plate tectonic movement.	Apply

Unit – I

(12 hours)

Evolutionary theories – Lamarckism, Darwinism, Neo-Darwinism, Modern synthesis. Evolutionary time scale – Eons, Eras, Periods, Epoch, Ages, Age dating. Primate evolution - Euprimates, Adapiforms, Omomyiforms, Origins of Modern Primate. Simian Radiations and Human evolution. Behavioural evolution – Social behaviour, learned behaviour, Adaptive behaviours. Altruism. Group selection and kin selection.

Unit – II**(12 hours)**

Molecular Evolution – Role of gene in evolution, Neutral theory, Molecular drive, Genetic drift, Molecular clock. Assessments of molecular variation. Theories of gradualism- Phylogenetic gradualism, punctuated equilibrium. Anagenesis. Cladogenesis. Trends in origin of higher categories - Micro evolution, Macro evolution.

Unit – III**(12 hours)**

Phylogenetics - *phylogenetic* trees-Types- Rooted, Un rooted. Dendrogram. Cladogram. Phylogram. Chronogram, Dahlgrenogram. Spindle diagram. Coral of life. Construction of *phylogenetic* trees - Distance method, Parsimony method, Cladistic *method*, Maximam likelihood method. *Phylogenetic* analysis, Applications of phylogenetic trees.

Unit – IV**(12 hours)**

Molecular phylogeny – DNA based phylogenetic trees, DNA- DNA hybridization data, Nucleotide sequence comparison and homologies. Species trees. Gene trees. Covarion Model. Protein evolution- Relative Rate Test & Clock Dispersion. Immunological techniques in phylogenetics. Applications of Molecular phylogenetics.

Unit – V**(12 hours)**

Artificial Evolutionary Ecology - Artificial evolution - Basic Aspects – *In vitro* evolution, Embodied artificial evolution, Directed evolution, Experimental evolution. Speciation- Allopatric and Sympatric. Meta population. Population extinct – Pseudo extinction, Mass extinction. Reasons for species extinction. Conservation of Genetic resources.

Text Books:

1. On the Origin of Species, By Charles Darwin, 6th Edition.
2. Process of Organic Evolution, G.L.Stebbins, Prentice Hall India, New Delhi.
3. Organic Evolution, Veer Bala Rastogi, Kadarnath & Ramnath Publication, New Delhi.
4. Evolution, T.K.Renganathan, C.M.S Printing Press, Palayamkottai.
5. Evolution, M. P. Arora. Himalaya Publishing House Pvt Ltd
6. Introduction to Evolution, Moody, Harper & Row; 3d ed. Edition

Reference Books:

1. Natural Selection: Domains, Levels and Challenges. Williams, New York: Oxford Univ. Press.
2. Basic Concepts in Population, Quantitative, and Evolutionary Genetics. Crow, New York: W. H. Freeman
3. The Causes of Molecular Evolution. Gillespie, New York: Oxford Univ. Press.
4. Ecology and Evolution of Darwin's Finches. Grant Princeton: Princeton Univ. Press.
5. Speciation and its Consequences. Otte, and. Endler (eds.). Sunderland.
6. Fundamentals of Molecular Evolution. Li, and Grauer. Sunderland,.
7. Molecular Systematics, Hillis and Mable. second edition.
8. The Nature of Selection, Evolutionary Theory in Philosophical Focus. Sober, Cambridge, MA: MIT Press.
9. The Genetic and Origin of Species, Dobzhansky, Columbia University Press.
10. Evolution Biology, Futuyama, INC Publisher, Dunderland.
11. Genes and Evolution, A.P.sha, John Publication, New Delhi.
12. Evolution and Genetics, Merrel, D.J., Holt, Richart and Winston, Inc.
13. Evolutionary Genetics, Smith. J.M., Oxford University Press, New York.

MAPPING WITH PROGRAM OUTCOMES										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	L	M	L		L	L	L
CO2	S	S	S	M	M		L	S	M	S
CO3	M	M	S	L		L	S	S	L	L
CO4	S	L	S		L	S	M	S	L	L
CO5	L	L	S	L	M			S	S	S

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

CORE COURSE XII: APPLIED ENTOMOLOGY

Course Code	Course Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit
21PZL12	Applied Entomology	60 hours	5	-	5

Course Objectives:

- ❖ To familiarize the students to understand insects of medical and agricultural importance
- ❖ To impart a thorough knowledge on types of insecticides and pest management techniques.
- ❖ Appreciate the impact that insects have (both positive and negative) on human society, including human health, agriculture, and the environment.
- ❖ The student is able to criticize conventional insect pest control and to know integrated pest management

Course Outcomes:

On successful completion of the course, students will be able to		
CO1	Understand insects encountered in agricultural fields.	Understand
CO2	Envisages an insight on economically important pests of various foods, fibers and household	Understand
CO3	Envisages an insight on economically important pests of various household stored products Understand the importance of insect vectors on human and animal health	Understand
CO4	Learn to apply various agricultural equipment and understand the effect of chemicals and its dosages in agricultural pest management	Application
CO5	Understands various insect pest management methods and its significance	Understand

Unit – I

(12 hours)

Pest, Kinds of pests (major and minor) – Key pests, sporadic pests, endemic pests, exotic pests, epidemic and pandemic pests, seasonal pests, occasional pests, regular pests, persistent pests. Types of damage to plants by insects.

Unit – II

(12 hours)

Insect pests of crops and their control measures: Paddy - Rice stem borer - rice bug; coconut - rhinoceros beetle - red palm weevil; cotton - spotted boll worm - pink boll worm; sugarcane - top shoot borer - inter node borer; ; mango -mango hopper - mango nut weevil.

Unit – III**(12 hours)**

Pests of stored products and their control- Rice weevil-red flour beetle-rice moth- khapra beetle-lesser grain borer- drug bore beetle- Cowpea weevil.Insects related to household: cockroaches, termites, silverfish

Unit – IV**(12 hours)**

Insect pest control - Cultural, mechanical, physical and biological methods of pest control. Integrated pest management- principle - advantages – disadvantages- IPM in agro ecosystem

Unit – V**(12 hours)**

Insecticidal formulations, classification of the insecticide, mode of action of insecticides, Chemosterilants - anti fedants –pheromones - insect repellants - attractants. Insects as a bioreactor – recombinant protein productions.

Text Books:

1. Tembhare, D.B., 2019. Modern Entomology, Himalaya Publishing House.
2. Vasantharaj David, B and Ramamurthy, V.V. 2016. Elements of Economic Entomology, 8th Edn. Namrutha Publications, Chennai.
3. Fenemore. P.G and Alka Prakash. Applied Entomology. New Age International (P) Ltd
4. Awasthi, V.B. Introduction to General and Applied Entomology, Scientific Publishers, India
5. Rajendra Singh, 2015. Elements of Entomology 2nd Edn, Rastogi Publications
6. Vasantharaj David. B and Kumaraswami. T. 1988. Elements of Economic Entomology. 4th Edn. Popular Book Depot. Madras.

Reference Books:

1. Richards, O.W. and Davies, R. G., 1984. A General Text Book of Entomology Vol. I & II, 10th Edition, Chapman Hall, Lane London.

Online Resources:

1. <https://projects.ncsu.edu/cals/course/ent425/text18/pestintro.html>
2. <http://agritech.tnau.ac.in/pdf/6.pdf>

MAPPING WITH PROGRAM OUTCOMES										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	L	M	L		L	L	L
CO2	S	S	S	M	M		L	S	M	S
CO3	M	M	S	L		L	S	S	L	L
CO4	S	L	S		L	S	M	S	L	L
CO5	L	L	S	L	M			S	S	S

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

CORE PRACTICAL – III : ANIMAL PHYSIOLOGY, ENDOCRINOLOGY AND ANIMAL CELL CULTURE TECHNOLOGY

Course Code	Course Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit
21PZLP3	Core Practical – III: Animal Physiology, Endocrinology and Animal Cell Culture Technology	-	-	40 hours	4

ANIMAL PHYSIOLOGY

1. Activity of salivary amylase in relation to temperature.
2. Effect of substrate concentration and activity of salivary amylase.
3. Quantitative estimation of proteins
4. Quantitative estimation of hemoglobin.
- 5 Detection of urea, uric acid, ammonia in the given sample
- 6 Blood Clotting Time, Bleeding Time, Preparation of Haemin Crystal
- 7 Detection of carbohydrates and proteins from the given sample

ENDOCRINOLOGY

1. Demonstration of endocrine glands in fish.
2. Identification of testis and ovary in fish.

ANIMAL CELL CULTURE TECHNOLOGY

1. Basic animal cell culture media preparation (Balanced Salt Solution-BSS Media, Minimal Essential Medium)
2. Animal cell culture- Rouge bottle

SPOTTERS

1. Deep freezer
2. CO2 Incubator
3. Disposable plasticware used for animal cell culture

CORE PRACTICAL – IV : ECOLOGY, EVOLUTION AND APPLIED ENTOMOLOGY

Course Code	Course Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit
21PZLP4	Core Practical – III: Ecology, Evolution and Applied Entomology	-	-	40 hours	4

ECOLOGY

1. Measurement of pH in a given sample.
2. Determination of dissolved oxygen in given water sample.
3. Determination of total alkalinity of a water sample.
4. Measurement of turbidity in a given sample of water.
5. Estimation of calcium in water sample.
6. Identification of planktons – fresh water and marine water (Qualitative)
7. Identification – Secchi disc, Rainwater gauge and Respirometer.

EVOLUTION

1. Study of Fossils (Ammonoids, Nautiloids & Echinoderm fossils).
2. Study of homology and analogy from suitable specimens.

ENTOMOLOGY

1. Study of morphology of an local insect and identification
2. Dissect and display of digestive, nervous, excretory, reproductive systems of any two insects of different orders.
3. Mounting of different types of mouthparts of insects (Mosquito, honeybee)
4. Field study – Collection of insects at least 10 insects belonging to different orders and preparation of insect box from the collected insects
5. Field study for various methods of pest management.